COASTAL HOUSEHOLDS ADAPTATION TO SEA LEVEL RISE USING FINANCIAL SELF-SERVICE COOPERATIVE (MICROFINANCE)

AMORNPUN KULPRANEET

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COASTAL HOUSEHOLDS ADAPTATION TO SEA LEVEL RISE USING FINANCIAL SELF-SERVICE COOPERATIVE (MICROFINANCE)

……
Mr.Amornpun Kulpraneet
Candidate

……...
Assoc. Prof. Sansanee Choowaew, Ph.D.
Major advisor

……..
Assoc. Prof. Anuchat Poungsomlee, Ph.D.
Co-advisor

……
Assoc. Prof. Orapan Nabangchang-Sri Sawaluk, Ph.D.
Co-advisor

…….
Asst. Prof. Anond Snidvongs, Ph.D.
Co-advisor

……..
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

…….
Assoc. Prof. Suriyapong Watanasak, Ph.D.
Program Director
Doctor of Philosophy Program in
Environment and Resource Studies
Faculty of Environment and Resource Studies
Mahidol University

Thesis
entitled

COASTAL HOUSEHOLDS ADAPTATION TO SEA LEVEL RISE USING FINANCIAL SELF-SERVICE COOPERATIVE (MICROFINANCE)

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Doctor of Philosophy (Environment and Resource Studies)
on
December 21, 2012

……
Mr.Amornpun Kulpraneet
Candidate

……
Assoc. Prof. Sitanon Jesdapipat, Ph.D.
Chair

……..
Assoc. Prof. Anuchat Poungsomlee, Ph.D.,
Member

……...
Assoc. Prof. Sansanee Choowaew, Ph.D.,
Member

……
Assoc. Prof. Orapan Nabangchang-Sri Sawaluk, Ph.D.
Member

……
Asst. Prof.Anond Snidvongs, Ph.D.
Member

……..
Prof. Banchong Mahaisavariya, M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

……
Assoc. Prof. Kampanad Bhaktikul, Ph.D.
Dean
Faculty of Environment and Resource Studies
Mahidol University

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Amornpun Kulpraneet

COASTAL HOUSEHOLDS ADAPTATION TO SEA LEVEL RISE USING FINANCIAL SELF-SERVICE COOPERATIVE (MICROFINANCE)

AMORNPUN KULPRANEET 5237310 ENER/D

Ph. D.(ENVIRONMENT AND RESOURCE STUDIES)

THESIS ADVISORY COMMITTEE: SANSANEE CHOOWAEW, Ph.D. (ENVIRONMENTAL PLANNING), ANUCHAT POUNGSOMLEE, Ph.D. (HUMAN ECOLOGY), ANOND SNIDVONGS, Ph.D. (OCEANOGRAPHY), ORAPAN NABANGCHANG-SRI SAWALAK, Ph.D. (LAND ECONOMY).

ABSTRACT

This research focuses its study on adaptation at the household level to climate change impacts. Its overall objective is to examine microfinance, whether it can be an effective measure to strengthen household financial adaptive capacity to the impacts of sea level rise. Six vulnerable coastal villages of three Tambons located in the Gulf of Thailand were selected as studied sites. A sample size of four hundred households was required to statistically represent the total amount of target households of all studied villages. Current and future adaptations of cost requirements to sea level rise impacts of those sampled households were assessed. An ideal microfinance was designed to support adaptation to sea level rise impacts. Such designed microfinance assumed a hypothetical market and was tested for its applicability, factors affecting participation and household's willingness to save. In addition, appropriateness and effectiveness of the microfinance were analyzed, particularly in view of its sufficient financial services delivery compared with required household adaptation costs.

The results revealed that sampled households in the studied villages were adapting their livelihood to the impacts of sea level rise. They spent their money for autonomous adaptation mainly for capital expenditure items. Research also indicated that microfinance was applicable and could be an effective tool for household autonomous adaptation to sea level rise impacts. Well-managed factors affecting participation, microfinance's conditions, including proper patterns of saving and microloan, could strengthen the financial adaptive capacities of vulnerable coastal households (microfinance members). In addition, as global assistance funds are limited, microfinance can be a potential channeling mechanism to facilitate those funds to flow to real vulnerable sectors of developing countries that lack financial resources. To adjust to climate change impacts, developing countries should accelerate and enhance its local adaptation programs as in microfinance.

KEY WORDS: SEA LEVEL RISE IMPACTS/ ADAPTATION/ COASTAL HOUSEHOLD/ MICROFINANCE

210 pages

การประยุกต์ใช้สถาบันการเงินชุมชนเพื่อการปรับตัวของครัวเรือนชายฝั่งต่อผลกระทบจากภาวะน้ำทะเลท่วมถึง

COASTAL HOUSEHOLDS ADAPTATION TO SEA LEVEL RISE USING FINANCIAL SELF-SERVICE COOPERATIVE (MICROFINANCE)

อมรพันธ์ กุลปราณีต 5237310 ENER/D

ปร.ด. (สิ่งแวดล้อมและทรัพยากรศาสตร์)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: ศันสนีย์ ชูแวว, Ph.D., อนุชาติ พวงสำลี, Ph.D.,
อานนท์ สนิทวงศ์ ณ อยุธยา, Ph.D., อรพรรณ ศรีเสาวลักษณ์, Ph.D.

บทคัดย่อ

งานวิจัยนี้ศึกษาความเป็นไปได้ในการใช้สถาบันการเงินชุมชนเพื่อสนับสนุนการปรับตัวของครัวเรือนชายฝั่งต่อผลกระทบจากภาวะน้ำทะเลท่วมถึง พื้นที่ศึกษาประกอบไปด้วยหกหมู่บ้านชายฝั่ง(ของสามตำบล)ติดอ่าวไทยตอนบน สี่ร้อยครัวเรือนคือจำนวนขนาดตัวอย่างที่ต้องการและถูกสัมภาษณ์ ค่าใช้จ่ายในการปรับตัวของครัวเรือนทั้งปัจจุบันและอนาคตถูกประเมินเพื่อใช้เป็นเกณฑ์อ้างอิง งานวิจัยดำเนินการออกแบบสถาบันการเงินชุมชนเพื่อปรับตัวต่อภาวะน้ำทะเลท่วมถึงและทดสอบปัจจัยที่มีผลกระทบต่อความต้องการเข้าร่วมเป็นสมาชิกและความต้องการออมของครัวเรือน ความเหมาะสมและประสิทธิภาพของสถาบันการเงินดังกล่าวถูกวิเคราะห์โดยเฉพาะความเพียงพอในการสนับสนุนด้านการเงินเทียบกับค่าใช้จ่ายในการปรับตัวของครัวเรือน

งานวิจัยค้นพบว่าครัวเรือนตัวอย่างปรับตัวต่อภาวะน้ำทะเลท่วมถึงโดยใช้จ่ายเงินประเภทเงินลงทุนเพื่อก่อสร้างหรือปรับปรุงบ้านเรือนเป็นหลัก ในส่วนของสถาบันการเงินชุมชน, มันสามารถนำมาประยุกต์ใช้เพื่อการปรับตัวในระดับครัวเรือนได้อย่างมีประสิทธิภาพถ้าปัจจัยที่มีผลกระทบต่อการเข้าร่วมเป็นสมาชิกรวมถึงรูปแบบการออมและการให้เงินกู้ได้รับการจัดการอย่างเหมาะสม นอกจากนี้สถาบันการเงินชุมชนอาจเป็นช่องทางหนึ่งเพื่อใช้รับการสนับสนุนจากภาครัฐหรือกองทุนเพื่อการปรับตัวระดับโลกต่อภาคครัวเรือนที่ได้รับผลกระทบจริง

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LIST OF ABBREVIATIONS

Adaptation costs	Costs of planning, preparing for, facilitating and implementing adaptation measures. This research focuses on direct costs (transition/ indirect costs not included).
Adaptation fund	The Adaptation Fund was established to finance concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change. The Adaptation Fund is financed from the share of proceeds on the clean development mechanism (CDM) project activities and other sources of funding. The share of proceeds amounts to 2% of certified emission reductions (CERs) issued for a CDM project activity.
Adaptive capacity	Ability of a system (human or natural), region, or community to adapt to the impacts of climate change, prevent or moderate potential damages, and cope with the consequences. The adaptive capacity inherent in a human system represents the set of resources available for adaptation, as well as the capacity of that system to use the resources effectively in pursuit of adaptation.
Adaptive measure	Measures, practices, instruments, and anything else to facilitate adequate adaptation to climate change.
Apex organization	A second-tier or wholesale organization that facilitates the disbursement of donation funds to and develops the sustainable capacity of retailing microfinance institutions.
Autonomous adaptation	Adaptation takes place simultaneously in reactive response (after impacts) to climatic stresses without directed intervention by a public agency.

LIST OF ABBREVIATIONS (cont.)

Capital expenditures	Money spent to acquire or upgrade physical assets such as home, buildings, land improvement, dams and machinery.
Household (coastal)	Persons inclusive of house/ buildings, facilities and farmland belong to a family located or living in coastal area.
Microfinance	Financial services that are provided to low-income individuals or groups who would otherwise have no other means of gaining services from formal financial institutions. The goal of microfinance is to give low income people an opportunity to become self-sufficient by providing a means of saving money, borrowing money and insurance.
Microfinance for sea level rise impacts	A microfinance institution that is designed to support adaptations to sea level rise impacts and assumed in hypothetical market
Microfinance institution	An organization that provides financial services to the poor. Microfinance institutions include formal providers (e.g. Agricultural development banks), semiformal providers (e.g. financial NGOs, credit unions and cooperatives), and informal providers (e.g. self-help groups).
Non-revolving loan	Non-revolving credit is when credit is extended via a fixed repayment plan. As payments are paid on non-revolving credit plans, further credit is not extended (unlike in a revolving credit plan).
Operating expenditures	An expense incurred in daily consumption and property/ physical asset maintenance.

LIST OF ABBREVIATIONS (cont.)

Overseas Development Assistance (ODA)	Developed countries provide funding to developing countries to support the adaptations to climate change
Planned adaptation	Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve a desired state.
Revolving loan	Arrangement which allows for the loan amount to be withdrawn, repaid, and redrawn again in any manner and any number of times, until the arrangement expires. Credit card loans and overdrafts are revolving loans.
Sea level rise impacts	Impacts that are results of sea level increased from polar glacier melting and sea thermal expansion due to global warming. . The potential effects of sea level rise to coastal areas are increasing flood frequency, inundation, coast erosion, rising of water table, saltwater intrusion, and biological effects.
Size of account receivable	Size of accounts receivable relative to total assets. The accounts receivable size is measured by dividing accounts receivable by total assets and it is normally calculated as part of the common size balance sheet. When compared over time this may indicate changes in marketing strategy of the firm. Another possible interpretation of growing accounts receivable is clients' difficulty to pay which should be investigated with the help of economic forecasts described in

LIST OF ABBREVIATIONS (cont.)

Vulnerability	The degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change. It is sensitivity of system to changes in climate and the ability to adapt the system to changes in climate.
Willingness to save (amount)	The maximum sum/ amount an individual is willing to save to a financial institution for specific future use purposes e.g. adaptation purposes. It analyses based on user preferences to services of such financial institution. The willingness to save of an individual, as such, may not be equal to his/ her ability to save.

CHAPTER I
INTRODUCTION

1.1 Introduction and Research Justification

The change in global climate has been caused by the greenhouse effect. When sunlight strikes the earth (solar radiation), it warms the surface, which then reradiates the heat as infrared (or "terrestrial") radiation. The greenhouse gases (GHGs), which consist of CO_2, CFCs, CH_4, N_2O, and O_3 and aerosol, exist naturally in the atmosphere. Those gases, particularly non CO_2 (Hansen et al., 2000), and water vapor absorb broadcast of the terrestrial radiation rather than continue passing it through the atmosphere to space. The atmosphere then traps heat and warms the earth acting like the glass panels of a greenhouse. This phenomenon is generally known as the "greenhouse effect". Without the greenhouse gases, the surface of the Earth, which is about 15°C, will be as cold as the surface of the Moon (about -18 degrees Celsius or °C) (Buchdahl, Twigg, & Cresswell, 2002). However, the anthropogenic disturbances have produced the amount of greenhouse gases over the balance of natural requirements. Therefore, the Earth continues increasingly warming rapidly amidst changes in atmospheric cycles, climatic conditions, various ecosystems, and biodiversity (United Nations Environment Programme, 2003). All impacted sectors must adjust or adapt to the changes in order to continue their requisite functions. Some can adapt naturally, whereas some cannot. The degrees to which those impacted are vulnerable are depended on the magnitude of impacts, their resilience, susceptibility, and their adaptive capacity. As human has brought about this climate change, it is therefore human responsibilities to increase the adaptive capacities of those impacted.

Coastal areas are considered as one of the most vulnerable sectors impacted by the change of global climate (Doukakis, 2005). Many coasts, especially low-lying areas, have been experiencing the adverse consequences of hazards mainly related to climate and sea level. According to Klein and Nicholls (1999), the aspects

of climate change to the coast are involved with the rise of sea level, the increase of sea water temperature, more precipitation intensity, the increase of wave height, and the variation of water runoff and storm frequency. Similar to Doukakis, Klein and Nicholls stated that among those aspects, the effect from sea level rise was considered the most serious threat due to the continued increasing of sea level from the polar glacier melting and sea thermal expansion. The magnitude of its effects varies by location depending on the physical and socioeconomic factors, including human responses (Turner et al., 1996; cited in Neumann, Yohe, Nicholls, & Manion, 2000). As such, sea level rise has been considered the ultimate planning challenge. It can create the problems of coastal flood, erosion, water resources, land use, loss of property and ecosystems. These challenges are further complicated by the broad spectrum of coastal characteristics of various locations. Therefore, the planning for providing adaptation measures of coasts to the impacts of sea level rise should be done at earlier stage as the cost of non-proactive actions (reactive actions) can be very higher than that for costs of proactive on an economic, environment, cultural and social scales (Titus et al., 1991, and European Communities, 2009).

In response to the sea level rise, there are three possible coastal adaptation strategies (Nicholls, 2007): a) Retreat – abandonment the current areas and resettlement in new development areas; b) Accommodate – continue occupancy the current areas but induce adaptive management responses; and c) Protect – defense the areas by using both structural (hard) and non-structural (soft). Illustration can be seen in Figure 1.1. Practically, the potential adaptation measures to sea level rise include but not limit to the wide variety of engineering measures, change in agricultural practices that are more flood-resistant, developing desalination techniques, planting mangrove belts to provide flood protection, improving drainage facilities, establishing setback policies for new development areas, and so forth. Obviously, there are numerous of adaptations to sea level rise, and there is no single set of adaptation can be universally appropriate. Therefore, at a very basic level, the success of adaptations is depended on the flexibility and effectiveness of the measures, such as their ability to meet objectives and local needs given a range of future climate scenarios (Carter, 1996; Smith and Lenhart, 1996, cited in Smit and Pilifosova, 2001). According to United Nations Framework Convention on Climate

Change (2009), the adaptations focusing on local needs currently are being paid attention globally and practically are extended beyond international - national to the individual or household levels. Some adaptive measures can directly reinforce and prolong the adaptive capacity of household, whereas some are only reactive for the short-term solution. Some adaptive measures are simple e.g. changing of behavior, and do not require money. Unfortunately, most of the measures more or less require individual financial investment.

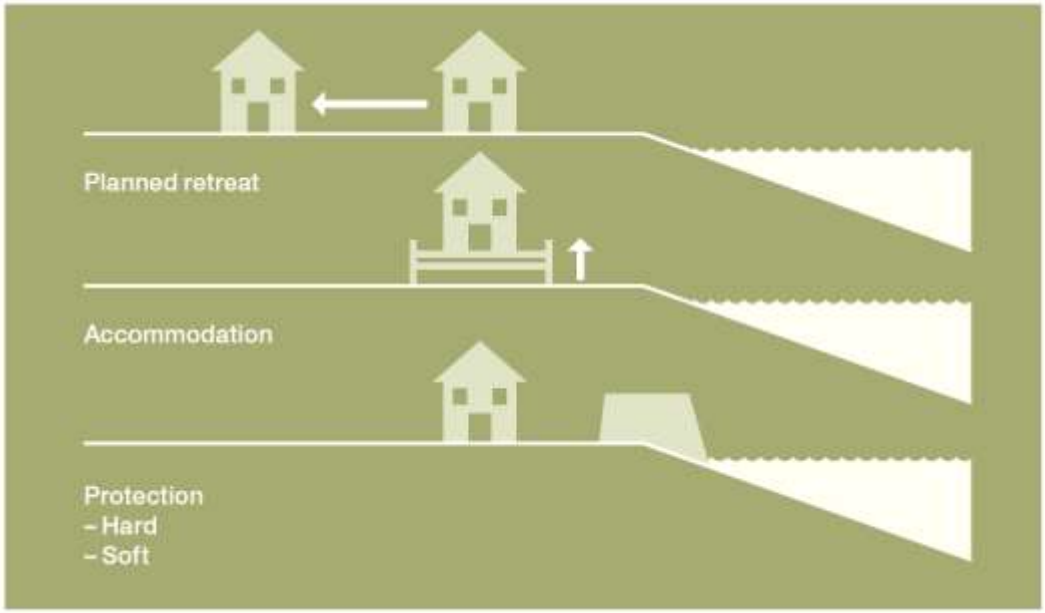

Figure1.1: An illustration of the possible adaptation responses to sea-level rise
Source: Nicholls (2007)

The implementations of the adaptation have required numbers of financial support, particularly for the developing countries. Though there is much uncertainty about the exact amount requirements, several calculations have been done roughly to estimate the costs of adaptation to climate change. World Bank (2006) indicated that the total costs of adaptation to climate changes required for developing countries could be as high as US$10 billion to US$40 billion per year. In addition to the World Bank, Organization for Economic Co-operation and Development (2008) combined the estimations of adaptation cost from various sources done in 2007. Assessed by Oxfam, adaptation cost requirement for developing countries was US$

50 billion per year in 2007. UNDP estimated that it would be US$ 86 billion per year in 2015, whereas references of United Nations Framework Convention on Climate Change (UNFCCC) stated that it could be ranged between US$ 28 – US$ 67 per year in 2030. Details can be seen in Table 1.1.

Table1.1: Assessment of annual adaptation costs requirement for developing countries

	Assessment Year	Estimated Cost (US$ billions)	Time Frame
UNDP	2007	$86	2015
UNFCCC	2007	$28-$67	2030
Oxfam	2007	$50	Present
World Bank	2006	$9-$41	Present

Sources: Organization for Economic Co-operation and Development (2008)

The study of United Nations Framework Convention on Climate Change (Parry et al., 2009b; and Nicholls, 2007) had further classified the adaptation costs requirement into sectors of agriculture, water, human health, coastal zones and infrastructures (details can be seen in Table 1.2). Particular for the coasts, they were estimated that the adaptation costs required for coastal zones due to sea level rise impacts, for developed and developing countries in 2030 respectively could be US$ 7 and US$ 4 billion USD annually. The estimations were based on building costs of the coastal engineering protection measures that would be required for the coast, assuming a 50-year planning horizon. All of these studies drawn on ‘hold the shore line’ with traditional coastal engineering responses e.g. dykes and beach nourishment.

Table1.2: Estimation of sectoral annual investment and financial flow needed by 2030 to cover costs of adaptation to climate change (billion US$ dollars per year in present values of 2007)

Sector	Global Cost	Developed Countries	Developing Countries
Agriculture	14	7	7
Water	11	2	9
Human health	5	Not estimated	5
Coastal zones	11	7	4
Infrastructure	8-130	6-88	2-41
Total	49-171	22-105	27-66

Source: United Nations Framework Convention on Climate Change (2007) cited in Parry et al., 2009b; and Nicholls, 2007

On the supply side, according to Lagos, Wirth, and El-Ashry (2009), the availability of adaptation funds for developing countries include dedicated multilateral and bilateral ODA (Overseas Development Assistance, developed countries provide funding to developing countries to support the adaptations to climate change) and the dedicated domestic resources in developing countries themselves. Examples of dedicated multilateral funds are Least Developed Countries Fund, World Bank Fund, and Adaptation Fund of the Kyoto Protocol. Examples of dedicated bilateral funds are International Climate Initiative (ICI) of Germany, Adaptation to Climate Change Initiative of Australia, and Cool Earth Partnership of Japan. Except Kyoto Protocol Adaptation Fund that clearly regulates that 2 percent from share of the sale of certified emission reduction must be allocated to developing countries (Protocol Parties), all other funds mostly are replenished through ODA (Oversea Development Assistance) in forms of donation. Mapping those funds into the multi-level of adaptations as defined by Chinvanno (2007): collective; national; and community, it can be noted that there is no adaptation funds specifically designed for the community level. Details can be seen in Figure 1.2.

Figure1.2: Multi level adaptations and availability of various adaptation funds

a) Collective adaptation: collaboration among communities, regional, and global

b) National level: large-scale infrastructure, high investment, high technology

c) Community level: community-based, small-scale, indigenous knowledge

Yet there has been a big gap between demand for adaptation costs and the supply for adaptation funds (Erda & Hui, 2008). Organization for Economic Co-operation and Development (OEDC) mentioned in 2008 that the budget available for adaptation for developing countries was less than US$ 1 billion, whereas the required costs were ranged from US$ 9 – 86 billion. Mandated by United Nations Framework Convention on Climate Change, the developed countries are required to assist developing countries in meeting the required costs for adaptation to the adverse effects of climate change. However, recent analysis by Lagos, Wirth, and El-Ashry in 2009 shows that developing countries have received less than 10 percent of the funds promised by developed countries. Such levels of adaptation investment for developing countries are considered far from adequate, and lead to their higher vulnerability to the climate change impacts (Parry et al., 2009a). This is termed as the 'adaptation deficit' (Burton, 2004, cited in Parry et al., 2009b). The lack of financial resources will limit the ability of particular low-income people to afford proper adaptive measures (Smit & Skinner, 2002). Currently, debates about the

additional amounts and possible new sources of funding are globally widespread.

In addition, distribution of the current available adaptation funds at collective and national level to the most required and high vulnerable groups at community level in developing countries are ineffective. Rather waiting for support of such in-doubted funds, those vulnerable groups should have set up their own community self-help financial services. World Bank (2000) stated that the existing financial distribution mechanisms might completely bypass households especially low income ones. As such, the need to develop community-based financial services at community level such as microfinance had become extremely important. Microfinance is the delivery of financial services to low- and moderate-income people that may lack resources or have low access to formal financial institutions e.g. commercial banks and insurance companies (The United States Agency for International Development, 2009; Robinson, 1998 cited in Srinivasarn & Sriram, 2003). Its services can be managed through a various forms of established organizations, called microfinance institutions (MFIs). To most people the term 'microfinance' is often used in a narrower sense to represent the established institutions or services related (Saqfalhait, 2010). The advantages of microfinance are that it creates cooperatives in economic, social and political among households in a community. It should be noted that microfinance does not work best only for the low income people but also higher income ones with high vulnerable (Cohen, 2003; cited in Hammill, Matthew, & McCarter, 2008). However, small microfinance institutions, managed by low income communities, without access to adequate external financial supports may be collapsed due to unable to maintain savings mobilization, credit repayment, and cash availability. Those microfinance institutions need financial cushion including well management to make them sustain.

This research is an empirical study on the use of microfinance as a coastal household adaptive measure, in term of financial preparation, to the impacts of sea level rise. Coastal areas are one of the most vulnerable sectors to the climate change. Unlike other sectors, the adaptations in coastal areas usually require large scale investment and have to be led by collective government activities. These requirements may not be any concern for developed countries whose their financial resources are abundant. However, for developing countries with limitation in their

national budgets, it is one of major problems. People who are living in the vulnerable coastal areas of such developing countries have to unwillingly adapt at their own costs to those climatic stresses. Therefore, it will be better to have some mechanisms that can help and create financial cooperative among those people. Microfinance is one of them that have potential to increase financial adaptive capacity at community level. Microfinance has been recognized for well supporting many small projects such as housing renovation, agriculture, and acquiring renewable energy technologies. However, through reviews of literature, there is no finding about microfinance used for projects related to sea level rise impacts. Any implemented microfinance ideally should be a kind of community based, or alternatively encourage high involvement of community's members (Tulungen, Kussoy, & Crawford, 1998).

The study sites of this research are vulnerable coastal communities located on upper Gulf of Thailand. Thailand is a developing country in Southeast Asia region, where its coastal areas are highly vulnerable to the climate change impacts, particular sea level rise (Cruz et al., 2007). However, referring Southeast Asia START Research Center, future effects of sea level rise to Thailand coast have not been yet clearly identified at present time (A. Sanitwong na Ayudhaya, personal communication, December 10, 2009). The studied communities are chosen from the ones that have been facing problems derived from the impacts of sea level rise e.g. coastal erosion, inundation from risen sea level or land subsidence. Households of those communities have continuously adjusted their homes, farmlands, and ways of living to such impacts, which have become more severe. For reference, a survey with a vulnerable coastal community in Thailand, done by Jarungrattanapong and Manasboonphempool (2008), indicated that an impacted household would require adaptation costs to sea level rise averagely 107,587 Thai Baht per year. With that amount, it is considered high comparing to average annual income of Thai coastal households, which are ranged from 123,732 to 508,676 Thai Baht (Thailand Community Development Department, 2009).

This research analyzes applicability, appropriateness, and effectiveness of microfinance as a (financial) measure to support household adaptation requirements to sea level rise impacts. The research designs and identifies required terms of microfinance for sea level rise impacts and assumes it is occurred in hypothetical

market. Such hypothetical designed microfinance hereinafter in this research is collectively called "microfinance for sea level rise impacts". Research also: assesses household adaptation cost requirements; evaluate attitude, acceptance, and willingness to save of community's members toward the designed microfinance, including review administrative and supporting needed to sustain such microfinance. Successful microfinance for sea level rise impacts is expected to strengthen financial adaptive capacity of studied communities. The more adaptive capacity they have, the less vulnerable to climate change impacts they are. In addition, climate change is caused by emission of transboundary greenhouse gases (United Nations Economic Commission for Europe, 1979). It is often argued that those vulnerable in many cases are not direct polluters, but they have to bear the costs associated to their adaptations. The issue of how direct polluters fund and distribute their funding to non polluters but vulnerable has become one of the major debates in the years to come. One additional advantage, but not last, of microfinance is that it is a potential receiving channel of external assistant funds or adaptation funds either from national or international to flow to real vulnerable parties at community level.

1.2 Conceptual Framework, Research Objectives and Hypothesis

1.2.1 Conceptual study framework

To connect all aspects of study and outline possible courses and effects, a conceptual framework is required in this research. The conceptual framework is developed by adjusting vulnerability models of Klein and Nicholls (1999), Mimura and Harasawa (2000; cited in Mclean & Tsyban, 2001), and combining with consumer's behavior model of Engel et al. (1986; cited in Kotler, 1991). The framework, as shown in Figure 1.3, demonstrates the linkages between the impacts of sea level rise to, the adaptative capacity via the usage of microfinance, and the vulnerability of a coastal socio-economic system.

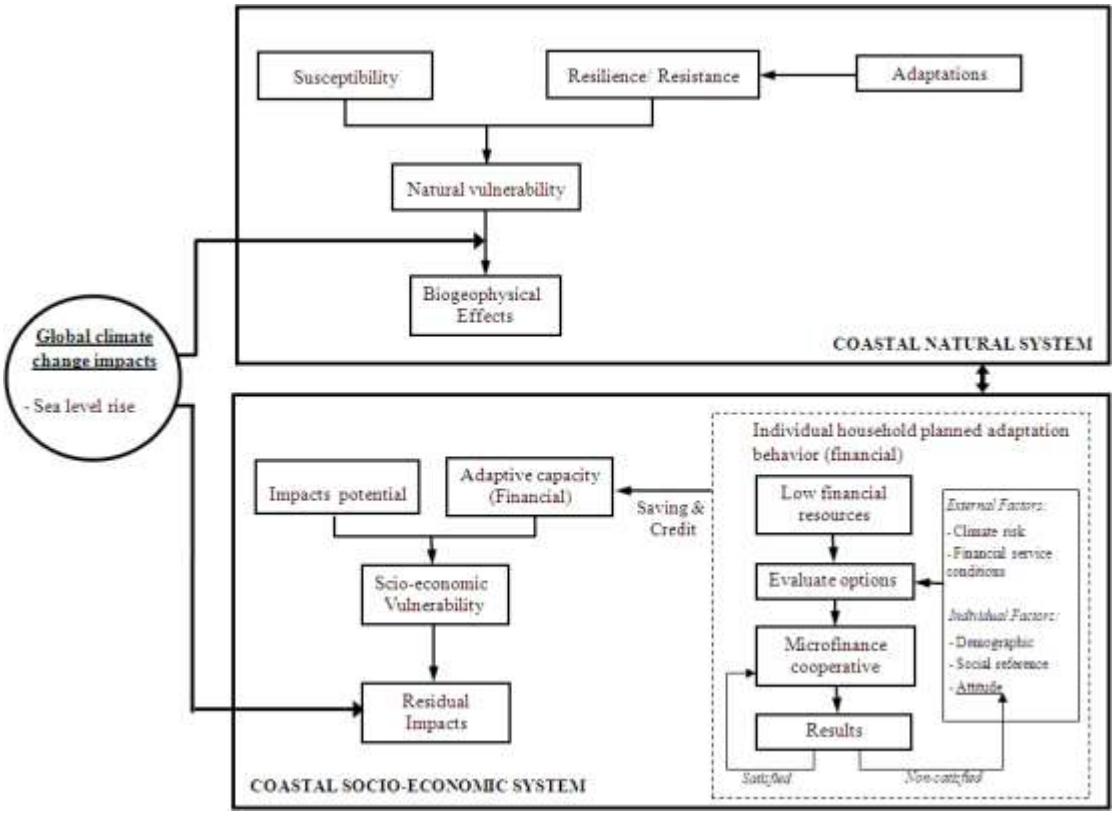

Figure1.3: Conceptual study framework of coastal vulnerability, impacts and planned adaptation (using financial self-service cooperative, microfinance)

A coastal system is composed of the interactions between natural and socio-economic systems. Impacts from global climate change such as sea level rise has direct negative effects to their biogeophysical and residual. The degree to which each system is vulnerable generally is depended on two factors: a) the system's potential to be affected by the impacts; and b) the system's ability to prevent to or continue functioning in the face of possible disturbance. In the coastal natural system, it is determined by its susceptibility and resilience/ resistance, whereas in the socio-economic system, it is determined by its impact potential and adaptive capacity. As the dynamic interactions take place between the two systems, well or poor managing of a system will affect to the other in a co-evolutionary way.

Adaptations provided by human can enhance the system's resilience or the system's adaptive capacity, and thus reduce the system's vulnerability at the given impacts. Adaptations have many forms, but overall they are referred to the use of any strategies, practices, processes, and technologies that support people in dealing

with the impacts of climate change. They can be categorized into two extremes subject to the considered aspects e.g. purposes, temporal, and spatial. In view of purposefulness, adaptations are mainly classified into autonomous and planned. The autonomous adaptation takes place simultaneously in reactive response (after impacts) to climatic stresses without directed intervention by a public agency. The planned adaptation is intentional, anticipatory, policy related and undertaken before impacts are apparent. In view of temporal and spatial, adaptations can be short term or long term, and localized or internationalized.

A coastal community that has lower financial resources will result to its limited capacity to implement the effective adaptive measures (adaptive capacity), and be highly vulnerable to any climate change impacts. Individual households in the community therefore seek the most appropriate financial service options to increase their financial capabilities depended on their attitudes, social references, and demographic factors. The external factors such as the level of climate risk they are facing with, the conditions of financial services options also influence their evaluation processes. Microfinance is an option that can create financial self-services cooperative among them and thus fulfill their financial requirement for adaptations at a level. Microfinance can be considered as a planned adaptation as it mainly involves with a financial planning for future use. The design of microfinance must be localized (fit to community requirements), create fairness, and be self-continuity. Successful microfinance will create the repeated behavior of participation by individual households and can enhance financial adaptive capacity of a coastal socio-economic system through the microfinance's saving and credit mechanisms. In contrast, the unsuccessful may influence individual's negative attitude toward microfinance and results to lower financial cooperative in the community.

1.2.2 Research objectives and hypothesis

This research contributes to development of adaptations to climate change. The research examines a way to fill up gap of fund requirements for adaptation at household level by mean of financial self-help/ self-service within a community. Its overall object is to study a measure (microfinance) whether it is applicable for adaptation, and be able to strengthen financial adaptive capacity of

vulnerable coastal communities to sea level rise impacts. At a given impact, higher adaptive capacity of a community will lead to better adaptation of households in such community. The studied communities are selected considering factors of physical characteristics of coast, existing coastal problems in the areas, and community's familiarization to microfinance. Specific objectives of this research are as follows:

a) To assess present and next 30 years coastal community adaptation cost requirements at household level to the impacts of sea level rise.

b) To test applicability of microfinance for sea level rise impacts by analyzing acceptance, attitudes, factors affecting participation, and willingness to save of community's member to such microfinance.

c) To evaluate appropriateness and effectiveness of microfinance for sea level rise impacts

The following hypothesis, which identifies applicability, factors affecting participation, and effectiveness of microfinance, are tested.

H1/ (H0): Microfinance can (cannot) be applied as an adaptive measure to strengthen financial adaptive capacity of household prepared for the impacts of sea level rise.

H1/ (H0): Factors of risk perceptions to sea level rise impacts, attitudes toward microfinance, social references, facilitating conditions of microfinance, government supports, and demographic influence (do not influence) individual household acceptance and degree of participation to microfinance for sea level rise impacts.

H1/ (H0): Financial services of microfinance are effective (ineffective) and derived fund can (cannot) fulfill adaptation cost requirements of household to the impacts of sea level rise.

1.3 Scope of Research

In this research, number of conditions is given as research scope. Those conditions are related with study area, impacts of climate change, adaptation and adaptation cost requirements, microfinance, and methodologies. They are described

as follows:

(a) Research focuses on applicability of conventional microfinance, and excludes Islamic microfinance. This is due to Islamic microfinance limits outreach and prohibits operations based on interest following Shari'a principles, thus requires unique study (Abdul Rahman, 2007).

(b) Studied sites are non-Islamic vulnerable coastal communities within the Kingdom of Thailand.

(c) Research focuses on sea level rise, one of the most critical aspects of global climate change impacts.

(d) Research focuses on coastal adaptations at household level, given that the large scale investments are to be provided by government at national level.

(e) Adaptation cost requirements are for household level and limited to direct cost, but excluded indirect and opportunity costs.

(f) It is assumed that microfinance serves well to household at the level of 'protect' and 'accommodate' adaptations to sea level rise impacts. When the magnitude of impacts so severe that it requires 'retreat' adaptation or 'abandon the area', it beyond household adaptative capacity and government supports become majority.

(g) Research adopts an elicitation method of willingness-to-pay so called 'Two-Way Payment Ladder (TWPL)' to measure amounts that people are 'willing to save' and 'unwilling to save' in hypothetical microfinance designed as an adaptive measure to sea level rise impacts.

1.4 Overview Research Results and Research Originality

1.4.1 Overview research results

This research is an empirical study with an attempt to provide an alternative measure for better financial preparation of vulnerable coastal households for adaptations to sea level rise impacts. Microfinance is chosen for experiment as it principally creates self-financial service cooperatives among households in a community. Accordingly, it is able to fulfill budget requirement gap arisen from

either insufficient own household's saving or insufficient supply of external assistances. Successful implementation of microfinance is expected to increase financial adaptive capacity, at a given degree of potential impact, and thus decreases vulnerability of households including their community.

The research explored applicability, appropriateness, and effectiveness of microfinance for sea level rise impacts. The applicability was measured by the test of attitudes and level of acceptance of community's members toward such microfinance. Types of microfinance institution were evaluated and necessary microfinance conditions were designed and reviewed in order to obtain appropriate microfinance for sea level rise impacts. The effectiveness was measured mainly in view of financial capability of microfinance services. This was done by assessing sufficiency of fund/ credit amounts generated from member's saving to microfinance against with their adaptation cost requirements. At community level, adaptation budget is a sum of member's saving. Adaptation deficit (adaptation budget is less than required adaptation costs) then can be determined in order to know donation amount, if any, needed from external. The research also tested factors of risk perceptions to sea level rise impacts, attitudes toward microfinance, social references, facilitating conditions of microfinance, government supports, and demographic which might influence individual household acceptance process and degree of participation to microfinance for sea level rise impacts. Results of the research may initiate economic, social and political corporative among stakeholder in response to climate stresses, for which currently may individually tackle the problems, and hence strengthen adaptive capacity of vulnerable household and community. Those results are fully described in the subsequent Chapter 4-8.

1.4.2 Research originality

This research examined a new possible measure to increase financial adaptive capacity of coastal households prepared for the impacts of sea level rise. A designed hypothetical microfinance for sea level rise impacts was originally tested for its applicability and effectiveness. Although results and methodologies of the research are particularly for selected coastal communities in Thailand, they are valuable references for broaden uses. Any parties concerned at national and regional

levels can further utilize them to support their local adaptations providing that differences in local conditions e.g. cultures and demography should be properly addressed. In addition, the 'Willingness-To-Save' was firstly used in this research to measure amounts people are willing to save to microfinance for sea level rise impacts, in hypothetical market, for their own future direct benefits. Research adopted an elicitation method for the willingness-to-pay, so called 'Two-way Payment Ladder', to develop a range of amounts that people were willing, uncertainty, or unwilling to bid to conserve something valuable in their views. Microfinance is a potential measure to increase people's financial capability to adjust conditions of their living areas in the face of future climate change. The value of microfinance in people view occurred hypothetically as it depended on how people believed in future microfinance benefits, and would reflect the bid amount people were willing or unwilling to save to. This research contributes its knowledge for further development of microfinance and adaptations. With a full hope, research somehow can help real vulnerable parties living better with the impacts of climate change.

CHAPTER II
LITERATURE REVIEW

2.1 Impacts of Climate Change (Sea Level Rise) to Vulnerable Coastal Areas

Coastal areas are composed of various resources and ecosystems. Importance of coastal areas has been recognized by all coastal countries whereby resources such as fisheries, mangrove forests, and reefs are abundant and diverse (AIDEnvironment, RIKZ, 2004). Unfortunately, depletion and deterioration of coastal areas and resources have widely occurred as they are currently overused by human. In addition, the impacts of global climate changes have accelerated the deterioration. There are many aspects of climate change impacts to the coasts with their related biogeophysical effects (Klein and Nicholls, 1999). Those aspects include increasing sea level, increasing sea water temperature, increasing precipitation intensity, increasing wave height, more variation in storm frequency and water run-off, and increasing atmospheric CO_2. All are described in Appendix A.

Among those aspects, the effect of sea level rise is considered the most serious threat due to the continued increasing of sea level from the polar glacier melting and sea thermal expansion. The potential effects of sea level rise to coastal areas are increasing flood frequency, inundation, coastal erosion, rising of water table, saltwater intrusion, and biological effects. The magnitudes of impacts vary from place to place depending on a number of local factors such as climate, coastal morphology, and coastal modification by local people. Table 2.1 summarizes the general indicatives of biogeophysical effects and impacted socio-economic sectors in coastal zones due to sea level rise (Nicholls, 2003). The damage from those impacts can be further categorized into direct and indirect (Messner & Meyer, 2005). Direct damage covers all varieties of harm which relate to the immediate physical contact of water to humans, property and the environment e.g. damage to buildings and economic goods. Indirect or consequential damage occurs as further consequence of

inundation and the disruption of economic and social activities e.g. loss of time and profits due to traffic disruption. However, the actual degree of damages of sea level rise to a specific coast depends on the adaptability of the affected socio-economic and ecological systems, and their potential to be harmed by a hazardous event (Cutter 1996).

Table2.1: Biogeophysical effects and impacted socio-economic sectors in coastal zones due to sea level rise

Socio-Economic Sectors	Biogeophysical Effects (X)					
	Flood Frequency	Erosion	Inundation	Rising Water Tables	Saltwater Intrusion	Biological Effects
Water Resources	X	X	X	X	X	X
Agriculture	X		X	X	X	
Human Health	X		X			X
Fisheries	X	X	X		X	X
Tourism	X	X	X			X
Human Settlements	X	X	X	X		

Source: Klein & Nicholls (1999).

Scientific knowledge about the associated increase in sea level is considered yet at a very initial stage. Numbers of studies were conducted with variation in results. Hoffman, Keyes and Titus (1983) estimated the rise of mean sea level in 2100 comparing with in 1983, at 345 cm for the worst case and 56.2 cm for the conservative one. Smith and Tirpak (1990) estimated a rise of 60 cm to 280 cm by 2100 in addition from the sea level at the time they made estimation. Wigley and Raper (1992) estimated a "best guess" at 48 cm (approximately 1.5 feet) higher than level in 1992 by the year 2100. More recent study of Meehl et al. (2007), details are shown in Table 2.2, projected the global mean sea level rise 'best estimate' relevant to coastal areas at the end of 21st century ranging from 28 cm for the best case to 43 cm for the worst case following the six socio-economic scenarios (Naki´cenovi´c et al., 2000; cited in Carter et al., 2007) of IPCC Special Report on Emission Scenarios (SRES).

Table2.2: Projected global mean sea level rise relevant to coastal areas at the end of the 21st century for the 6 SRES scenarios

Climate driver			B1	B2	A1B	A1T	A2	A1FI
Surface ocean pH (baseline today: 8.1)			8.0	7.9	7.9	7.9	7.8	7.7
SST rise (°C) (relative to 1980-1999)			1.5	-	2.2	-	2.6	-
Sea-level rise (relative to 1980-1999)	Best estimate (m)		0.28	0.32	0.35	0.33	0.37	0.43
	Range (m)	5%	0.19	0.21	0.23	0.22	0.25	0.28
		95%	0.37	0.42	0.47	0.44	0.50	0.58

Source: Meehl et al. (2007)

Remark: B1, B2, A1B, A1T, A2, A1FL are families of socio-economic scenarios in the Special Report on Emission Scenarios (SRES). Details are in the IPCC 4th assessment report, Chapter 2 – Assessment methods, Box 2.2.

Normally variations in sea level are measured in two ways. Eustatic sea level represents the level of the ocean independent of land movements. Relative sea level is measured relative to the local land surface. Most researchers focus on relative sea-level change (Carter & La Rovere, 2001). The most primary concern when assessing the impacts of sea level rise to coastal resources is to determine how much land will be lost in response to the rise. This can be possible through the use of the 'Bruun Rule' for estimation of retreat through beach and dune erosion, assuming the sea level rise is the only forcing factor that will bring about the change (Jallow, Barrow and Leatherman, 1996). Alternatively, Aggarwal, Horner and Wang (2006) estimated the size of inundated inland area from sea level rise by assuming a certain rising level and applying a model of combination of bathymetry and topography to find the inundation zone, and then compared with the national land cover data to find the impacted areas. They mentioned that the tidal effect must be taken into account. With the current mean seal level, there are already some parts of land above mean sea level inundated by the tidal high effect (H). Those areas should not be counted as being inundated due to global warming. The actual impacted area caused by global warming should be the zone between H and future MSL (X) + H as shown in Figure 2.1.

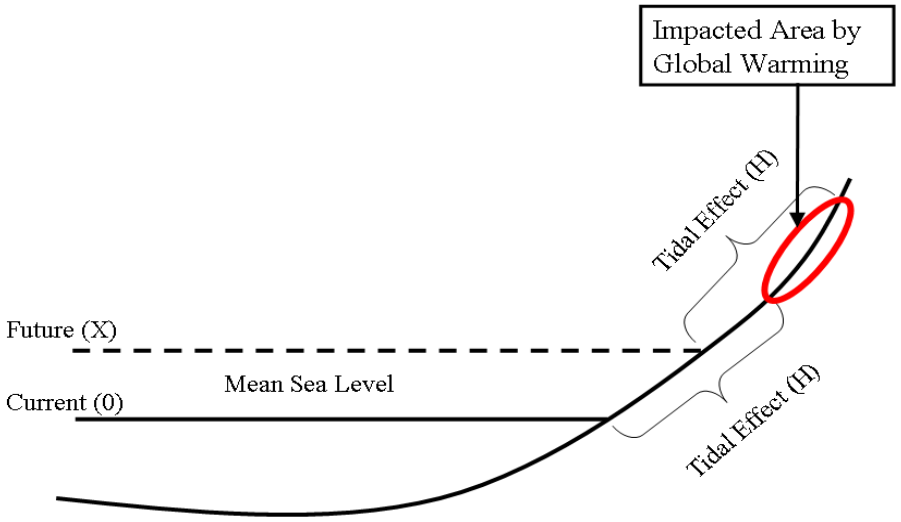

Figure2.1: Tidal effect and impacted area by global warming

Source: Aggarwal et al. (2006)

For the studies on economic impact due to sea level rise, there are several examples of studies which mostly have focused on the loss value of direct use of coastal resources such as impact from loss of land (land price), impact from loss of business transactions (national income), and costs of mobilization or accommodation relocation. Morisugi, Ueda, Asma, Asano and Muto (1997) used a macro socio-economic model based on the general equilibrium theory to evaluate economic impact of land loss due to sea level rise. Betts (2002) used GIS based model to estimate flood damage for property. Darwin and Tol (2001) evaluated economic effects of full coastal protection to a 0.5 meter seal level rise by comparing with the Direct Cost (DC) of dry-land and wetland valued at 2 million dollars per km^2 and 5 million dollars per km^2 respectively (Fankhauser, 1994). Their study results indicated that it was worth to implement the coastal protection because the total direct costs with optimal protection were lower than the total direct costs without optimal protection. Bayani (2007) estimated economic vulnerability or the total potential damages of coastal erosion under the 'no action/ protection' assumption. He also found that the damages value from 'no action' is higher than 'protection'.

2.2 Coastal Vulnerability

Coastal areas are particularly vulnerable to the climate changes. At very high confidence from IPCC Fourth Assessment Report (Nicholls et al., 2007), it has indicated that coasts have been experiencing the adverse consequences of hazards related to climate. The impacts may include changes in chemical (ocean acidification) and physical characteristics of marine systems, saltwater intrusion, spread of invasive species, habitat loss, species migrations, changes in population dynamics among marine and coastal species, especially with respect to accelerated sea level rise, shoreline erosion, increased storm frequency or intensity, changes in rainfall, and related flooding. When assessing the coastal vulnerability to sea-level rise, most studies use the mean sea level at a reference date based on IPCC global projected ranges (Carter & La Rovere, 2001). However, the impacts of sea level rise to the coastal socioeconomic sectors are varied by sites (Volonte, 1999). As such, to develop the specific regional coastal vulnerability, it requires the estimation of regional sea-level rise integrated with the estimated local land movements. Yet, there are limitations of data of regional changes in sea level. In addition, the magnitudes of vulnerability are influenced by many particular regional factors. It is therefore hardly to provide projections of these phenomena with high confidence. Many assessments of regional coastal vulnerability simply use projections of global average sea level to baseline records of short-term variability (Ali, 1996; McDonald and O'Connor, 1996; McInnes and Hubbert, 1996; Lorenzo and Teixiera, 1997; cited in Carter & La Rovere, 2001).

IPCC (2007) also has quoted that the most vulnerable groups to the climate change are those industries, settlements and societies located in coastal and river flood plains, especially where rapid urbanization is occurring. Poor communities can be especially vulnerable, in particular those concentrated in high-risk areas. They tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources. Based on observations over the past decade, the property/casualty segment is more vulnerable to weather-related events than the life/health segment. According to Scott (1993), the impacts of climate change on human settlements and societies can come from one of three sources: a) indirect socioeconomic impacts of changes in resource dependent sectors such as

agriculture and fisheries; b) direct impacts on infrastructure, accommodation and the population; and c) deterioration of regional or national natural demographic, technological, economic and social trend.

Generally, vulnerability can be expressed as a function of potential impacts (PI) and adaptive capacity (AC). This can be interpreted that, at a given degree of impact, the more adaptive capacity it has, the less vulnerability it will be.

$$V = f (PI, AC)$$

Another concept developed by Metzger et al. (2006), expressed in mathematical, the vulnerability (V) is a function of exposure (E), sensitivity (S) and adaptive capacity (AC).

$$V = f (E, S, AC)$$

For assessing coastal vulnerability, one of the most common worldwide methods is the Coastal Vulnerability Index (CVI) (Gornitz et al., 1997, cited in Doukakis 2005). This approach combines the coastal system's susceptibility to change with its natural ability to adapt to changing environmental conditions and yields a relative measure of the system's natural vulnerability to the effect of sea level rise. It is based upon the interactions of six risk variables: coastal slope (CS), subsidence (S), displacement (D), geomorphology (G), wave height (WH), and tidal range (TR). The square root of the product mean of the six variables is used to calculate the CVI of the target coast. Then, quartiles (0-25%, 25-50%, 50-75%, and 75-100%) are used to characterize from low, moderate, high, to very high vulnerability.

$$CVI = \sqrt{[CS.3S.3D.3G.3WH.3TR]/6}$$

In addition to the mathematical functions, Klein and Nicholls (1999), and Mimura and Harasawa (2000) (cited in Mclean and Tsyban, 2001) has designed a coastal vulnerability assessment framework to indentify the relationships between the vulnerability of natural and socio-economic sectors of a coastal system in response to climate change impacts via their susceptibility (potential to be impacted), resiliencies (ability to prevent or continue functioning), and the adaptations provided to them. Alternatively, some information can help identifying the criticality or the vulnerability of the coastal areas. Examples of those include the topographic maps with contour

interval, aerial photographs, tide information, evidence of subsidence, population density and other demographic data, and historical data such as damage caused by flooding and coastal erosion.

For human aspects, vulnerability is an indication of people's exposure to external risks and stresses and their ability to cope with, or recover from the impacts (DFID, 2004). Human is a social creature and living together as a group in a specific geographic territory with interaction of multiple purposes, so called community (Magis, 2007). To assess the human group (or community) vulnerability to climate stresses, Nakalevu (2006) used the Community Vulnerability and Adaptation Assessment and Action (CV&A). This CV&A guide outlined six main executing phases consisting of: Adaptation Context, Diagnostic, Assessment and Evaluation, Development, Implementation, and Monitoring. Chinvanno (2007) applied the simple methods of community vulnerability assessments, shown in Figures 2.2, in order to analysis on potential future climate threats. He mentioned the implementation of these steps of action respectively: a) scenario-based study, use climate threats scenario and proxy of its impact to evaluate potential socioeconomic impacts; b) use multiple indicators to evaluate sensitivity / exposure / coping capacity; c) assess disasters impact on household/community livelihood condition; d) compare livelihood conditions to understand household/community vulnerability. The ultimate purpose of vulnerability assessment is to implement the appropriate adaptation. In general, the key questions are 'what do we know?', 'what don't we know?', 'what needs to be done?', and 'what are priority gaps and needs?' Though various guidelines have been mentioned, the common methodological frameworks for conducting vulnerability assessment (Warrick, 2000) can be summarized starting from: 1) Scoping; 2) Select Methods; 3) Data-sets and Baselines; 4) Test Methods; 5) Develop Scenarios; 6) Examine Future Impacts; 7) Identify Adaptation Options; and 8) Integrate & Synthesize.

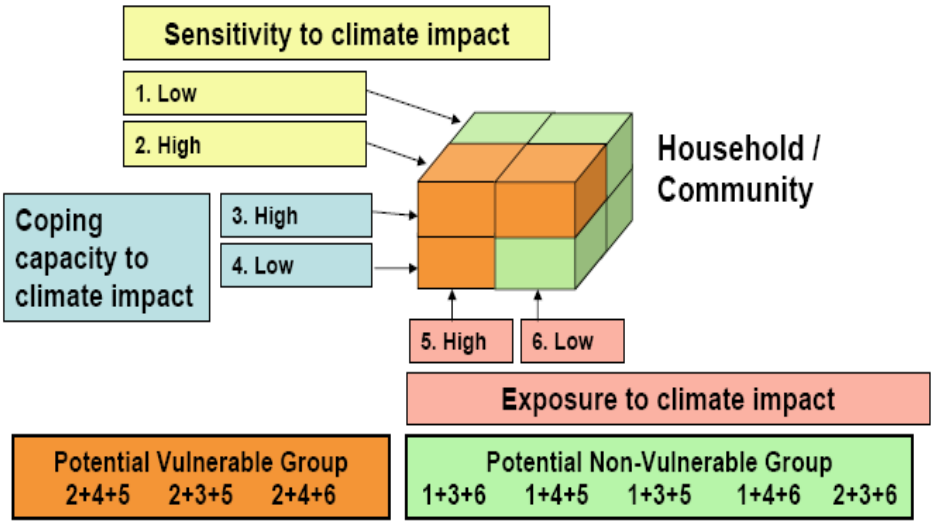

Figure2.2: Understand vulnerability: identifying vulnerable group (Household/ community) using multi-criteria analysis

Source: Chinvanno (2007)

2.3 Coastal Adaptations

2.3.1 Adaptations in the context of climate change

Generally there are 2 main solutions to cope with the threats of climate change, adaptation and mitigation. Adaptation will provide immediate and longer-term reductions in risk in the specific area that is adapting. On the other hand, mitigation (reducing greenhouse gas emissions) reduces future risks in the longer term and at the global scale. Although mitigation is the most preferable, as it limits greenhouse gases at source, it requires contributions and coordination of all humans in this planet. Local adaptations, by enhancing the community participation and ability of natural systems resilience, are more controllable and need to be done in parallel. However, it is often argued the tradeoff between adaptation and mitigation. This is because people who pay for local adaptation costs may not be the major ones who create the pollutant directly.

Adaptation can come in a huge variety of forms. It refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It also refers to changes in processes, practices,

and structures to moderate potential damages or to benefit from opportunities associated with climate change (Smit & Pilifosova, 2001). Thorne, Kantor, and Hossain (2007) also gave the similar definition that adaptation to the impacts of climate change referred to the use of any number of strategies, practices, processes, and technologies that support people in dealing with the impacts of climate change. Measures (adaptive measures) could range from actions being taken by individuals or by communities all the way through to policies which were related to planning and infrastructure development. Differentiation in the adaptations to climate change influences include: (i) adaptation that economic agents will undertake on their own in the absence of government policies or programs, and (ii) actions that a government undertakes (Sathaye and Christensen 1998). In another view, adaptations are classified into two main categories: autonomous and planned (Schneider & Sarukhan, 2001). Autonomous adaptations take place in reactive response (after initial impacts) to climatic stimuli without directed intervention by a public agency. Planned adaptations can be reactive or anticipatory, but must be undertaken before impacts are apparent. In a perfect world, with no market failures, autonomous adaptation is the best way to adapt to climate change and public involvement will be unnecessary (Malik et al. 2010). However, due to constraints with respect to information and resources, autonomous adaptation alone may not be optimal.

Adaptation in practice can be the high investment by the provision of irrigation water through increases in storage capacity, alterations of water management, or it may involve nothing more complicated than a farmer altering a planting date or adjusting fertilizer use. Objectives of adaptations are to reduce the sensitivity. From a temporal perspective, adaptation to climate risks can be viewed at three levels: a) current variability; b) observed medium and long-term trends in climate; c) and anticipatory planning in response to model-based scenarios of long-term climate change (Adger et al., 2007). For a spatial perspective, following Chinvanno studies in 2007, adaptations are the multi level: a) Collective Adaptation; b) National Level; and c) Community Level. The following Table 2.3 shows the differentiation of various adaptation concepts to climate change.

Table2.3: Differentiating adaptation to climate change

General Differentiating Concept orAttribute	Examples of Terms Used
Purposefulness	Autonomous ⟷ Planned Spontaneous ⟷ Purposeful Automatic ⟷ Intentional Natural ⟷ Policy Passive ⟷ Active Strategic
Timing	Anticipatory ⟷ Responsive Proactive ⟷ Reactive *Ex ante* ⟷ *Ex post*
Temporal Scope	Short term ⟷ Long term Tactical ⟷ Strategic Instantaneous ⟷ Cumulative Contingency Routine
Spatial Scope	Localized ⟷ Widespread
Function/Effects	Retreat - Accommodate - Protect Prevent - Tolerate - Spread - Change - Restore
Form	Structural - Legal - Institutional - Regulatory - Financial - Technological
Performance	Cost - Effectiveness - Efficiency - Implementability - Equity

Source: Smit et al. (1999), cited in Smit & Pilifosova (2001)

Adaptation should be prioritized to the high vulnerable and less adaptive capacities sectors e.g. poor and vulnerable people. Pro-poor adaptation (Prowse & Scott, 2008) is the adaptation that should be achieved in relative terms with poor people benefiting more from adaptive measures than the rich. Adaptive capacity is the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change. Enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties in climate, which reduces vulnerabilities and promotes sustainable development (Goklany, 1995; Burton, 1997; Cohen et. al., 1998; Klein, 1998; Rayner and Malone, 1998; Munasinghe, 2000; Smit et al., 2000, these are cited in Smit & Pilifosova, 2001). Determinant of adaptive capacity is to identify the main features of these aspects: economic wealth, technology, information and skills, infrastructure, institutions, and equity.

Designing of short-term adaptive measures do not require climate scenarios. However, adaptive measures that require large investments and expected to be effectively in use for a long time (25 years or more) may require climate

scenarios (Santoso, 2007). Adaptation also should be designed to suit both ecosystem and community needs. According to IUCN (2009), ecosystem-based adaptation (EBA) identifies and implements a range of strategies for the management, conservation and restoration of ecosystems to ensure that they continue to provide the services that enable people to adapt to the impacts of climate change. Community based adaptation is aimed to increase community resilience to thrive in a dynamic environment characterized by change to sustain the community. Effective adaptation needs to make vulnerable people resilient, and able to return to normal status quickly, even after a major disaster. The solution is to build local capacity and resilience in a way that links sustainable development, disaster management, and climate adaptation for a win-win-win situation. Effective adaptation, as such, should yield a 'triple dividend' (UNEP FI Climate Change Working Group, 2006).

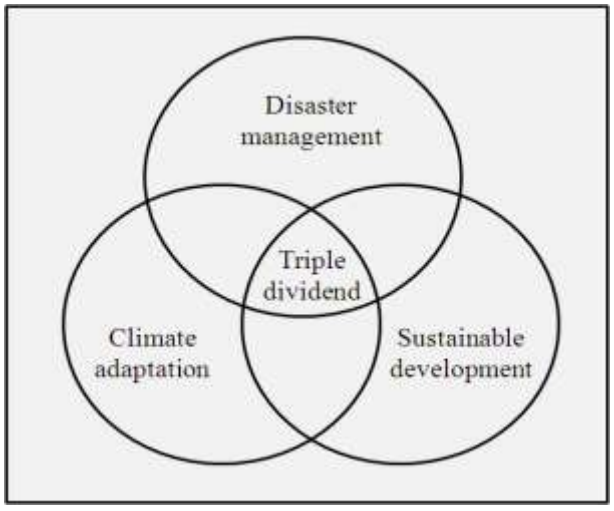

Figure2.3: Effective adaptation and triple dividend

Source: UNEP FI Climate Change Working Group, 2006

2.3.2 Coastal adaptations to sea level rise

Generally, there are three possible coastal adaptation strategies to the sea level rise: 'retreat' – abandonment of land and structures in highly vulnerable areas and resettlement of inhabitants; 'accommodate' – conservation of ecosystems, continued occupancy and use of vulnerable areas and adaptive management responses; and 'protect' – defense of vulnerable areas, population centers, infrastructure and natural resources using both hard, "structural" options and 'non-

structural' solutions. The structural approach, such as sea wall, dyke, wave breaker, and groin, though can build immediate protection but will not last longer (Macintosh & Ashton, 2004) and may create long term impact to other ecosystems. The non-structural ones e.g. wetland, and mangrove greenbelt are more sustainable but requires much efforts and high participation from stakeholders for implementation. Besides that, non-structural may provide additional benefits in term of additional ecosystem services. Some common adaptations for coastal resources sectors have been identified by United Nations Framework Convention on Climate Change (2007). They include protection of economic infrastructures, building sea walls and beach reinforcement, public awareness to enhance protection of coastal ecosystems, integrated coastal zone management, development of legislation for coastal protection, and research and monitoring of coasts and coastal ecosystems.

Two aspects of adaptations to climate change impacts and disasters risk management are interacted. There are the synergies and differences between those aspects (Sperling & Szekely, 2005). The commonalities between disaster risk management and adaptations to climate change is that both measures aim to address underlying vulnerabilities put the natural and human systems at risk. However, the time horizons tend to be different. Disaster risk management is more concerned with the present. Emphasis is placed on vulnerabilities revealed through past disasters and the focus tends to be more on near term trends (the next 5–10 years). In anticipating climate change, the scientific and policy debate usually takes a much longer time horizon than disaster risk management e.g. next 20, 50 and 100 years. Financial mechanisms are the measures that can contribute to climate change adaptation and disaster risk management. The insurance sector especially property, health and crop insurance can efficiently spread risks and reduce the financial hardships linked to those extreme events. Based on observations over the past decade, the property/casualty (P/C) segment are more vulnerable to weather-related events than the life/health segment. As such, within those insurance sectors, the property insurance industry is most likely to be directly affected by the climate change (Vellinga & Mills, 2001).

The disasters insurance markets mostly are limited to major industrial and commercial properties. This is due to the covariant nature of the natural risks that

affect an entire community or region at the same time, claims must be paid to all members and it threatens the solvency of the insurer. To implement disasters insurance down to household level (micro-insurance schemes), there are special challenges of ensuring the long-term viability. An example of disaster micro-insurance to limit solvency of insurer is a move from traditional to index-based schemes (Arnold, 2008). Traditional indemnity insurance pays claims based on actual losses, whereas the index-based schemes feature limited payment against a physical trigger (parametric insurance), regardless of actual losses. Reinsurance also can provide a significant and essential form of risk spreading capacity for primary insurers to either public or private insurers. For natural catastrophes, governments in many countries intervene the insurance systems by adopt the role of insurer, reinsurer, or regulator in establishing risk-pooling mechanisms or tax subsidization for insurance business. However, there are some unintended consequences of such government interventions (Pidot, 2007). Those include: a) create liability for all country taxpayers; b) potential unfair subsidize; c) drive out other private insurers; d) potential increase vulnerability due to the moral hazard and free ride effects.

2.3.3 Evaluation of adaptation options

There are many forms of adaptations to climate change. To select the most fit to the required vulnerable sector, it needs a proper evaluation. For evaluating adaptation options, Erda and Hui (2008) used a framework of multi-criteria analysis (MCA). Multi-criteria analysis or multi-objective decision making is a type of decision analysis tool that is particularly applicable to cases where a single-criterion approach (such as cost-benefit analysis) falls short. MCA allows decision makers to include a full range of social, environmental, technical, economic, and financial criteria. MCA normally uses the techniques of quantitative comparing and scored ranking. The quantitative comparing can be applied with both threshold and criteria weight values, but the latter provides more sensitivity (Hanandeh & El-Zein, 2006).

Smit and Pilifosova (2001) mentioned that criteria of costs, benefits, equity, efficiency, and implementability should be used for evaluating the adaptation options. Lagos, Wirth, and El-Ashry (2009) said that a national adaptation strategies

should be evaluated by these four principles: a) scale - match responses to the numbers of people impacted; b) speed; c) focus - manage risk, build the resilience and enhance the ecosystem functions; and d) integration - synergies between environment, economic development, and climate change. Evaluating and selecting of the appropriate adaptations are only the prerequisite stage. Another subsequent important issue is how to ensure the adaptations meet the requirements after implementation. Prabhakar & Srinivansan (n.d.) has proposed a way, so called adaptation metrics, to monitor the efficiency of adaptation. It is to know how much 'adaptation' we want to achieve at each stage to meet the target by setting the baseline of adaptation to compare the progress and effectiveness, and agree on measurement system.

2.4 Adaptation Costs to Sea Level Rise

Adaptation costs increase as the level of adaptation increases, while the level of unmitigated damages decreases as adaptation increases. However, some damage will not be adapted to over the longer term, because adaptation is either not economic or not feasible. This is termed 'residual damage' (see Figure 2.4). Fankhauser (1996) said that adaptation actions are justified as long as the additional costs of adaptation are lower than additional benefits from reduced damage levels. He also referred that there were 5 types of costs associated with climate change.

1. Adaptation costs (AC): the costs of the resources used by society to undertake adaptation measures both in the baseline and future climates.

2. Climate change damages (CD): the value of the extra damages that occur exclusively because of climate change

3. Ordinary climate damages (OD): the adverse effects associated with the current climate that would be occurred even in the absence of climate change.

4. Other relevant costs (OC): the indirect costs that result from taking an adaptation action.

5. Imposed costs of climate change (ICCC): the difference in overall costs (AC+CD+OD+OC) between the climate change and the reference scenario.

These above costs definition are useful for analyzing the projects that have market price. However this approach does not work easily on behavioral adaptation e.g. changing planting date on crops.

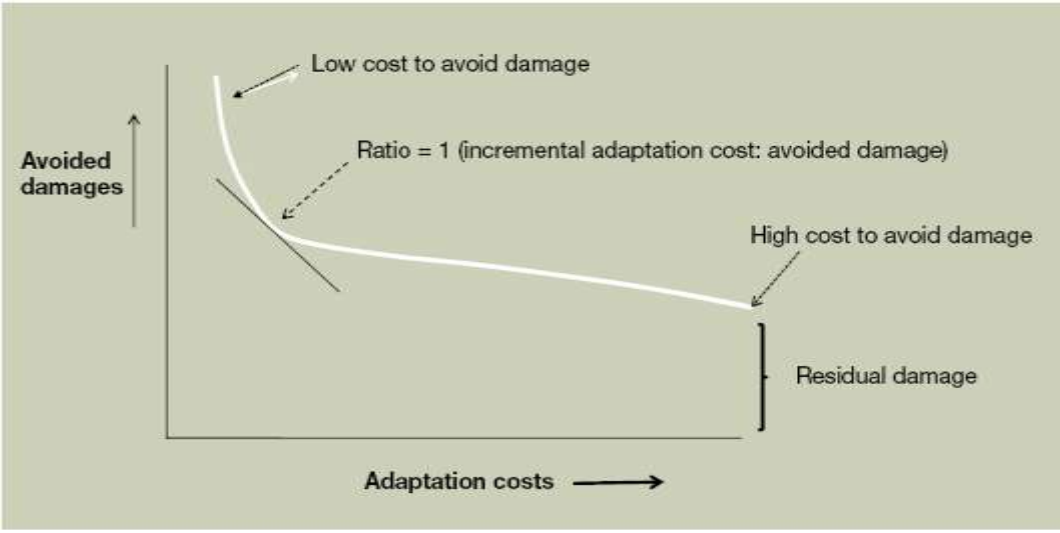

Figure2.4: Schematic of compared adaptation costs, avoided damages, and residual damage

Source: Parry et al. (2009b)

A common basis for evaluating impact costs from climate change is to sum adaptation costs and residual damage costs (Fankhauser, 1996; Rothman et al., 1998, cited in Smit, & Pilifosova, 2001). Most researches/ approaches consider equilibrium adaptation costs at a time, and ignore transition costs at temporal scale such as maintenance costs. The optimal adaptation consists of two main components: a) economic agents adapt autonomously to climate change in their production, consumption, and investment decisions; b) governments take additional actions to address the market imperfections (Callaway, Naess, & Ringius, 1998). However, two potential problems in case of government support for autonomous adaptation actions are that;

- There is a tendency to 'free ride'. Subsidization by government tends to create incentives for economic agents not to take actions to avoid climate change impacts and to wait for the compensation instead.
- Another related problem is 'moral hazard', which occurs when economic

agents are given incentives to cheat by altering their behavior (from optimal to suboptimal) in response to government programs to spread risks e.g. crop insurance, house insurance, disaster relief.

Assessing the costs and benefits of adaptation options forms an important part of adaptation planning since it can: a) identify the scale of the adaptation issue and raise awareness; and b) provide sufficient information to allow decision makers to choose the proper adaptation options (United Nations Framework Convention on Climate Change, 2010). On economic perspective, the economic efficiency (cost and benefit analysis) provides basis for optimal adaptation in which the costs for adaptation are less than the adaptation benefits (Sathaye and Christensen, 1998). The basis for the estimation of adaptation costs is the value of the real resources society gives up (opportunity costs) to create adaptation benefits; whereas, adaptation benefits are the value of the climate change damages avoided by adaptation. Since the actual costs of adaptation will occur at different times in the future, economic costs are converted to 'present values' using a discount rate (Karakaya 2007). There are various choices of discount rate for climate change policy: social discount rate (Stern et al. 2006), market rate, and the rate that people actually pay for day-to-day decisions (IPCC 1996 cited in Markandya and Milborrow 1998). The former leads to a relatively lower rate. The arguments for either approach are unlikely to be resolved. As such, the adaptation costs calculated at more than one rate should provide policymakers some guidance regarding sensitivity analysis. Although several studies have reported the costs of adaptation, they most likely are underestimations due to a lack of many aspects of consideration, for example sector coverage, residual damages, and ecology (Parry et al. 2009b). It is important to enhance future studies to be based upon case studies that cover a wide range of places and sectors, support top-down analyses, and thus provide a choice range for preparedness to pay.

Focusing on sea level rise, the required adaptations will be based on the local value of the relative sea level rise rate: the net combination of levels of sea rise and land subsidence (Hillen et al. 2010). The levels of adaptation, including the required costs, therefore vary according to the different areas and sea level rise scenarios. Wealthy, densely populated countries, and areas of high economic value, such as harbors and cities, are more highly protected than others are, and result in

higher adaptation costs (Fankhauser 1995, cited in Dore and Burton 2000). According to Dore and Burton (2000), for the cost assessment methodologies, the consistent methodologies for estimating adaptation costs at the micro level do not exist. However, what does exist are methodologies at the macro scale regarding climate change. One example related to the sea level rise impacts at the global scale, from the review of Parry et al. (2009b), was the estimation of United Nations Framework Convention on Climate Change for the adaptation costs required for coastal zone for developed and developing countries. The estimation was based on 'hold the shore line' with traditional coastal engineering responses (e.g., dykes and beach nourishment). Another example was the recent study of Nicholls, Brown, Hanson, and Hinkel (2010), who used the Dynamic Interactive Vulnerability Assessment (DIVA) model to compare the global adaptation costs for coastal areas to climate change over three main protection responses, sea dikes, beach nourishment, and port upgrade. However, there are few studies at the household (micro) level for assessing the adaptation cost requirements to sea level rise impacts. Jarungrattanapong and Manasboonphempool (2008) estimated the costs for household adaptation due to coastal erosion/flooding at Bang Khun Thian District, Bangkok, Thailand. Hideyuki (2004) assessed the costs of household adaptations to sea level rises in Indonesian coastal cities using factors of the amount of material used per house and per area, along with workdays that would be lost. Although from different target respondents (house owners and housing construction companies), in both cases, field interview survey methods were used by asking the market price.

Future sea level rise can impact various socio-economic sectors and their associated biogeophysical effects. To precisely assess the adaptation cost requirements, thus it needs to identify required adaptive measures for each of those particular effects. The factors to be taken into consideration when assessing costs of physical adaptive measure mainly are;

- The maintenance cost of existing adaptation measures
- The cost of implementing new adaptation measures
- Inflation
- The usage life of adaptation measures

Those above factors exclude the costs of opportunity loss (opportunity costs) from the use of measures e.g. sea wall will decrease recreation of beach therefore tourist lost, biodiversity lost. The rise of sea level is the projection, therefore estimation of adaptation cost requirement needs to be in line with sea level rise scenarios. In addition, the cost of 'no action' should be considered whether it is more benefit than 'taking adaption action'. Saizar (1997) mentioned that the cost of 'no action' is similar to the cost of planned retreat, abandon the area and relocation. He estimated adaptation costs requirements for sea level rise on Montevideo coast, Uruguay. In his study, he assumed that every 10 years approximate 50% of existing maintenance costs should be added for further maintenance. According to Parry et al. (2009b), the additional costs of adaptation have sometimes been simply calculated as 'climate mark-ups' (increased by %) against the previous assumed investment. To determine total costs at macro level, cost results of micro units can be analyzed together with satellite image formulated in GIS based on UTM coordinates. Then, urban typology borders identified from image itself, and contours of low flat region estimated from the single points of height in geographical maps are merged to approximately calculate the sum total loss of each urban type.

2.5 Microfinance

2.5.1 Introduction to microfinance

The difference between private and public financing for climate project is that private sector financing involves highly market mechanisms e.g. carbon dioxide trading. Market mechanisms will encourage participants in the market to find the least-cost solutions to any environmental problems. Public sector financing is normally in the forms of grants, overseas development assistance (ODA), and funding from host country governments. Microfinance, by its function, can contribute to both sectors. It is the forms of financial cooperatives among group member in private sector, whereas it can extend its services as a receiving channel for donation from public sector.

What is microfinance? According to Hammill, Matthew, & McCarter (2008), microfinance is the delivery of loans (credit), savings, insurance and other financial services to the group of people so they can engage in productive activities, helping them build assets, stabilize consumption and protect themselves against risk. Microfinance therefore can make many contributions to livelihood asset such as increasing household financial saving, strengthening social network, and capital for natural resources management. Another brief explanation from Harper (1998) who said that microfinance could be built on two traditional forms of financial mediation in poor communities, moneylenders and local savings groups. Microfinance has the potential to help the vulnerable populations adapt to climate change by providing individuals and households with a means of accumulating and managing the assets and capabilities. The logic here is simple that the more assets and capabilities people have, the less vulnerable they are.

Microfinance works best to support the economically active poor, or those hovering just above the poverty line to help them stay above it (Cohen, 2003; cited in Hammill, Matthew, & McCarter, 2008). Diaphragm can be seen in Figure 2.5, microfinance and poverty line. However, microfinance typically do not reach the poorest of the poor, who are often the most difficult to reach in a normal system. Those are over-represented by socially excluded groups such as sex workers, the disabled and elderly, street children and refugees. According to Hossain (2005), the indicators of poverty line analysis based on solely household consumption or income do not capture all dimensions of poverty, especially from the viewpoint of poor people themselves. As such, poverty should be used broader concepts to include deprivation and insecurity. Deprivation occurs when people are unable to reach a certain level of functioning or capability e.g. disability person. Fallavier (1994) provided the common characteristics that identified poverty across frontier was a situation of exclusion from: a) access to basic survival needs due to insufficient income - a poverty of income; and b) access to the tools necessary to improve economic productivity - a poverty of choices.

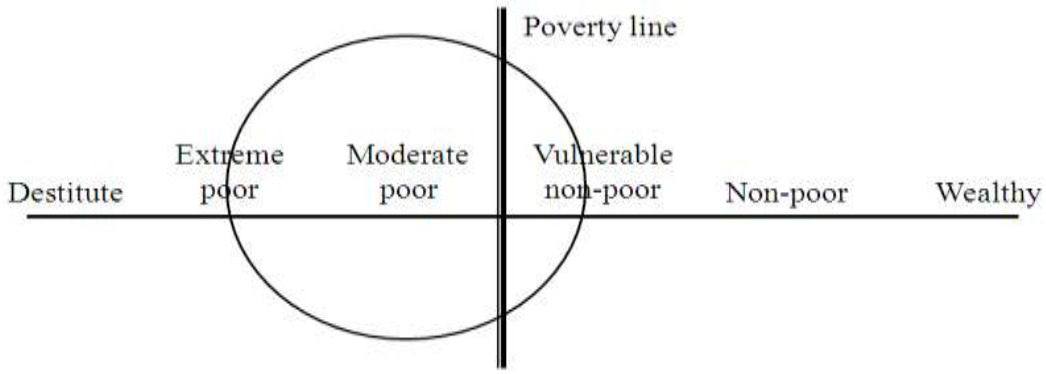

Figure2.5: Microfinance and poverty line

Source: adapted from Cohen (2003)

An important job for government in the microfinance is to effectively regulate and provide supervisory framework for the protection of depositors. There is a need to make a case for risk based supervision of banks engaged in microfinance (Llanto & Fukui, 2003). Also in order to support the microfinance in attracting savings, governments should provide technical assistance, support the development of the insured deposit fund, and encourage the progressive integration of the microfinance into domestic and foreign capital markets. Microfinance should be able to self-dependency. To be that, it needs well manage of funding. Maisch, Soria & Westley (2006) characterized the four types of funding for microfinance as: a) deposits from any depositors; b) borrowing from public sector, donors, local commercial bank, or international organizations; c) bond issues; and d) stock issues. For a small to medium microfinance (deposits less than 5 MUSD, 50 MUSD) the least costs to most expensive for funding are sequentially borrowing, deposits, and stock issues. For the large microfinance (deposits higher than 50 USD), they are bonds issues, deposit and borrowing, and stock issues respectively. Maisch, Soria and Westley mentioned that the best mix of funding sources depended on the microfinance's maturity level (how solidly sustainable the microfinance is) and the characteristics of the country where the microfinance was located.

2.5.2 Common microfinance institutions

Target groups of microfinance are not homogeneous. Therefore, no single microfinance can possibly match needs of groups that its programs intended to

serve. One type does not fit all. Different forms of microfinance and their related administrative are necessary to cater and to satisfy the varying needs of the groups (Haim, Abidin, Zamzuri Noor & Majid, 2007). Examples are the microfinance designed for the youth in Indonesia (Shrader, Kamal, Darmono & Johnston, 2006), and microfinance designed for financing water supply and sanitation services (Mehta, 2008). Microfinance can be managed through a various forms of established organizations, so called microfinance institutions (MFIs). According to the United States Agency for International Development (2009), microfinance institutions include but not limit to:

- Credit unions,
- State-owned development agencies,
- Financial NGOs,
- Saving cooperatives, and
- Village banking.

The overview of some common microfinance institutions, their typology and conceptual work are shown in Appendix B. Though, there are many different types of microfinance, it can be distinguished by two criteria: their legal status and their lending technology (Zeller, 2007). Churchill, Hirschland, & Painter (2002) classified those microfinance institutions into three types: formal (regulated), semiformal, and informal (non-regulated), and also identified their advantages and disadvantages (details are shown in Table 2.4 and Appendix C).

Table2.4: Formal, semiformal and informal of microfinance institutions

Formal	Semiformal	Informal
• Commercial banks • Finance companies • Regulated credit unions • Regulated rural banks • Upgraded microfinance institutions	• Credit NGOs • Multiservice NGOs • Unregulated credit unions • Unregulated rural banks	• Village banks • Self-help groups

Source: Churchill, Hirschland, & Painter (2002)

Microfinance can be used for various purposes. Examples of those include: 'microfinance for agriculture farming' (Andrews, 2006); 'microfinance for water and sanitation' that lending to people required drinkable water accessibility and storage (Kouassi-Komlan, Faso, Fonseca, 2004); and 'microfinance to eliminate child labor' that helping parents to expand income-generating activities to replace the former earning by their child laborers (Doorn & Churchill, 2004). Successful microfinance must be designed to fit community requirements with accessibility. People in communities though considered a bank as a safe place to make deposits but they would definitely go to microfinance services if they needed a loan quickly. In other words, people value microfinance in term of convenience more than safety (Arteaga, 2009). The social sanctions also would be necessary. Without government interference, the group lending from microfinance tends to provide more benefit to wealthy groups than poor groups (Baland, Somanathany, & Wahhaj, 2010). This is due to the distributions of lending amount mostly are in favor of the wealthiest groups who need to borrow small amounts frequently, while it might reduce welfare in poor groups that need to borrow a lot. The profitability of microfinance is depended mainly on 2 factors: higher interest rate and lower operating costs. Therefore the design of microfinance lending contract should consider trade-offs between group lending and individual base lending. (Cull, Demirgüç-Kunt, & Morduch, 2005). Group lending has advantages on lower operating costs, but it cannot respond to individual requirement effectively. Individual base lending though has higher operating costs, it can be easily adjusted interest rate and serve individual specific purpose. However, the higher interest rate is, the less attractive will be for the customer.

2.6 Review of Climate Change Impacts, Coastal Adaptations and Microfinance in Southeast Asia and Thailand

2.6.1 Sea level rise impacts to Southeast Asia and Thailand coasts

Sea level along the Asian coasts has been rising by 3.1 mm per year over

the past decade, compared with 1.7~2.4 mm per year over the 20th century (Lu, NCSP, & UNDP-GEF, 2007). As such, coastal and low lying areas in Asian will be significantly affected. Projected sea level rise can flood the residence of millions of people living in the low lying areas of South, Southeast and East Asia such as in Vietnam, Bangladesh, India and China. In addition, there are potentially increase water resource stresses in the regions by increasing salinity of groundwater and surface water resources, and more poses substantial risks to human health. World Bank (Dasgupta et al., 2007) assessed the consequences of continued sea level rise up to 1-5 metres for 84 developing countries using Geographic Information System (GIS) software. The results revealed that, at the highest sea level rise scenario, East Asia would be the most severely impacted region in the developing world. Among those East Asian countries, Vietnam would be the most seriously impacted in all sectors. Thailand would be the fifth serious rank for the land impact, second rank for the population and GDP impact, and third serious rank for the wetlands impact.

Thailand has an extensive coastline on both sides that are opened to Thai Gulf on the east and the Andaman Sea on the west covering area of 513,115 km^2 within 24 provinces (Sudara, 1999; cited in Srisakulchairak, 2000). On the Gulf of Thailand side, it covers roughly 320,000 km^2 and is relatively shallow (mean depth is 45 m, and the maximum depth is 80 m). This makes for a slow water exchange, and the strong water inflow from the rivers makes the Gulf low in salinity and rich in sediments (Burnetta et al. 2007). From the IPCC 4^{th} assessment report (cited in WWF, 2007), the loss of Thailand land due to sea level rise of between 50 cm and 100 cm could decrease Thailand national GDP by 0.36% to 0.69% (300 to 600 Million USD). In addition to sea level rise problems, the stronger wind, wave, and land subsidence has accelerated the shoreline erosion of Thailand coast. The erosion apparently is critical and becoming more serious (Maneerat, 2009). A well known example is the erosion at Bangkhuntien, one of the fifty districts under the control of Bangkok Metropolitan Administration (BMA), with its erosion rate is about 1-4 meters per year (Mekvichai, 2008). According to Nasuchon (2008) the Thailand coastline has already lost about 40,000 acres or 2,600 KM2 of shoreline. On the Gulf of Thailand (east) side, the coastal erosion has been occurred at every coastal province. The critical areas with erosion rate over 5 metres per year cover distance

180.9 Kilometers or 10.9% of Gulf of Thailand coastal line. The high risk areas with erosion rate 1-5 metres per year cover distance 305.1 Kilometers or 18.4 % of the coastal line. On the Andaman side (west), there is also the problem of coastal erosion but averagely the severity is less than that of the Gulf of Thailand side. Some coastal areas are declared as critical with total distance of 23 Kilometers along the Andaman coastal line. The following Figure 2.6 is the map shows the erosion areas along the Thailand coast. The map also identifies the critical (red) and high risk (blue) areas. To deal with those various Thailand coastal issues, the Thailand Department of Coastal and Marine Resources (DCMR) has established 'The strategy to manage Thailand coast'. The said strategy has been endorsed by The National Environmental Committee on the 24th of October 2007. In parallel, DCMR also has been preparing an Act namely 'Coastal Resource Management Act' to integrate all related existing Thailand coastal laws. Financial constraint is one of the major challenges in Thailand coastal management. As such, one section of the drafted Act is clearly dedicated for financial mechanism supports and determined the requirement of decentralization approach to administrate fund effectively to manage the coastal resources.

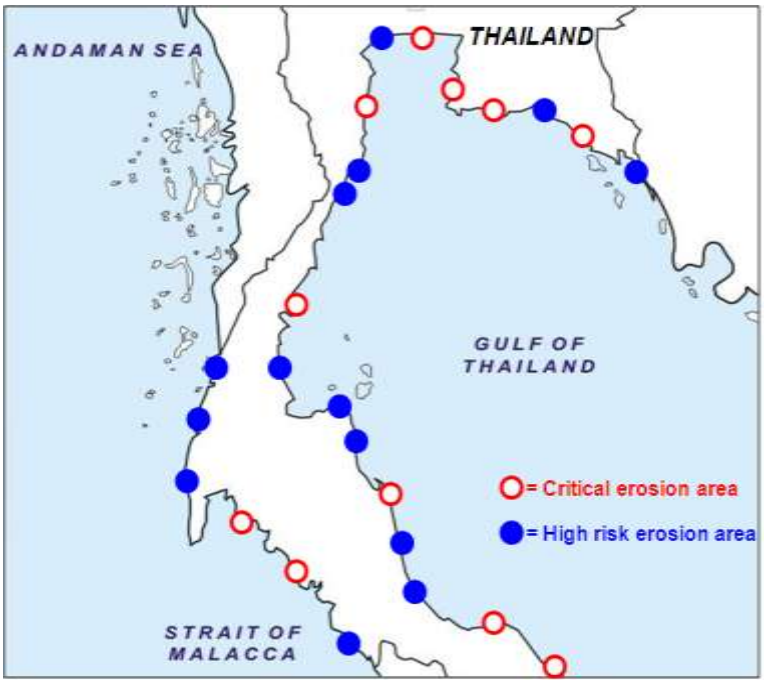

Figure2.6: Map identifies the erosion area along the Thailand coast.
Source: Maneerat (2009)

2.6.2 Adaptations available in Southeast Asia

In a number of Southeast Asia countries, the level of knowledge and awareness on climate change impacts, vulnerability and adaptive measures is low among local officials and insufficient to prompt them to formulate proactive and anticipatory actions. Any required actions at this stage including future, therefore, should be in the way that policy driven, building up knowledge, facilitating and initiating good adaptive measures, and strengthen networks among social, government, related organizations both local and international, and vulnerable people (The United States Agency for International Development, 2010). In Southeast Asia countries, the survey of local adaptations practices to the climate stress at household and individual level was documented by Resurreccion, Sajor, and Fajber (2008). Focusing only the ones related to sea level rise impacts (details shown in Appendix D), they included physically reinforcing the house structure, relocate to new development areas, increase of food stock, alter to flood resistant crop varieties, change in planting schedules, construction of protective structure such as dike, sandbags, and small dams, diversification of livelihood sources; flood insurance; information and knowledge acquisition, acquiring loan from formal sources at higher rates, obtain financial assistance from government, NGO, social network and family members, and so forth. However, where related to in-land agricultures (non-coastal areas), the most commonly used adaptive measures were more simple by changing in cropping patterns and the cropping calendar, and improving farm management (ADB, 2009). Similar to other developing regions, the most countries in Southeast Asia are developing countries and have had limit of budget. Increasing or securing social financial capacity for adaptation in the Southeast Asia is thus a priority.

2.6.3 Microfinance in Southeast Asia and Thailand

Microfinances have been organized widely in Asia including Southeast Asia. Yet, there are number of challenges for the achievement in microfinance in the regions which include policy environment, inadequate financial infrastructure, limited retail level institutional capacity, and inadequate investments in social intermediation (Asian Development Bank, 2000). A paper study of Fukui & Llanto (2003) focused on microfinance development in transition countries in Southeast and East Asia;

Cambodia, Lao PDR, Myanmar, Vietnam, and Mongolia. They found the diverse formal and semi-formal financial institutions e.g. agricultural banks, microfinance NGO, and other financial cooperatives. They said any single type of microfinance institutions to dominate the rural financial markets of those countries was impossible. In the Asia region, microfinance also has been used as the major delivery channels of micro-insurance to the poor. Unfortunately, the average coverage of micro-insurance is only 2.7% of poor people, meaning that 97.3% of low-income people in Asia have no insurance (Roth, McCord, & Liber, 2007).

There are many examples of microfinance in Southeast Asia countries. At The Lao People's Democratic Republic, Northern area, the Lao-German Program for Integrated Rural Development of Mountain Areas (RDMA) implemented the village banking for 36 villages in 2005. It was found that the relative success of those village banks was directly related to the type and character of leadership involved (Behrle, 2005). The history of microfinance in Vietnam and Cambodia could be referred to UNESCAP (n.d.). The savings and credit programs in Vietnam were growing rapidly during the socio-economic transition. From that, there had been some 60 savings-and-credit programs operating throughout Viet Nam. They were supported by community members, NGOs and international organizations. In Cambodia, as of 1997, there were 2 federations of urban poor communities formed for savings-and-credit: the Urban Sector Group (USG), community groups participating with NGOs; and the Squatter and Urban Poor Federation (SUPF), run and managed solely by the community people. During that time, numbers of memberships of SUPF and USG were more than 75 communities. According to Chou, Castri, Hoy, Pen, Soung (2008), the financial requirements of microfinance comparing with commercial banks in Cambodia were much different. Microfinance required much less capital paid-up, but higher for financial liquidity. In Myanmar, the microfinance has been much intervened by military government. Though the financial NGO has high potential in poverty reduction in Myanmar, the military government's control over such microfinance is also high Yukawa (n.d.). There was a case that the government recommended Myanmar Agricultural Development Bank, which is controlled by state (the coalition of military leaders), to the people instead of using financial NGO services.

For Indonesia, Universities have played important role in the development of microfinance. Since 1995, every University has been required to have a Centre for Community Services (Lembaga Pengabdian Kepada Mayarakat, LPKM). This rule is enforced by the Education Department and its purpose is to make universities socially active in their local area by doing: research, providing basic needs to the poor (Brouwer & Dijkema, 2002). Compared to some developing countries such as Bangladesh, Philippines and Indonesia, microfinance activities in Malaysia are relatively less developed (Haim, Abidin, Zamzuri Noor, & Majid, 2007). This is probably due to the effects of Islamic environments. It is to note that Islamic micro-finance in Southeast Asia occurred in Indonesia and Malaysia mainly. Especially, Indonesia currently has the greatest diversity of both conventional and Islamic microfinance. Allen & Overy (2009) criticized that even the interest elements in the successful Grameen mode (initiated by Nobel Prize winner Mohammed Yunus in Bangladesh) they might be unsuitable for replication in an Islamic environment. The Islamic environment is potentially a limit of microfinance outreach. In the Islamic environment, the Shari'a (or Islamic) law is meant to regulate all aspects of a Muslim's way of life. There are a number of key Shari'a principles and prohibitions relevant to finance and commercial transactions which distinguish Islamic finance services from the conventional forms: 1) prohibition on usury and interest (riba); 2) prohibition on realizing a gain from speculation (mayseer); 3) prohibition on uncertainty in commercial transactions, no insurance (gharar); 4) all activity must be for permitted purposes (halal).

The microfinance movements in Thailand are regarded as an important factor for economic and social development, especially in the rural sector and low income people (Thuvachote, 2006). Therefore, microfinance activities have received both technical and financial supports from the Thai government. According to Thailand Community Development Department, none of low income people are considered poor as none of Thai people have per capita income lower than the poverty line determined at 23,000 Thai Bath (M. Sukanda, personal communication, December 16, 2009). Thai government has established three organizations in charge of microfinance. Those are: 1) The office of the Registrar of Cooperative Societies (ORSC); 2) The Cooperative Promotion Department (CPD); and 3) The Cooperative

Auditing Department (CAD). As of January 1, 2007, there have been 6,872 microfinance institutions in Thailand with 9,920,942 members (Cooperatives Promotion Department, 2007). Among those, the major one is for the Agricultural sector. Table 2.5 shows the main types of microfinance institutions in Thailand. To promote microfinance in Thailand, government has set Cooperative Development Fund (CDF) under the management of Cooperatives Promotion Department (CPD). The objectives of CDF are to fund and promote the microfinance activities. Sources of funding to CDF are from government revenue share, donation, asset sales and incomes from investment in time deposit, bonds, and stocks (Cooperatives Promotion Department, Thailand, 2009). The study of Tonsuchart, Singhwara, Cheumuangpan & Tonwattankul (n.d.) reveals that another significant factor for the successful of microfinance in Thailand is the trustworthiness of chairman and committees of microfinance institution.

Table2.5: Types of Cooperative Institutions in Thailand

Types	ประเภท
Saving Cooperatives in private firm	สหกรณ์ออมทรัพย์ ในสถานประกอบการ
Agricultural cooperatives	สหกรณ์การเกษตร
Land settlement cooperatives	สหกรณ์บริการ (เคหสถาน)
Services cooperatives (public transport)	สหกรณ์บริการ (เดินรถ)
Services cooperatives (general)	สหกรณ์บริการ (บริการทั่วไป)
Cooperatives in Industrial zone	สหกรณ์ในนิคมอุตสาหกรรม
Fishery cooperatives	สหกรณ์ประมง
Consumer cooperatives	สหกรณ์ร้านค้า
Credit union cooperatives	สหกรณ์เครดิตยูเนี่ยน

Source: Cooperatives Promotion Department, Thailand, 2009)

CHAPTER III
RESEARCH METHODOLOGIES

To fulfill research objectives and to test hypothesis of the applicability, appropriateness and effectiveness of microfinance for sea level rise impacts, the following Figure 3.1 shows a required flow of methodologies to be applied in this research. Details of each methodology are described hereafter in this chapter.

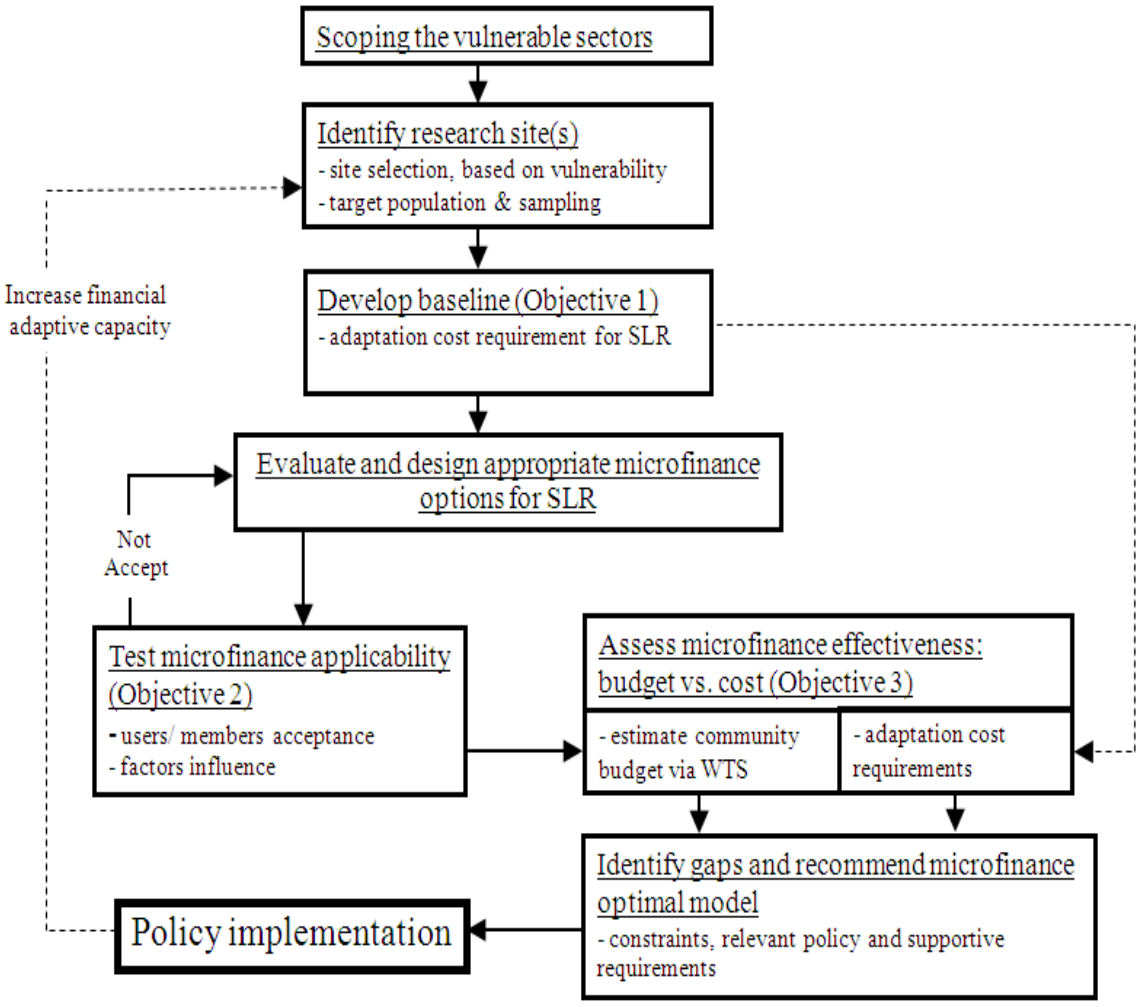

Figure3.1: Research methodological framework

Overview, the research methodologies started from scoping the vulnerable sectors to the impacts of sea level rise, for which in this research, it was coastal households. Next step was to identify the coastal vulnerable areas to be studied considering factors of physical characteristics of coast, existing coastal problems in the areas, and community's familiarization to microfinance. After the study areas were identified, household adaptation cost requirements for sea level rise of such areas were assessed in order to know the baseline requirements. Microfinance options/ types were evaluated and related microfinance conditions were preliminarily designed by focus groups to obtain an appropriate hypothetical microfinance for adaptation to sea level rise impacts. Such designed microfinance then was tested its applicability at community level via the acceptance test of individual household. Factors influence acceptance and participating with microfinance for sea level rise impacts also were identified and a model of microfinance participation is developed. If the designed microfinance was unacceptable, the step of evaluation and design was re-proceeded until obtaining satisfactory results. To obtain community adaptation budget, amounts that households were willing to save to microfinance for sea level rise impacts were assessed and summed. The effectiveness of such microfinance then was evaluated by comparing the budget obtained from household willingness to save with the baseline adaptation cost requirements. The final step was to identify the gaps and constraints, review relevant policies and any required external supports to successfully implement microfinance for sea level rise impacts at national level including make it sustained.

3.1 Study Sites Selection, Target Population and Sampling

3.1.1 Study sites selection

Appropriate study site is one of the most important factors that make research results valid. The study of microfinance for sea level rise impacts requires coastal sites that are low lying areas and have been experiencing loss (or have not experienced but well-informed) from those impacts. This is to ensure that people

living over there, who have recognized sea level rise problems and are seeking adaptive measures, will respond well to research questions. In this research, study sites were selected by considering the factors of: 1) level of vulnerable due to physical characteristics of coast; 2) non-Islamic condition; 3) experiences to impacts of sea level rise e.g. inundation and coastal erosion; 4) expert judgment; and 5) familiarity with other microfinances. The last factor is considered necessity because microfinance for sea level rise impacts is a new tool. It will better validate of research results if the study starts with sites that are familiarized with services of microfinance. Overall processes of study sites selection are summarized as follows:

a) Identify very high vulnerable coastal areas in Thailand based on the physical coastal characteristics. According to Thailand Marine and Coastal Resources Department, coastal characteristics of Thailand can be classified as rock, sand, mudflat and sand, and mudflat, and are ranked respectively as low, moderate, high and very high vulnerable to the climate change impacts (P. Chareonsith, personal communication, November 30, 2009). Map of Thailand coasts and their physical characteristics can be seen in the Appendix E. By analyzing vulnerability based on coastal characteristics and excluding topographic and tide information, Appendix F shows Thailand coastal provinces with their vulnerable degrees. It was found that the very high vulnerable coastal provinces are mostly located in the Upper Thai Gulf.

b) Identify the coastal areas with non-Islamic environment. Thailand coastal zones can be divided into five parts: Eastern Thai Gulf, Upper Thai Gulf, Middle Thai Gulf, Lower Thai Gulf, and Andaman. Most coastal communities in Middle Thai Gulf, Lower Thai Gulf and Andaman are Islamic or partly Islamic. Non-Islamic environment can be found at most coastal communities in the Eastern and Upper Thai Gulfs. Considering the non-Islamic environment together with the very high vulnerable areas, the potential study areas were limited to the following five coastal provinces.

1. Samutprakarn
2. Samutsongkhram
3. Samutsakorn,
4. Chachengsao

5. Bangkok

c) Identify coastal Tambons (a territory governed as an administrative or political unit of a province in Thailand) of those 5 provinces that are high risk to sea level rise impacts. The high risk areas of Upper Thai Gulf are analyzed by Thailand Climate Change Information Management Center assuming the 2 metres rise of sea level (see Appendix G). Following such analysis, 14 high risks coastal Tambons were identified and shown in Appendix H.

d) Review with experts and conclude for final study sites. Through discussion with Southeast Asia START, Thailand Corporate Promotion Department, and Thailand Marine and Coastal Resources Department, Tambons with existing severe problems and require urgently solution are shown below. Those Tambons become studied sites.

1. Tambon Laem Fapha, Samutprakarn Province
2. Tambon Khlong Dan, Samutprakarn Province
3. Tambon Phan Thai Norasing, Samutsakorn Province

3.1.2 Target population and sampling

a) Target population and sample size

Target population were households of both 'directly impacted (near-shore)' villages and 'not yet impacted but well-informed (inland)' villages in studied Tambons. To note that 'inland' village is located next to the 'near shore' one, or approximately one thousand meters from shore. Research requires mix of communities with different degree of impacts and vulnerability in order to assess and verify distinct degree of household participation to microfinance and adaptation cost requirements. One village representing for each group of 'near-shore' and 'inland' from each studied Tambon, total 6 villages, were selected considering their familiarity with microfinance services and recommendation of Tambon Administrative Organization. General information of studied Tambons and their six studied villages are shown in the following Table 3.1 and 3.2.

Table3.1: Number of 'near shore' and 'inland' villages, male and female, number of households, and household per capita income of Tambons Khlong Dan, Laem Fapha, and Phan Thai Norasing.

Tambons	No. Villages (1)		Population Statistics (2)			Per capita income Baht (3)
	Near shore	Inland	Male	Female	No. Households	
Khlong Dan	3	7	8,741	8,920	4,478	53,669
Laem Fapha	3	5	3,249	2,683	1,658	49,847
Phan Thai Norasing	3	5	8,591	9,714	10,772	53,756
Total number of households					16,908	

Source:

(1) Provincial Cooperative staffs (personal communication, 2010)

(2) Department of Provincial Administration (2010). Population statistics as of December 2010. www.DOPA.go.th, retrieved 5 March 2011.

(3) Community Development Department (2009). Fundamental household information. Thailand, Ministry of Interior. ข้อมูลความจำเป็นพื้นฐาน (จปฐ.) 2552,

Table3.2: Six studied villages

Tambons	Study sites (Villages)	
	Near-shore	Inland
Phan Thai Norasing	Sahakon	Sandap
Laem Fapha	Khun Samut Chin	Khlong Suan
Khlong Dan	Si Long	Khlong Nang Hong

In this research, dichotomous variable was applied to the acceptance test of microfinance (expressed as a rate or proportion of a yes/no outcome), and continuous variable was applied for the estimation of mean willing-to-save (WTS) amount. Those dichotomous and continuous variables require different sample size to represent their target population at a given statistical confident level. The higher number sample size was chosen to cover all different sample size requirements in this

research In general, four factors must be known to estimate the sample size (Dell, Holleran, & Ramakrishnan, 2002): (1) the effect size; (2) the population standard deviation; (3) the desired power of the experiment, β; and (4) the significance level, α. The formulas related and the sample sizes required in this research were determined as follows:

- Determination of sample size required for microfinance acceptance test. According to Department of Livestock Development (2004) and Komoltri (n.d.), the formulas to calculate minimum sample sizes required for dichotomous variable is show below. Given the acceptance level criteria at 50%, allowable error at 0.05, and the Z value at 1.96, the minimum sample size required is 385 households.

$$n = \frac{z_{\alpha/2}^{2} pq}{d^2}$$

p = expected population proportion (example, the acceptance level must be over 50%, in this research define minimum p = 0.5)

q = 1− p

d = allowable margin of error (50% +/- 5%, d = 0.05)

$Z_{\alpha/2}$ = level of significant in the two-tailed value. In this study determine alpha is equal to 0.05 (Z values are 1.96).

- Determination of sample size required for willingness-to-save survey. According to Yamane (1973) formula, the sample size required for continuous variable in case known the population size is shown below. Given the allowable margin of error at 0.05 (or confident level at 95%) and population size at 16,908 households, the minimum sample size required is 391 households.

$$n = \frac{N}{1 + Ne^2}$$

n = sample size required

N = population size

e = allowable margin of error

From the calculation results, research therefore used sample size of 400 households, which covered all requirements. Sample size was allocated equally to every studied village. Approximate 65 – 67 households in each village were studied.

b) Sampling method

For selecting sampling unit (household), this research used simple random sampling method. This was due to target population were in homogenous group (living in same area and mostly having same occupation). Households in a studied village were assigned the associated numbers (1,2,3,…). The assigned numbers then were randomly selected by researcher to determine the household to be interviewed. Such process was repeated until total number of required sample units in a village was obtained.

- Inclusion criteria: Participants/ respondents must be household leaders (husband or wife) or persons who mainly generate income for household at least last 6 months. Those who volunteer to participate in the interview signed on the consent form before the interviews started.
- Exclusion criteria: Persons who may not be able to provide good information. Those included persons that their ages were over 80 years, or not living continuously in the house over the last 12 months.
- Termination criteria: Participants who disagreed to participate in the interview were not interviewed.

3.2 Assessment of Household Adaptation Cost Requirements for Sea Level Rise Impacts (Research Objective 1)

In this research, household adaption cost to sea level rise impacts was assessed in order to know baseline cost requirements. Such required costs then were compared with fund generated from household's saving amounts to microfinance for sea level rise impacts. This would answer one of research hypotheses whether such microfinance was effectiveness and its financial services were sufficient to those cost

requirements. The adaptation costs were assessed for past 5 years and also for future requirements of next 30 years. The related assessment methodologies are described as follows:

a) Define scope of adaptation costs:

This research focused on direct costs (excluded indirect costs) required for household autonomous adaptations. Research also excluded costs of 'planned retreat', which was definitely over the household's financial capacity and needed government to address this market imperfection. Behavioral adaptations e.g. changing planting date were considered as insignificant cost impact and were not included in the assessment. Factors that are considered when assessing household direct adaptation costs are as follows:

- Investment costs of physical adaptive measures (capital expenditures)
- Maintenance costs of existing physical adaptive measures (maintenance costs)
- Household miscellaneous expenses for adaptations (operating expenditures)

b) Identify household autonomous adaptive measures to sea level rise impacts:

There are numbers of biogeophysical effects from sea level rise impacts to various coastal socio-economic sectors. This research combined available coastal household autonomous adaptive measures provided by ADB (2009), Scott and Sujatagupta (2001), and Smit and Pilifosova (2001) and then identifies their direct (indirect) costs and cost types. Details are shown in above Table 3.3. These combined adaptive measures were used as a guide asking sampling units how much cost they paid to each measure particularly for their household adaptation to sea level rise impacts.

Table3.3: Coastal household autonomous adaptive measures, and their direct costs and cost types

Socio-economic Sector	Adaptive measures	Direct/ Indirect cost	Cost types
Water resources	Buy more drink bottle water for consumption	Direct	Operating expense
	Increase water tank storage capacity for general use	Direct	Capital expenses
Agriculture	Dam or any physical protection construction for irrigation	Direct	Capital expenses
	Changes in fertilizer use and soil fertility maintenance	Direct	Operating expense
	Introduction of new crops	Direct	Operating expense
	Changes in planting and harvesting times.	Indirect	-
Health	More medical expenses for water borne disease	Direct	Operating expense
	More medical expenses from consumption of fish/ shellfish contaminated with biotoxins	Direct	Operating expense
Fisheries	Changes in fishery time and number of frequency	Indirect	-
Human Settlements	House renovation to accommodate sea level rise	Direct	Capital expenses
	Improvement of transportation e.g. house entrance, car park	Direct	Capital expenses
	Relocate, replacement or upgrade of movable assets e.g. electric appliances, kitchen appliances.	Direct	Operating expense
	Improvement of land use and landscape	Direct	Capital expenses
	Construction of flood or erosion barrier	Direct	Capital expenses
	Improve sanitation, water supply, electric power distribution systems	Direct	Capital expenses
Disaster preparation	Buy insurance cover extreme conditions e.g. flood	Direct	Operating expense

Adapted from ADB, 2009; Scott & Sujatagupta, 2001; Smit & Pilifosova, 2001

c) Assess adaptation cost requirements to sea level rise impacts using questionnaire survey (interview) method:

The engineering cost survey is appropriate for estimation of large scale infrastructure investment (e.g. the study of Hideyuki in 2004). To assess adaptation cost requirements at household level, questionnaire survey (interview) method have

been widely used (e.g. the study of Jarungrattanapong and Manasboonphempool in 2008). In this research, designed questionnaire shown in Appendix I (part II) was used with household sampling units asking them amounts of cost they spent for autonomous adaptive measures listed in Table 3.3 over the past 5 years. Such adaptation costs were mainly classified into two types: 1) investment adaptation costs (capital expenditure); and 2) annual adaptation expenses and maintenance costs (operating expenditure). In addition, the costs obtained from questionnaire survey were used to forecast future adaptation cost requirements of households of studied villages.

d) Develop projections of future adaptation cost requirements

With the continued rising of sea level, more impacts will be occurred to coast and further inland areas. To assess future household adaptation cost requirements due to the rising of sea level, it requires a combination of sophisticated techniques, which include sea level projection modeling, GIS identifying inundated household units in coastal area, and adaptation costs per household. The primary aim of this research is to study the using of microfinance as an adaptive measure for sea level rise impacts, whereas adaptation costs at household level are assessed as baseline for testing the effectiveness of such microfinance. In order to focus on primary aim, assessment of adaptation costs in this research was done plainly on the assumption that degree of sea level rise impacts in those studied villages was maintained. Accordingly, the required future costs of those villages largely depended on numbers of reinvestment of current adaptive measures due to their useful life. Research selected impacted and well-aware villages for study to see differentiated of required costs. Research estimated future adaptation cost requirements for short and long term periods.

For the short term period, the research used a questionnaire asking informants their anticipated required future household autonomous adaptation costs for the next 5 years. To assess future adaptation cost requirements in longer term, the results from the survey of past autonomous adaptation costs were extrapolated to obtain future amounts required for next 30 years. Given that similar adaptive measures were currently being used by households can cope with whatever degree of sea level rise impacts will be in the future, the budgeting for recurrent costs of

investment and future value of an equal annual expenditures payment (Brigham and Gapenski, 1991) were applied respectively to capital and operating expenditures. The following factors all received consideration when estimating the future cost requirements: a) investment costs for adaptive measures, b) useful life of adaptive measures, c) maintenance costs, and d) inflation. The following equations were used:

Capital expenditure items:

Summation of -

(Present costs of adaptive measures) x $(1 + r\ \%)^{(\text{Useful life of adaptive measure}) \times (i)}$

Operating expenditures items:

= Future value of an equal annual payment

= (Present value of annual operating expenditures) x $((1 + r\ \%)^{30} - 1)/ r\ \%)$

r% = 2.98%, average Thailand consumer price index during past 5 years of 2006 - 2010 (Bank of Thailand, 2011)

i = 1, 2, 3,..X; X = round-down maximum number of times reinvest or refurbish the adaptive measures over the next 30 years (round-down of 30 years/ useful life of adaptive measure)

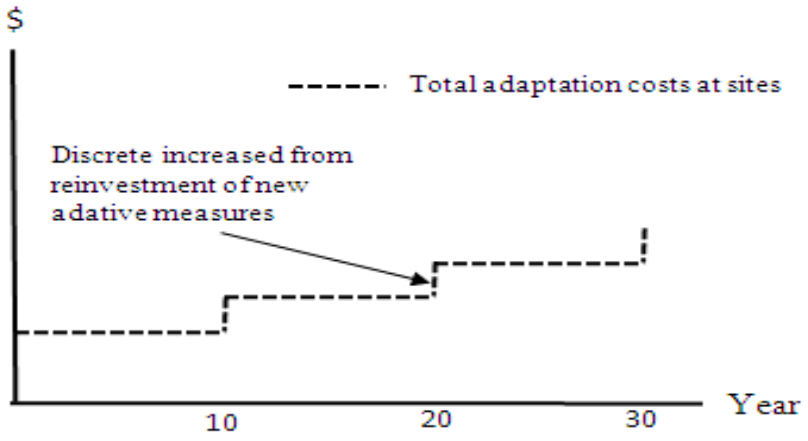

Figure3.2: Pattern of total (accumulated) future household adaptation cost requirements to the impacts of sea level rise.

Capital expenditures have discrete pattern as the investment is normally occurred once and valid through a certain period of time. Operating expenditure have continuous pattern as they are expenses continuously spending. The Figures 3.2 shows a pattern of future household adaptation cost requirements.

3.3 Evaluation and Design of Microfinance for Sea Level Rise Impacts

3.3.1 Evaluate microfinance institutions by multi-criteria factors analysis

There is a number of microfinance institutions available, such as credit union, financial NGOs, saving cooperatives, and village banking (Greuning, Gallardo, and Randhawa, 1998). All of them have same purpose of creating self-financial services cooperative in a community, but slightly are varied in their forms of administration. Each of them has different advantages and disadvantages compared to others. There is a need to evaluate those microfinance institutions in order to find the one that is most appropriate to be applied as household (financial) adaptive measure for sea level rise impacts. Most common methods for measuring the appropriateness are ranking, paired comparison, and rating/ scoring (Ellis, 1969). Ranking (rank from choices more than two) is easily applied and interpreted, but do not measure the magnitude of preference. Paired comparison is ease of application. Two samples are presented and a preference choice is made. A scoring is applicable for number of choices. Each choice can be determined its preference magnitude through score provided. Comparing all methods, in this research, the scoring was used. Research scored the appropriateness of available microfinance institutions in accordance with pre-determined multi-criteria factors. The related methodologies are described as follows:

- Identify microfinance institutions, their associated characteristics, advantages and disadvantages through literature reviews. Details can be seen in Appendix B-C. However, a microfinance institution that is appropriate for adaptation to

sea level rise impacts may not require a newly implemented, but an extended existing one that households have familiarized with. Therefore, available microfinance institutions for evaluation are inclusive of credit union, financial NGO, saving cooperative, village banking and extended existing microfinance.

- Use multi-criteria factors analysis and scoring to evaluation microfinance. Those microfinance institutions including their advantages and disadvantages were simplified into diaphragm and presented to focus groups. The focus group members consisted of the provincial Corporative Promotion Department staffs, community (village) leaders, and the members of Tambon Administrative Organization (TAO). Members were asked to score for appropriateness of microfinance institutions for adaptations to sea level rise impacts following equally weighted pre-determined multi-criteria factors. In this research, the multi-criteria factors are adapted from key success factors of adaptation and microfinance identified by Smit and Pilifosova (2001), and Churchill, Hirschland, and Painter (2002). Those factors are: a) implementability; b) community-base; c) continuity; d) fair and equity; and e) deep outreach. It is to note that a factor of cost efficiency is not considered. This is due to, at provincial and national policy level, political factors more affect the successful implementing of new policy/ tool than factor of cost efficiency within a democratic system (Jagers and Hammar 2009, cited in Jagers, Löfgren, & Stripple, 2009). The microfinance institutions, pre-determined multi-criteria factors, and scoring system are shown in the evaluating Table 3.4.
- A microfinance institution that obtains highest score was designed its proper conditions for adaptation to sea level rise impacts. In line with research objectives, such designed microfinance was further tested/ assessed for acceptance, applicability and willingness to save of households of studied villages. However, there is a concern for assessment of willingness-to-save to microfinance, in case the ‘extended existing microfinance’ is evaluated as the most appropriate. It needs to clearly identify with respondents during

interview that the amounts they are willing to save to the 'extended existing microfinance' must be in addition to the amount they currently save to such existing microfinance. This is to validate the effectiveness of existing microfinance if it is further applied for adaptation to sea level rise impacts.

Table3.4: Multi criteria evaluation for microfinance types:

	Implement-ability (0-10)	Community base (0-10)	Continuity (0-10)	Fair/ Equity (0-10)	Deep outreach (0-10)	Weighted total score
Weighted (%)	20%	20%	20%	20%	20%	100%
Credit unions						
Financial NGO						
Saving cooperative						
Village banking						
Extended existing microfinance						

- Scoring: high = 10, potential high = 8, moderate = 6, potential low = 4, low = 2

3.3.2 Design preliminary conditions of microfinance for sea level rise impacts using focus group interview

Aspects related to general conditions of microfinance were reviewed through literature and listed as guidelines for focus group discussion. Focus group members were composed of village leaders and members of Tambon Administrative Organization. Focus group members were asked to discuss the listed guideline items. Researcher limited his opinion during the group discussion, but mainly acted as moderator, controlled discussion time, and used audio tape for recording. For different opinion among members for any particular items, majority vote was applied to have the final conclusion. However, all opinion was described in this research results. The concluded conditions by focus group members were used to design microfinance for sea level rise impacts. Such microfinance then was used for household acceptance test and willingness to save assessment in hypothetical market (in subsequent methodologies 3.4 - 3.5). Generally, the conditions of microfinance for focus group interview are as follows:

- Objective of microfinance: encourage saving, networking vs. standalone, provide adaptation knowledge, channel for external subsidization.
- Sources of fund: members, government, oversea assistance, etc
- Loan policy: purpose of money use, interest, period, etc
- Investment policy: deposit, lending, etc
- Membership: role of members, benefits of membership, etc
- Management: management committees, administrations, etc
- Accounting and auditing

3.4 Test of Applicability and Factors Affecting Participation of Microfinance for Sea Level Rise Impacts (Research Objective 2)

In this research, the applicability of the designed microfinance for sea level rise impacts, whether it can be a (financial) adaptive measure, was verified by analyzing acceptance of members in studied villages. The acceptance was measured mainly with member's attitudes toward microfinance. Research also identified and tested factors affecting participation of members to microfinance. Those affecting factors were used to develop a model of intention to participate to microfinance for sea level rise impacts. Research applied methodologies of Sahu and Gupta (2007). They are described as follows:

a) Study design:

The factors affecting acceptance and participation of a person usually are relevant to behavior, beliefs, attitudes and values: BBAV (Niemirowski, Baldwin & Wearing, 2003). In this research, possible factors affecting acceptance and participation to microfinance for sea level rise impacts were identified and shown in Table 3.5. Those factors were hypothesized their influencing to the degree of acceptance and intention to participation. Questions related with those affecting factors were designed (see Appendix I, questionnaire part II), and used to interview respondents. Likert scale was used in formulating the questionnaire, in which

respondents were asked to mark their position on the continuum having two extreme ends. The continuum was divided into seven intervals of measurement (numbers 0 – 6) starting with "fully disagree" to "fully agree".

b) Test of applicability by analysis ratio of acceptance:

Criteria for acceptance of microfinance for sea level rise impacts are that acceptance values of all affecting factors are above average. In other word, the designed microfinance will be applicable as an adaptive measure to the impacts of sea level rise if the average acceptance value of all affecting factors is above 0.5. Acceptance ratio for an affecting factor was calculated by average value assigned to factor by respondents and the maximum value possible for such factor. For example, a rating scale has values between 0 and 6. Therefore, the maximum value for a factor over 400 surveys is 2,400 (6 X 400). If the rating value obtained from survey for factor was averagely 4, the total value of such factor was 1,600 (4 X 400), and the ratio of acceptance would be 0.67 (1,600/ 2,400). The equation for the calculating the "Ratio of Acceptance" is shown below.

$$Ratio\ of\ Acceptance(V) = \frac{\sum_{i=1}^{N}\left(\sum_{j=1}^{S_v} R_j^i\right)}{N * M * S_V}$$

V = Variable

S_V = Number of Sub-variables of Variable V

M = Maximum Rating

R^i_j = Actual Rating for the j^{th} Sub-variable of the i^{th} Response

N = Maximum Number of Responses

c) Analyze affecting factors and develop participation model:

The hypothesized affecting factors were examined their correlations with respondent's intention to participate with microfinance for sea level rise impacts, using Pearson correlation analysis. In addition, stepwise regression was used to develop a model predicting intention to participate. To test fitness of such model, research applied adjusted R square.

Table3.5: Possible factors affecting acceptance and participation to microfinance for sea level rise impacts

Hypothesis		
Risk factors	R1	'Perceive of risks from the impacts of sea level rise are the protective motivation
Microfinance acceptance/ participation affecting factors	A1	'Attitudes' toward are predictor of acceptance and intention to participate
	A2	'Social influences' are predictor of intention to participate
	A3	'Facilitating conditions' are predictor of intention to participate
	A4	'Government supports' are predictor of intention to participate

3.5 Evaluate Effectiveness of Hypothetical Microfinance for Sea Level Rise Impacts via Willingness-to-Save (Research Objective 3)

In this research, effectiveness of microfinance for sea level rise impacts was evaluated by considering sufficiency of fund/ budget obtained from household's saving amounts to such microfinance to their baseline adaptation cost requirements. However, as such microfinance was hypothetical, household's saving was assessed on a basis of 'willingness'. To estimate household 'Willing-to-Save' (WTS), research adopted an elicitation method for willingness-to-pay so called 'Two-Way Payment Ladder (TWPL)' (Jones-Lee et al., 1995; Hanley et al., 2009: cited in Mahieua, Rierab, & Giergicznyc, 2010). With TWPL, the width of range for WTS amounts was known as respondents are faced with a ladder to indicate all amounts that they would definitely pay, uncertainty to pay, and definitely reject to pay. Services and benefits of microfinance for sea level rise impacts were assumed in hypothetical market. The degree to which people were willing/ unwilling to participate (including willing/ unwilling to save) was much depended on their awareness of sea level rise impacts, beliefs and attitudes to the benefits of hypothetical microfinance. The

related methodologies are described as follows:

a) Set up hypothetical microfinance

The designed microfinance for sea level rise impacts (results of section 3.3) was proposed and sequentially explained to respondents with simple diaphragm of these items: 1) impacts of sea level rise and their associated risks; 2) what possible adaptive measures a household currently requires and will require in the next decades; 3) how such designed microfinance will help them to increase financial adaptive capacity to adapt the impacts; 4) what benefits members will obtain and what conditions required from members for microfinance participation; and 5) how the designed microfinance should be administrated to gain fairness, transparency, and sustainability.

b) Obtain amount of willing-to-save to microfinance

Respondents were asked their maximum willing-to-save amount, uncertainty-to-save amount, and minimum unwilling-to-save amount to the hypothetical microfinance for sea level rise impacts in a unit of Thai Baht per month. To obtain those amounts, there are numbers of elicitation method: open-ended question, closed-ended question, and dichotomous choice. For an open-ended question, respondents are asked a simple question on their single desired amounts. Therefore, open-ended question works well for those who have had experiences of purchasing similar goods (Arrow et al., 1993). For a closed-ended question, a range of values is presented and respondents choose one of them. A single amount is presented to respondents for their agreement or disagreement, for a dichotomous choice question. However, a large-scale pilot survey is essential for formatting dichotomous choice to ensure such single amount is well calibrated (Garrod & Willis, 1999). Considering all, in this research the close-ended type was the most suitable for bid elicitation because respondents (household leaders) somehow have no experience in designed hypothetical microfinance. The choices of close-ended for willing-to-save amounts (e.g. 200 Baht, 500 Baht) and unwilling-to-save amounts (e.g. 2,500 Baht, 2,000 Baht) were presented to respondents for their selection. However, to ensure obtaining well calibrated choices, a small pilot survey was firstly done with the same focus group members when evaluating microfinance types (section 3.3).

c) Evaluate effectiveness of microfinance by comparing fund from willing-to-save amounts with adaptation cost requirements

Bid amounts of 'willing-to-save', 'uncertainty-to-save', and 'unwilling-to-save' from respondents were averaged to get a mean value per household. Interval regression analysis was also applied to mean to obtain a range of uncertainty. Willing-to-save amounts were extrapolated for 30 years period together with various conditions e.g. size of account receivable, interest rate to get fund for adaptation. The estimated fund then was compared with household adaptation cost requirements (result of section 3.2). The effectiveness of microfinance for sea level rise impacts then was evaluated in view of fund sufficiency to the cost requirements. It is noted that the range of 'uncertainty-to-save' amounts reflect possible additional 'willingness to save' amounts in future, as there is the possible links between the uncertainty and context-dependence (Hanley and Kriström, 2002). In other words, respondents reserve their current judgments on the deal until exact future circumstances are revealed.

3.6 Questionnaire Design, Data Analysis and Validation

3.6.1 Questionnaire

The research used questionnaire-base approach to obtain interviewed data of households in studied villages. Two following types of questionnaire were used for design of microfinance for sea level rise impacts and interview of households. Details of questionnaires are shown in Appendix I.

- Type A: Evaluation of microfinance institution options using multi-criteria factors analysis and design of microfinance for sea level rise impacts by focus group interview.
- Type B: Interview of coastal households
  - Part I Assessment of coastal household adaptation cost requirements to sea level rise impacts.
  - Part II Test of acceptance and factors affecting participation of microfinance for sea level rise impacts

Part III Estimation of household's willingness-to-save to microfinance for sea level rise impacts

Part IV Respondents and their households information

3.6.2 Data validation and analysis

a) Data validation

A combination of methods for data validation was applied in this research.

- A test of validity for hypothetical setting are required (Bateman et al., 2002; cited in Andersson, 2007) because assessing willingness-to-save is not relied on actual market data. This can be done by validating likelihood that respondents will save the amounts that they say they are willing. Hypothesis is that amount of willing-to-save positively correlates with income, attitudes and belief to microfinance, and then analyzed by using the statistical tools of multivariate analysis.
- Minimizing strategic bias (respondents understate or overstate their 'true' willing-to-save amount by sorting the legitimate amount observations by value then trimming top and bottom 5% of all observations.
- All estimations (e.g. adaptation cost requirements, willing-to-save amount) will be averaged statistically at 95% confident level.

b) Data analysis:

According to Stair & Reynolds (1999), information is a body of facts or data that are in a format suitable for decision making and have additional value beyond the value of the facts themselves. All collected data of this research was analyzed and processed as below Figure 3.3 (Sonquist & Dunkelberg, 1977), by beginning with data editing, data encoding, data conversion, and ending with analysis and interpretation.

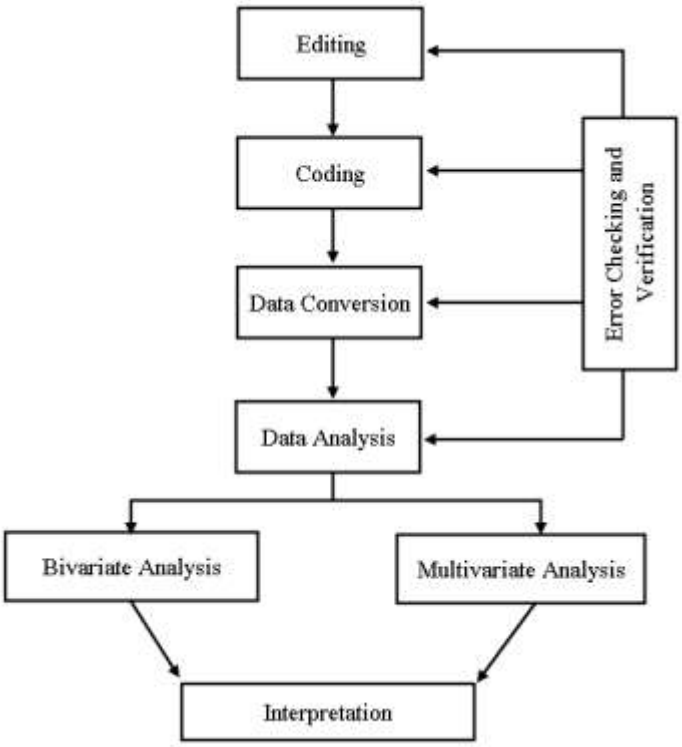

Figure3.3: Data Analysis Processes

Source: Adapted from Sonquist & Dunkelberg, 1977

CHAPTER IV
DESIGN OF MICROFINANCE FOR COASTAL HOUSEHOLD ADAPTATION TO SEA LEVEL RISE IMPACTS

4.1 Overview

This chapter focuses on design of microfinance to support adaptation to sea level rise impacts (hereinafter called 'microfinance for sea level rise impacts'). The study results of this chapter are used for studies of subsequent Chapters 6 and 7, which are related to applicability, factors affecting participation, and effectiveness of microfinance for sea level rise impacts. Specific purposes of the study are to: a) identify proper microfinance institution(s) for adaptation to sea level rise impacts; and b) initially design framework and conditions of such microfinance. The study adopted a guideline of microfinance new product development (Tran, 2000; Brand, 1998) to survey customer needs and market conditions, and to determine required conditions of microfinance.

To identify proper microfinance institution(s), multi-criteria factors analysis was used considering factors of implementability, community base, continuity, equity, and deep outreach. Those factors were adapted from key success factors of adaptation and microfinance identified by Smit and Pilifosova (2001), and Churchill, Hirschland, and Painter (2002). The analyzed microfinance institutions were credit union, financial NGO, saving cooperatives, village banking, and extended existing microfinance. The last one was included as microfinance for sea level rise impacts might not require a newly implemented microfinance institution, but extended from ones currently local community had. Informants were presented purposes, advantages, and disadvantages of each microfinance institution, prior asked to rate for equally weighted multi-criteria factors. The rating scores were ranked into 5 levels: 10 = high, 8 = potential high, 6 = moderate, 4 = potential low and 2 = low. Microfinance institution that obtained highest mean score was considered the most proper to support coastal household adaptation to sea level rise impacts.

To design framework and conditions of microfinance for sea level rise impacts, the study used focus group interview. Informants (group members) were asked to discuss guided items, which included but not limit to possibility of using microfinance for adaptation, purposes of microfinance, sources of fund, loan and investment policies, management, and membership. Interviewing time was between 1-2 hours for each group and researcher acted as moderator. Audiotape, written and pictures were recorded for data collection. Focus group is a good method to obtain insight information (Grudens-Schuck, Allen, and Larson, 2004), and generate ideas or initiatives for common concern (Parker & Tritter, 2006). The method is to look for answers that are reappeared, which represent trend of group's attitudes and lead to group's behavior to response to the subjects being studied (Lewis, 2000). Focus group is widely used in various microfinance studies (Wright, 1999; Asian Development Bank, 2007). It enables the better understanding of clients and can generate new ideas related to microfinance development and improvement (Consultative Group to Assist the Poor, 2003).

Key informants who participated in focus group interview and multi-criteria factors analysis were stakeholders. Those included staffs of Cooperative Promotion Department, members of Tambon Administrative Organization and conservation groups, village leaders and villagers. They have involved with microfinance and/or experienced with impacts of sea level rise. For focus group, the study organized groups composed of 8 - 12 members for each group, the recommended size (MacFarlane Smith, 1972; Bellenger et al., 1976: cited in Tynan & Drayton, 1988). Study results of this chapter do not provide complete detail of required regulations for microfinance for sea level rise impacts, but broadly identify ideal of conditions making such microfinance functions. Results and discussions are shown in the following sections.

4.2 Results and Discussions

4.2.1 Identified suitable microfinance institution for sea level rise impacts using multi-criteria factor analysis

Multi-criteria factors analysis was used in order to find out the most

suitable microfinance institutions that could be well applied as a financial adaptive measure for sea level rise impacts. The analyzed multi-factors and their short interpretation (in parenthesis) included: implementability (ability to implement successfully), community base (well serving to community requirements), continuity (sustainable work after implementation), equity (fairness to all members), and deep outreach (services reachable to peoples at all level). Informants, who performed analysis, were selected from various disciplines involving with microfinance and adaptation to sea level rise impacts. This was to ensure different/ broader views on subject being studied were addressed. Details of informants and multi-criteria analysis results are shown in the following Table 4.1-4.2.

Microfinance institutions that were scored included credit unions, financial NGO, saving cooperative, village banking, and extended existing microfinance. Their typology and conceptual works are shown in Appendix 2.1. The scoring results of multi-criteria factor analysis (MCA) showed that, among microfinance institutions, saving cooperative was the most implementable with average score 6.83 (from full score at 10). Using existing microfinance applied for sea level rise impacts was the most-fit to community requirements with average score 6.33, whereas saving cooperative was secondary with score 5.58. Saving cooperative also obtained highest ranked for other two factors, continuity and fairness, with average scores 6.17 and 6.08 respectively. For the last factor of deep outreach, using existing microfinance was the most response with average score 6.00.

On contrary, analyzing the least scored factors, it was obvious that financial NGO obtained lowest scores in all factors comparing with other microfinance institutions. This can be clearly explained that the financial NGO is not totally suitable to be applied as adaptation for sea level rise impacts. Examining financial NGO's conceptual work, its main purpose is being a channel for donators to financially support poor people. With that reason, financial NGO is not the proper institution for building up community's self collaborations in saving including adaptation activities. Of the analyzed factors, two factors were apparently lower scored in most microfinance institutions, except in saving cooperative. Those factors were continuity and equity (fairness). The continuity and fairness of a microfinance institution are depended on its financial sustainability and how well it is managed.

It therefore was assumed that informants gave lower scores to such two factors because they felt uncertain about supporting and control measures provided from government toward relevant microfinance institutions. Unlike others, saving cooperative has been long-time developed in Thailand communities, including supported and regulated by Thai government. It results to informants feel more confident with the continuity and fairness of saving cooperative.

Table4.1: Informants and number of informants performed multi-criteria factor analysis to identify the proper microfinance institution(s) for sea level rise impacts.

Informants	No. of informants
Analysts from Cooperative Promotion Department	3
Staffs Provincial Cooperative Section	3
Members of Tambon Administrative Organization	4
Village leaders of sea level rise impacted villages	2
Total number of informants = 12	

Table4.2: Weighted scores of proper microfinance institution(s) for adaptation to sea level rise impacts by multi-criteria factors analysis

		Scored multi- criteria factors (*)					
		Implement-ability (0-10)	Community base (0-10)	Continuity (0-10)	Fair/ Equity (0-10)	Deep outreach (0-10)	Weighted total score
	Weighted (%)	20%	20%	20%	20%	20%	100%
Microfinance institutions	Credit unions	5.33	4.75	4.58	3.58	4.33	4.52
	Financial NGO	4.58	3.33	3.00	3.33	3.58	3.57
	Saving cooperative	6.83	5.58	6.17	6.08	5.27	5.97
	Village banking	5.50	5.33	3.75	4.33	5.58	4.90
	Extended existing microfinance	5.83	6.33	5.67	5.50	6.00	5.87

* Remark for scoring: high = 10, potential high = 8, moderate = 6, potential low = 4, low = 2

Overall consideration against all analysis of multi-criteria factors, the saving cooperative was the most proper microfinance institution for adaptation to sea level rise impacts with highest total weighted score at 5.97. The subsequent proper ones were using existing microfinance, village banking, credit union, and financial NGO with total weighted scores 5.87 4.90, 4.52, and 3.57 sequentially. It is to be mentioned that the existing microfinance that informants has been thinking of or currently membership mostly are the saving cooperative or saving group. This is a reason that saving cooperative and extending/ using existing microfinance get similar ranking with slightly different scoring. Conclusively, in view of informants, applying "Saving Cooperative" as a financial adaptive measure for sea level rise impacts can be mostly implemented with chance of success, work sustainably, and serve requirements of community members with fairness at all level.

4.2.2 Designed conditions of microfinance for sea level rise impacts using focus group interview

Three focus group interviews were arranged in order to determine possible conditions of microfinance for sea level rise impacts. Informants participated in each focus group were key members of vulnerable studied sites. Table 4.3-4.5 show details of informants. Interviews were conducted to seek informant's opinion to interesting subjects, which included using microfinance for adaptation to sea level rise impacts, objectives of such microfinance, microfinance's financial policies, membership benefits, and relevant administrations. Informants responded freely to those guide questions. Their responses are summarized in Table 4.6.

Table4.3: Informants participated in focus group interview for design of microfinance for sea level rise impacts (Group 2 – Village members in Tambon Phan Thai Norasing, Samutsakorn Province, organized on 1st April, 2011)

Number of Informants	Informants Details
1	Village leader
2	Co-village leaders
3	Village committee members
Total number of informants = 6	

Table4.4: Informants participated in focus group interview for design of microfinance for sea level rise impacts (Group 1 – Members of The Upper Thai Gulf Coastal Conservative Network (กลุ่มเครือข่ายรักษ์อ่าวไทยตอนบน), organized on 18th September 2010)

Number of Informants	Informant's house locations	
	Village, Tambon, Amphur	Provinces
1	Moo 2, T. Laemyai, A.Mueng	Samutsongkhram
1	Moo 5, T. Bangpoomai, A.Mueng	Samutprakarn
2	Moo 9, T.Laem Fapha, A.Prasamutrchedi	Samutprakarn
1	T.Kokkam, A.Mueng	Samutsakorn
2	M00 10, Takam, A. Bangkhuntien	Bangkok
2	M00 10, T. Bangkunsrai, A. Banlaem	Petchaburi
Total number of informants = 9		

Table4.5: Informants participated in focus group interview for design of microfinance for sea level rise impacts, (Group 3 – Village members in Tambon Khlong Dan, Samutprakarn Province, organized on 2nd May 2011

Number of Informants	Informants Details
1	Village leader
1	Co-village leaders
3	Village committee members
4	Tambon Administrative Organization members
Total number of informants = 8	

Table4.6: Required conditions of microfinance for sea level rise impacts as a result of focus group interview.

Discussed items	Responses of focus group members
a) Using microfinance as an adaptive measure	➢ Many informants think that the 'Microfinance for sea level rise impacts' may be workable. ➢ Informants that are village leaders fully agree that there should be financial collaboration for self-service but need to clearly educate or communicate with members in the community. ➢ There are few informants disagree the use of microfinance as they think the saving fund will not be sufficient anyway. They require government to fully subsidize. ➢ Some informants say that there is no need to implement a new microfinance. The implementer can extend services of some existing microfinance to cover the adaptation for sea level rise impacts. ➢ Require government agents to mange microfinance, or take care the financial requirements for adaptations to sea level rise impacts.
b) Objectives	➢ For household financial preparation (saving) for future adaptation to sea level rise impacts. ➢ Scopes of microfinance services cover the household level. ➢ To create collaboration and knowledge sharing among villagers in a coastal community, including between communities.
c) Source of fund	➢ Each member saves his/her money monthly in equal amount to microfinance fund. Saving amount is depended on individual financial capacity. ➢ Setting low amount saving policy e.g. 50 Baht per household per month to induce every villagers in a community to participate ➢ May apply funding mechanism similar to Healthy

c) Source of fund (continued)	Microfinance Funds in some villages (members save for their own future medical treatment requirements). ➢ Most coastal households have limited income, which are sufficient for daily living. How can they allocate such limited income to save for future use? ➢ May be difficult to call for financial collaboration among members in a community. ➢ Definitely need government subsidization. ➢ Funding should come from tri-parties contributions: microfinance members (villagers), government, and private donation. However, it is preferable that major contributions are from the latter two. ➢ Need an initial reserve fund (e.g. 1,300,000 million Baht) for the first time microfinance implementation, due to members may require money at early stage before saving amount is sufficient.
d) Microloan policy	➢ Microloan delivered to members can be used only for the purposes of household adaptation to sea level rise impacts. ➢ Required emergency loan for the case that a household is immediately impacted with high scale damage. ➢ How to allocate the microloan to many households that may be impacted at a same period. There are concerns of insufficient or reducing of microfinance fund ➢ Microfinance management committee must have the clear decision criteria for approval of microloan. ➢ Loan amount is varied and depended on the magnitude of impacts each household received, and must be in line with fund amount household already save in microfinance. ➢ Installment period is depended on the repayment ability and occupation of microfinance members. For example, those earn by shrimp, fish, and mollusk farming will have money after grow and sell in every 3-4 months, 6-8 months, and 12 months respectively. However, for those who are employees, they have salary and can repay every month.

e) Investment policy	➢ Investment of microfinance is mainly from microloan delivery and receiving income from interest payment. ➢ Interest rate for microloan should be much lower than formal financial institutions including informal sources such as 8.5% per year.
f) Membership	➢ Members should have monthly meeting to acknowledge fund management performances and to report various requirements. ➢ Members should have right or be able to participate in microfinance management. ➢ Member can terminate his/her membership any time after he/ she clears of loan balance. ➢ Benefits to members for becoming membership are generating saving, receiving adaptation knowledge, and obtaining microloan for adaptive measures. ➢ Integrity of the member is the most important. Experiences from many existing microfinances show that members have not repaid the microloan as promising. To solve this issue, some propose the use of 3rd party (another member) guarantees the repayment. ➢ Household that already impacted will be willing to become membership. Household that not yet impacted may not be realized and unwilling to participate.
g) Management	➢ The chairman of the management committee is not necessary to be the Village Leader. ➢ Selection of committee members to be done with free voting by microfinance members. ➢ Should not use the existing committee from other microfinances, because most of them currently have problem of manage microloan repayment ➢ Require new committee set up, which compose of government or Tambon Administrative Organization representatives. These persons can set rules and better control of microloan repayment by members.

g) Management (continued)	➢ Management committee must have integrity, knowledge and experiences in managing microfinance.
h) Accounting and audit	➢ Require 3rd party auditor e.g. government to audit microfinance in every 3 months. ➢ Should set up another committee compose of villagers for auditing? ➢ Should have regular audit at least once a year ➢ Require expert to set up the accounting system for microfinance.
i) Government subsidization	➢ Need government subsidization, but do not want microfinance to be regulated/ or registered due to government processes are slow and complicated. ➢ Government should subsidize in similar format as 'Village Fund' (Free funding provided by government to village. Villagers then can lend money from this fund and repayment later.)
j) Others	➢ If microfinance fund size is big enough, money can be allocated to buy some insurance relate to flood and natural disasters.

Results of focus group interviews (responses of informants) demonstrated that the possible required conditions of microfinance for sea level rise impacts were similar with typical ones of saving cooperative. In other word, applying saving cooperative for adaptation to sea level rise impacts is practical. However, there are some particular issues that need to be addressed:

- The objective of microfinance must be emphasized on saving and knowledge sharing with specific purpose for future household adaptation to sea level rise impacts. Microloan is a by-product benefit after sufficient saving. Most informants expected microloan from becoming membership of microfinance without concerning their saving.
- For funding of microfinance, though informants require external

subsidization, it should not be included into the conditions until further study and having agreement with subsidizing parties. At initial stage, identification of conditions, main funding therefore should be from the microfinance members.

- The limited and inconsistent income of some coastal households will make them hardly to allocate for continuous saving, unless in lower amount. Policy to have all members save monthly at same amount is then not recommended. It should be subject to their financial capability to promote funding size. However, ruling that each member save monthly and constantly (in equal amount) should be enforced to sustain microfinance fund.
- Microloan management, which includes delivery and repayment of loan, is the crucial that can make microfinance failure or success. Microloan amount delivered to each member therefore should take into account various factors e.g. magnitude of damage from sea level rise impacts and money required for adaptation, saving amount a member already has, and ability for repayment. Mechanisms for repayment guarantee are also needed. Some recommendations include use of 3rd party (other member) guarantee, use of government agents to manage microloan, or limit maximum of loan equal to saved amount.
- Participation of members should be encouraged to ensure that they are truly involved with good governance, performances and financial stability of microfinance. As such, members should not solely delegate the authorities to committee, but hold some important rights such as voting of committee selection, decision making in important aspects (e.g. approval of regulations), and audit.
- Essential traits of committee members are integrity and maturity. These are the most informants concern. Committee members also should have experiences in microfinance management. Village leader does not need to be appointed as the committee chairman. This somehow can be interpreted that informants require committee to be free from any political issues and conflict of interests.

Altogether, the required functional flows of microfinance for sea level rise impacts can be simply diagrammed and shown in below Figure 4.1

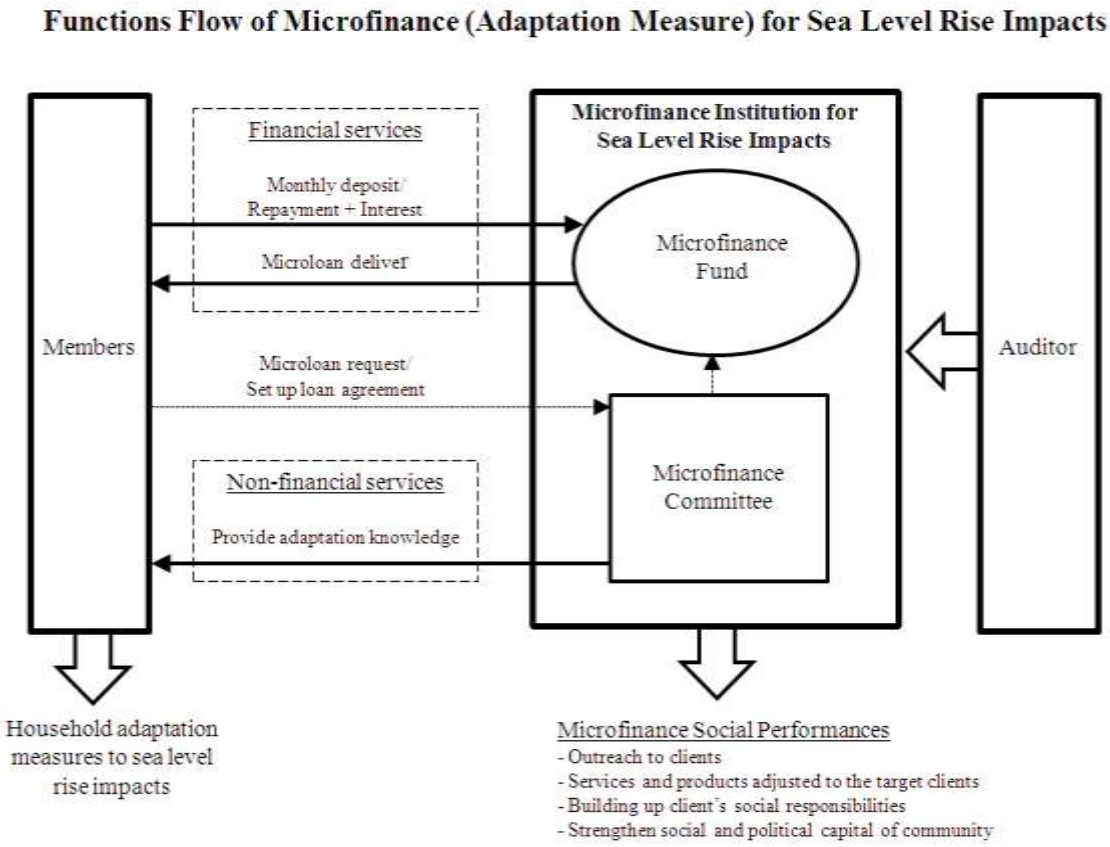

Figure4.1: Functions flow of microfinance for sea level rise impacts

In addition, there are some other observations obtained from focus group interview that need to be deliberated. Many informants intended to use money from microloan in reinvesting their businesses impacted by sea level rise e.g. replanting, and buying new young fishes or shrimps for aquaculture faming. It needs to educate microfinance members and to be controlled by the committee that the purposes of microfinance are for protecting and accommodating their livelihoods. Examples of money usage for right purposes are: trial of new crops easily grow in flooding condition (accommodate) instead of replanting same crops (reinvesting); constructing barriers for protecting the flood and erosions to their farming areas (protect) instead of buying new young fishes or shrimps for next aquaculture farming (reinvesting). Another notice was that the requirements of external subsidization either from

government or private sectors were thoroughly mentioned by most informants. This can be interpreted by one or combination of two possible aspects. Firstly, informants did not sure that their own saving will be sufficient for adaptation cost requirements. Secondly, they might think that sea level rise impacts they have currently faced were not come from their own acts, and therefore external parties should be responsible with. The last observation was the different degree of collaboration among members between 2 coastal community types, industrialized and typical. There was tendency that villagers of Tambon Khlong Dan, a coastal community developed via industrialization, provided less degree of collaboration than that of other two Tambons, Phan Thai Norasing and Laem Fapha, which were typical coastal communities living via fisheries and farming. Any new implementing tools in such industrialized coastal community that require cooperative may have less change of success unless enforcing. This observation supports the sequential effects of social development (Jeong, 1997) that industrialization has brought about urbanization as well as individualism of social and environmental consciousness.

4.3 Conclusion and Recommendations

Ultimately, the proper microfinance should response to social performances in 4 dimensions: poverty or clients outreach; ability to adjust services and products to target clients; building up social responsibilities to clients; and strengthen social and political capital through transparency and empowering clients with voting systems (Zeller, Lapenu, and Greely, 2003; International Fund for Agricultural Development, 2006). In this study, to design microfinance for sea level rise impacts, those dimensions were considered and used in the multi-criteria factors analysis and as guided questions during the focus group interview. However, there was one limit of this study that need to be mentioned, the low number of informants in view of statistical requirements. Such limit may lead to some biased. However, to mitigate such biased, the study selected informants that were key persons in the communities e.g. village leader, members of Tambon Administrative Organizations, and government officers, which were able to provide in depth information. Through the use of appropriate tools, the study provided some meaningful results in view of

the proper microfinance institution and the necessity conditions for an ideal microfinance for sea level rise impacts. Other remains are assessment of the market applicability and efficiency of this designed microfinance whether it is the effective mean for coastal household adaptation.

CHAPTER V
COASTAL HOUSEHOLD ADAPTATION COST REQUIREMENTS TO SEA LEVEL RISE IMPACTS

5.1 Overview

Sea level rise is one of the most serious impacts induced by global climate change to coasts. People living along the coasts need to adapt their livelihoods with the increasing costs. Information related to adaptation costs to sea level rise is far from adequate in terms of both being outdated and the category requirements (Parry et al., 2009a). Although most studies related to the adaptation costs to sea level rise have focused on planned adaptations and been conducted on the basis of models and approaches originally designed for the market-based economy of industrialized countries (developed countries), the same models are generally applied to developing countries when studying their adaptation costs (Margulis et al., 2009). The models typically assess adaptation costs based on building dikes, beach nourishment, and port upgrades. Such adaptive measures undoubtedly require financial support from respective government authorities. An example utilizing such models was the additional global investment, of 11 billion USD, toward the coastal zone for a planned adaptation to a sea level rise needed in 2030, as assessed by United Nations Framework Convention on Climate Change (2007). Developing countries would need about half of the required investment. For the autonomous adaptations at the sectoral level to sea level rise impacts, there are few studies on the associated cost requirements or the appropriate cost assessment methodologies.

This chapter studied the autonomous adaptation cost requirements of household sector at the level of accommodate and protect (excluding retreat). The studied sites included six vulnerable coastal villages located in the Gulf of Thailand, the most impacted area by sea level rise in Thailand and one of the most impacted in Southeast Asia (Umitsu, 2000). Half of the villages under investigation were near-shore villages, and the other half were further inland (next to the near-shore,

approximate one thousand meters from shore). The study used a sample size of 400, allocated equally to every selected village (65–67 households per village for six villages). Previous studies, provided the requisite research, were reviewed to identify common household adaptative measures used to accommodate to and protect from the impacts of a rise in sea level. Using questionnaires, the method typically used in collecting data at the household level in developing countries (United Nation, 2005), in personal interviews, informants provided detailed information about their household adaptation costs for those adaptive measures. Focusing on direct costs, this study classified household adaptation costs into two types: capital expenditures and operating expenditures.

To survey past autonomous adaptation costs, informants were asked for the amounts of costs they spent for adaptive measures (they could answer more than one measure) over the past five years using fill-in questionnaires. An analysis of variance and two-sample t tests were used to respectively test the difference of mean adaptation costs of all villages and between two villages. To assess future autonomous adaptation costs, for short-term period, the study also used a questionnaire asking informants their anticipated required future household autonomous adaptation costs for the next five years. In longer term, the results from the survey of past autonomous adaptation costs were extrapolated to obtain the future amounts required for the next 30 years. Given that similar adaptive measures were currently being used by households that could cope with whatever the degree of sea level rise impacts would be in the future, the budgeting for the recurrent costs of investment and future value of an equal annual expenditures payment (Brigham and Gapenski, 1991) were applied respectively to capital and operating expenditure items. The following factors all received consideration when estimating the future cost requirements: a) investment costs for adaptive measures, b) useful life of adaptive measures, c) maintenance costs, and d) inflation. The following equations were used:

Capital expenditure items (equation 5.1):

Summation of -

$$(\text{Present costs of adaptive measures}) \times (1 + r\,\%)^{(\text{Useful life of adaptive measure}) \times (i)}$$

Operating expenditures items (equation 5.2):

= Future value of an equal annual payment

= (Present value of annual operating expenditures) x $((1 + r\ \%)^{30} - 1)/ r\ \%)$

r % = expected inflation

i = 1, 2, 3,..X; X = round-down maximum number of times reinvest or refurbish the adaptive measures over the next 30 years (round-down of 30 years/ useful life of adaptive measure)

The assessed autonomous adaptation costs served as references for: a) required costs for which impacted households should plan their self-financial resources to cope with; b) testing the effectiveness of designed microfinance for sea level rise impacts by comparing with the amount of saving (willingness to save) obtained. In addition, knowing the amount of costs required for autonomous adaptations of households will be of additional benefit to policy makers in preparing for future assistance programs. Such assistance is perhaps more practical with less time and costs needed for their implementation in comparison with the large investment costs of planned adaptations.

5.2 Results and Discussions

5.2.1 Surveyed households

Four hundred households from six studied villages were surveyed. Numbers of surveyed households were allocated equally to each village.

Those six villages were from three Tambons. One ‘near-shore’ and one ‘in-land’ village selected from each Tambon were comparatively analyzed with the intent to see, if any, the differences in the degree of impacts from the degree of adaptations (costs) taken for, and the level of preparedness to the sea level rise. The ‘near-shore’ villages were Sahakon, Khun Samut Chin, and Si Long; the ‘in-land’ villages were Sandap, Khlong Suan, and Khlong Nang Hong for Tambon Phan Thai Norasing,

Tambon Laem Fapha, and Tambon Khlong Dan respectively. Results of survey are summarized in Table 5.1.

Table5. 1: Number of households surveyed, number of households impacted, and not yet impacted by sea level rise in the studied sites, surveyed in April 2011

Studied sites			Number households surveyed	Number households impacted by sea level rise	
Near shore (Y)	Tambon	Villages		Impacted	Not yet
Y	Phan Thai Norasing	Sahakon	67	44	23
	Phan Thai Norasing	Sandap	67	49	18
Y	Laem Fapha	Khun Samut Chin	65	49	16
	Laem Fapha	Khlong Suan	67	48	19
Y	Khlong Dan	Si Long	67	58	9
	Khlong Dan	Khlong Nang Hong (K-N-H)	67	54	13
	Total households		400	302	98

For general describing characteristics of studied villages, the villages in Tambon Phan Thai Norasing (Sahakon and Sandap) and Tambon Laem Fapha (Khun Samut Chin and Khlong Suan) are fishery coastal communities. Although houses in those villages are predominantly made of wood, they use some amount of concrete and metal as well. Good relationships and collaborative efforts among members of the villages are noticeably evident. Most members earn their living by fishery or aquaculture, and have a lower income average compared with villagers in Tambon Khlong Dan. More modernized, the villages in Tambon Khlong Dan (Si Long and Khlong Nang Hong) are located near industrialized areas. This is due to the process of urbanization (Singh, 1987; Sharma and Maithani, 1998; cited in Basyal and Khanal, 2001). Members in the villages earn their living serving as employees such as laborers, in merchandising, and in making and selling dried salted damselfish. They have sufficient income to build better quality houses. However, as with typical urbanized communities, the relationships and cooperation among members of such communities are less.

There was about 75% (302 from the 400 households) of surveyed households confirmed their current experience of sea level rise impacts. From those impacted households, the number of households impacted by sea level rise from 'near-shore' and 'in-land' villages was not different, but indeed equaled at 151 households. However, the difference in the degree of the impacts, and/or the severity, is another subject that needs further analysis. Informants, regardless of gender, were household leaders or members who primarily generated income for such households. Most of them resided in the study sites or over 10 years. Family members privately own all of the houses in which they were dwelling (none are rental).

5.2.2 'Capital Expenditure' autonomous adaptation costs: Past experiences of coastal households during 2006–2010

To adapt to sea level rise impacts during the past five years (2006–2010), the autonomous adaptive measures that impacted and surveyed coastal households mainly applied were renovating their houses, improving lands, and followed by building physical barriers for their accommodation and farms. There were few adaptive measures taken that related to increasing water storage tanks or the improvement of water and electrical utility systems. Some households applied more than one measure. These types of adaptive measure are considered as capital expenditure items since they are physical assets with a useful life of more than one year, or the rehabilitated existing physical assets to extend the useful life (Jacobs, 2009). Such adaptive measures can well cover household adaptations to sea level rise impacts at the level of 'accommodate' and 'protect' (exclude 'retreat'). Table 5.2 shows studying results, the numbers of households apply adaptive measures (capital expenditure items) and associated investment costs. Considering all studied sites, for the past five years, an impacted coastal household paid for capital expenditure items as autonomous adaptations averagely 60,059 Baht. Major adaptation cost undoubtedly was for house renovation, with the average cost per household at 92,946 Baht. However, the costs for other mentioned adaptive measures were also significant as their average range was between 20,000 and 40,000 Baht per household.

Table5.2: Number of households applied adaptive measures (capital expenditure items), and average investment costs of adaptive measures during the past five years (2006–2010), from the 400 households surveyed in the studied sites

Villages	Number households applied adaptive measures – capital expenditure items (No.), average and standard deviation[1] investment costs of adaptive measures (Thai Baht) during the years 2006–2010													
	Fresh water storage		Barrier-farming protection		House renovate [2]		Land improve		Barrier-house protection		Others [3]		Overall	
	No.	Baht	No.	Baht	No.	Baht	No.	Baht	No.	Baht	No.	Baht	No.	Baht
Sahakon	4	1,250 [1,215]	11	37,091 [40,076]	16	50,467 [124,973]	31	29,826 [55,828]	4	25,000 [17,321]	1	4,700	67	33,579 [72,247]
Sandap	-		3	35,500 [55,886]	14	38,943 [76,948]	12	13,909 [20,787]	9	12,222 [16,873]	2	8,000 [8,485]	40	23,615 [50,339]
Khun Samut Chin	-		8	27,813 [39,374]	27	48,778 [95,356]	10	9,300 [4,923]	5	31,500 [34,453]	-		50	35,800 [73,457]
Khlong Suan	2	2,500 [707]	-		17	38,265 [50,074]	18	9,778 [7,256]	1	4,000	-		38	21,987 [36,497]
Si Long	-		1	1,000	31	116,129 [71,865]	7	51,429 [14,639]	1	10,000	-		40	99,275 [71,375]
K-N-H	-		1	200,000	41	162,195 [180,146]	6	69,167 [47,793]	-		1	1,000	49	148,286 [169,520]
Overall	6	1,667 [1,184]	24	39,083 [51,753]	146	92,946 [129,364]	84	25,423 [40,863]	20	19,075 [22,443]	4	5,425 [5,926]	284	60,059 [103,002]

(1) Standard deviation values are shown in bracket

(2) Two data related to new house building, 'retreat,' that costs over 1,000,000 THB are edited/replaced to consider the adaption cost requirement for 'accommodation' and 'protect' only. The value used to replace is the maximum adaptation costs of the household in the same community that uses accommodate or protect.

(3) Others: Sahakon—improved water and electrical systems; Sandap—bought wooden shelf, refurbished shrimp pond; and Khlong Nang Hong —repaired wooden bridge to home.

Analyzing the amount of autonomous adaptation costs required between communities, it was clear that the impacted households of 'near-shore' villages paid for higher adaptation costs than 'in-land' villages. For Tambon Phan Thai Norasing, a household in Sahakon and Sandap villages paid for all autonomous adaptive measures averaging 33,579 and 23,615 Baht, whereas for Tambon Laem Fapha, households in

Khun Samut Chin and Khlong Suan villages paid an average of 35,800 and 21,987 Baht respectively. However, there was an exception for the villages in Tambon Khlong Dan. A household in the Si Long village ('near-shore') paid for adaptation costs averaging 99,275 Baht, which was lower than that for the Khlong Nang Hong village ('in-land'), where household paid an average of 148,216 Baht. This was largely from house renovation costs. One assumption is that Khlong Nang Hong village is more urbanized. Houses in such a village are made of better quality materials resulting in higher costs for renovation. Apparently, the study results showed that the impacted households in urbanized coastal communities (Si Long and Khlong Nang Hong villages) paid for higher autonomous adaption costs for 'capital expenditure items' than households in fishery coastal communities (Sahakon, Sandap, Khun Samut Chin, and Khlong Suan).

The two-sample t tests and the analysis of variance were performed to test whether there were differences in means of adaptation costs between villages. With the probability of 2 tails tests, the calculated t-scores were compared with the critical values at a 5% significant level ($\alpha/2 = 0.05$) for the t distribution following various degrees of freedom (d.f.). The results showed that at a given level of confidence, 95%, there were no significant differences between the means of adaptation costs between 'near-shore' and 'in-land' villages in the same fishery coastal communities (villages in Tambon Phan Thai Norasing and Tambon Laem Fapha), except in the urbanized one (Tambon Khlong Dan). In addition, comparing between Tambons, there were no differences of means between 'near-shore' and 'near-shore,' and 'in-land' and 'in-land' villages in the fishery coastal communities, except the urbanized one. For the analysis of variance, it was used to compare the means of the village groups (more than two villages), in this case, a group of fishery villages (villages in Tambon Phan Thai Norasing and Tambon Laem Fapha) and a group of all villages (villages in all Tambons). At the $\alpha = 0.05$, with the results of the F test and p value, it was found that the compared means of fishery villages were equal. However, when comparing all villages, inclusive of urbanized, their means were not equal. The statistical data and calculations are shown in Table 5.3 - 5.6 below.

Table5.3: The average investment adaptation costs, standard deviation, and the number of sampling units (n) of the sampled population from the studied villages

Near shore (Y)	Tambon	Villages	Mean	Standard deviation	n
Y	Phan Thai Norasing	Sahakon	33,579	72,247	67
	Phan Thai Norasing	Sandap	23,615	50,339	40
Y	Laem Fapha	Khun Samut Chin	35,800	73,457	50
	Laem Fapha	Khlong Suan	21,987	36,497	38
Y	Khlong Dan	Si Long	99,275	71,375	40
	Khlong Dan	K-N-H	148,286	169,520	49

Table5.4: Test of the difference of two means (Two-sample t test) between 'near-shore' and 'in-land' villages in the same studied Tambon

Tambon	Compared villages	t-score	Degree of freedom	t-value α/2 (0.05)	Mean differences
Phan Thai Norasing	Sahakon (near)- Sandap (in-land)	0.8383	105	+/- 1.659	-
Laem Fapha	Khun Samut Chin (near)- Khlong Suan (in-land)	1.1552	86	+/- 1.663	-
Khlong Dan	Si Long (near)- KNH (in-land)	(1.8344)	87	+/- 1.663	Difference

Table5.5: Test of the difference of two means (Two-sample t test) between 'near-shore' and 'near-shore,' and 'in-land' and 'in-land' villages in the different studied Tambons

Compared Tambons	Compared villages	t-score	Degree of freedom	t-value α/2 (0.05)	Mean differences
Phan Thai Norasing-Laem Fapha	Sahakon (near)-Khun Samut Chin (near)	-0.1630	115	+/- 1.658	-
Phan Thai Norasing-Laem Fapha	Sandap (in-land)-Khlong Suan (in-land)	0.1642	76	+/- 1.665	-
Laem Fapha-Khlong Dan	Khun Samut Chin (near)-Si Long (near)	-4.1382	88	+/- 1.662	difference
Laem Fapha-Khlong Dan	Khlong Suan (in-land)-KNH (in-land)	-5.0661	85	+/- 1.663	difference
Phan Thai Norasing-Khlong Dan	Sahakon (near)-Si Long (near)	-4.5855	105	+/- 1.659	difference
Phan Thai Norasing-Khlong Dan	Sandap (in-land)-KNH (in-land)	-4.8906	87	+/- 1.663	difference

Table5. 6: Analysis of variance between groups of villages

	Sum of squares	d.f.	Mean square	F test	p value
Between groups of fishery villages	5.4E + 09	3	1.8E + 09	.447	.720
Between groups of all villages	6.2E + 11	5	1.25E + 11	14.593	.000

In summary, the study revealed that an impacted coastal household paid high cost for autonomous adaptations (capital expenditure items), averaged 60,059 Baht during 2006–2010, to cope with the impacts of sea level rise. The payment pattern for capital expenditures is periodic, which means households normally invest one time for any required adaptive measures at a high amount for an expected long service period of such adaptive measures. Further analysis is necessary to ascertain whether households have sufficient income to cope with the high payment amount. According to the Thailand Community Development Department (2009), the per capita income (average annual income per person) of those studied sites is about 50,000 Baht. With the average number of working members in a household at 2.4 persons, resulting from the field survey, a household then had an annual income of approximately 120,000 Baht. The high investment for adaptation at 50% of annual income, though in any given year during the study period of 2006–2010, would require that a household plan saving very carefully. Alternatively, households might already have sought out financial support from other various formal (e.g., commercial bank) and/or informal (e.g., private loan) financial sources.

5.2.3 'Operating Expenditures' autonomous adaptation costs: Past experiences of coastal household during 2006–2010

This study also surveyed the miscellaneous expenses and maintenance costs that impacted households had to spend for their adaptations to sea level rise impacts during the period of 2006–2010. The expenditure items used in the survey were buying more drinking water, changing fertilizers, medical expenses, buying home appliances, and maintenance of exiting physical adaptive measures. Due to their consumable and relative low costs, such expenditure items are considered operating expenditure items; and, therefore, should be analyzed on the basis of annual payment. Results of survey are shown in the following Table 5.7.

Table5.7: Number of households that applied adaptive measures (operating expenditure items), and average annual costs of adaptive measures over the past five years (2006–2010), from the 400 households surveyed in the studied sites

Villages	Number households applied adaptive measures – operating expenditure items (No.), average and standard deviation(1) annual costs of adaptive measures (Baht) during year 2006–2010											
	Buy more drinking water		Change fertilizer/ Soil maintenance		Medical expenses (water borne disease)		Household appliances/ miscella-neous		Maintenance physical adaptive measures		Overall	
	No.	Baht	No.	Baht	No.	Baht	No.	Baht	No.	Baht	No.	Baht
Sahakon	6	1,298 [897]	2	1,750 [1,061]	1	1,600	8	2,153 [1,214]	2	10,750 [13,081]	19	2,716 [4,304]
Sandap	5	1,532 [1,089]	-		3	533 [416]	5	1,600 [189]	-		13	1,328 [1,159]
Khun Samut Chin	2	2,200 [283]	-		-		2	1,550 [778]	2	3,500 [2,121]	6	2,417 [1,351]
Khlong Suan	-		-		-		1	2,000	4	3,250 [1,258]	5	3,000 [1,225]
Si Long	-		-		-		-		-		-	
K-N-H	-		-		1	1,000	-		-		1	1,000
Overall	13	1,527 [916]	2	1,750 [1,061]	5	840 [555]	16	1,895 [1,174]	8	5,188 [6,129]	44	2,258 [3,019]

(1) Standard deviation values are shown in bracket

It was also found out that the surveyed households did not completely realize such operating expenditures. Most informants seldom remembered to categorize the items and amount they have paid for them. This resulted in a low response rate of the survey, which was about 10% of the 400 surveyed households (44 households responded). For some items, informants provided their purchasing records once during the past five years, such as for home appliances. The costs of such items were then allocated equally to the annual expenditures. Due to the limited and fragmented data received from the surveyed villages, the average expenditure for each adaptive measure and the different adaptation costs between ‘near-shore’ and ‘in-

land' villages could not be well analyzed. Nevertheless, for general reference, by considering all studied sites, the average of 2,258 Baht per household could be used as annual operating expenditures for autonomous adaptations to sea level rise impacts.

5.2.4 Future adaptation cost requirements

The future adaption cost requirements for the surveyed coastal households were forecasted for two periods: short-term and long-term. For the short-term, or within the next five years, the results from the personal interview or the expected future cost requirements for capital expenditure items from the informant's views (as shown in Table 5.8) were used. Over 60% of the surveyed households (249 from 400 households) confirmed their future adaptation requirements. The study results showed that the expected future adaption costs of urbanized coastal villages were apparently higher than for those of the coastal fishery villages. The average expected future costs required by Si Long and Khlong Nang Hong villages in Tambon Khlong Dan were over 100,000 Baht per household; whereas, the Sahakon and Sandap villages in Tambon Phan Thai Norasing, and Khun Samut Chin and Khlong Suan in Tambon Laem Fapha required an average of between 18,000 and 33,000 Baht per household. The difference in the degree of future cost requirements between 'near-shore' and 'in-land' villages could not be concluded, as the survey results were not clustered (not for all cases that 'near-shore' would require higher future costs than 'in-land,' or vice versa). Overall, a household would require an average of 57,140 Baht for capital expenditure items to adapt to sea level rise impacts in the next five years. The purposes of money usage were still mainly for house renovation, followed by land improvement, building physical barriers, and other miscellaneous items. It was noticeable that many informants predicted their required future adaptation costs from their own past experiences, and the result to the costs required in those two different time periods (past and future) were nearly the same. This is in line with a cost estimating method, extrapolating from actual costs. The extrapolation is best suited for estimating the same item when there are properly normalized current or past data (U.S. Government Accountability Office, 2009).

Table5. 8: Numbers of households (not) requiring future adaptation costs, estimated future household adaptation cost requirements, and the percentage of usage purposes within the next five years (2015), from the 400 households surveyed in the studied sites

Villages	No. Households responded to future costs requirement		Estimated future household adaptation cost requirements and standard deviations(1) within the next 5 years (2015)						
			Average amount per household (Baht) (2)	Usage purposes (%)					Total usage purpose (%)
	Not required	Required		Build water barrier	Renovate house	Improve land	Buy/ change new crops	Others (3)	
Sahakon	14	53	33,020 [34,174]	25%	27%	40%	1%	7%	100%
Sandap	20	47	26,633 [37,918]	23%	35%	35%	0%	6%	100%
Khun Samut Chin	21	44	17,738 [27,831]	21%	45%	21%	2%	11%	100%
Khlong Suan	41	26	18,080 [39,071]	9%	41%	50%	0%	0%	100%
Si Long	34	33	102,727 [64,179]	5%	82%	11%	0%	3%	100%
K-N-H	21	46	143,163 [153,809]	0%	88%	8%	0%	4%	100%
Total	151	249	57,140 [90,977]	15%	51%	28%	1%	6%	100%

(1) Standard deviation values are shown in bracket.
(2) Five data related to new house building, 'retreat,' that costs over 1,000,000 THB are edited/ replaced to consider adaption cost requirement for the 'accommodation' and 'protect' only. The value used to replace is the maximum adaptation costs of household in the same community that uses accommodate or protect.
(3) Others include house relocation, growing mangrove, buy various home appliances, and refurbish shrimp pond.

For the longer term of future adaptation cost requirements in the next 30 years, the study used the aforementioned equations 5.1 and 5.2 to forecast, respectively, the required future costs for capital expenditure and operating expenditure items. Following equation 5.1, the required parameters were the present costs of the adaptive measures, the average useful life of those adaptive measures, and the expected inflation. According to the Thailand Ministry of Finance (2000), the

useful life of a concrete building or house is 25 years. For other wooden and concrete facilities, their useful life ranges from 10 to 15 years. The study then applied the minimum useful life of facilities, which is approximately 10 years, as the average useful life of those adaptive measures. With this, in the next 30 years, a household would have to pay three times for reinvesting their adaptive measures. The inflation or discount rate to be used also is debatable. However, it must well represent the local risks. Therefore, the study used the average Thailand consumer price index, determined by the Bank of Thailand, during the past five years of 2006–2010, which was about 2.98% per year (Bank of Thailand, 2011). Given the average investment costs of adaptive measures at 60,059 Baht (result from the survey, Table 5.2), a household would require future costs totaling 334,966 Baht for capital expenditure items to adapt to sea level rise impacts in the next 30 years, partially paid every 10 years. Projection of forecast is demonstrated in a graph as shown in below Figure 5.1.

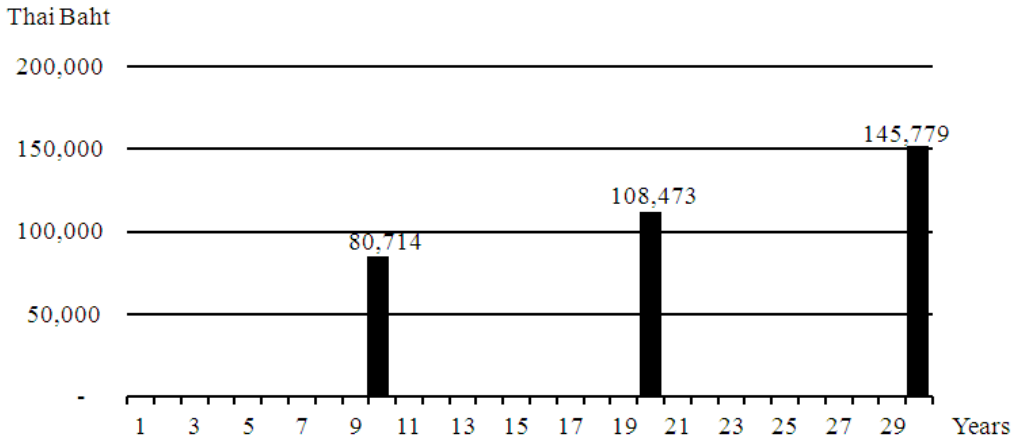

Figure5. 1: Projection of costs for 'capital expenditure' adaptive measure for adaptation to sea level rise impacts in the next 30 years with accumulated value equal to 334,966 Baht

To forecast the future required adaption costs in/as related to operating expenditure items, the figures of past actual annual expenditures were used and adjusted for inflation. With the future value of an annuity equal payment (equation 5.2), given the average annual expenditures at 2,258 Baht (result from the survey,

Table 5.7), a household would require future adaptation costs for operating expenditure items totaling 110,648 Baht throughout the next 30-year period. The cost projection of such forecasted future adaptation cost requirements is presented in Figure 5.2.

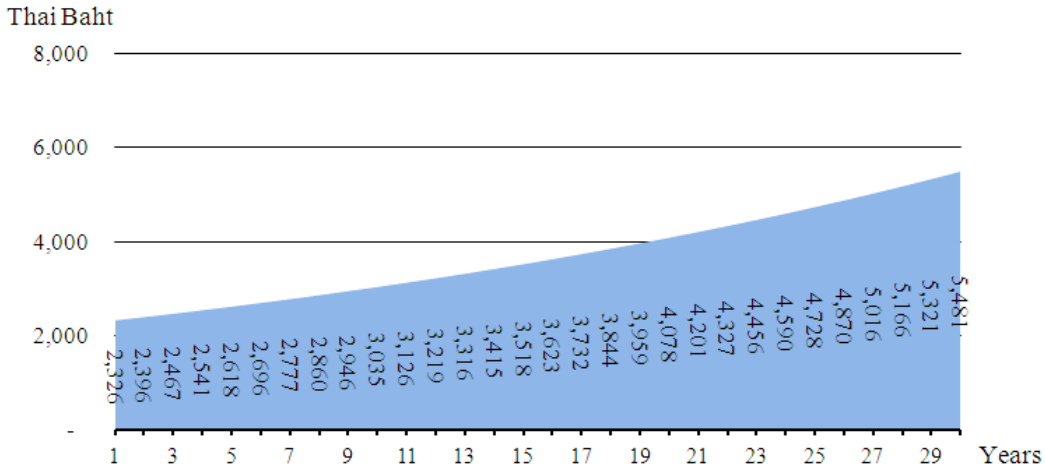

Figure5.2: Projection of annual operating expenditures for adaptation to sea level rise impacts in the next 30 years with accumulated value equal to 110,648 Baht

As long as sea level rise impacts remain, the additional future autonomous adaptation cost requirements for coastal households are inevitable. The estimated short and long-term future cost requirements, both in view of impacted households and by using financial formulas, supports such claims. However, those estimations were done on the assumption that the degree of sea level rise impacts was maintained. If the sea level continues rising with a slightly increasing rate, as quoted by Hulme et al. (2002; cited in Nicholls et al., 2005), degree of impacts certainly will be more severe. Accordingly, the required future autonomous adaptation costs for impacted households will likely be much higher than these forecasted costs. To develop the relationship between the increasing rate of sea level rise and additional adaptation costs required in the future, information regarding both adaptation costs and sea level through different periods of time is required. One benefit of this study is that its cost results can be used as a reference for any future study that attempts to find such a relationship.

5.3 Conclusion and Recommendations

The study results clearly showed that the coastal households in the studied sites, which were experiencing the impacts of sea level rise, had to autonomously adapt their living conditions. In doing so, households spent their money primarily for capital expenditure items related to home and farming environments (e.g., house renovation, land improvement, and building physical barriers for house and aquaculture land) so that they could still accommodate and adequately protected their current home land to and from the impact of a rise in sea level. The operating expenditure items for adaptations such as maintenance costs, medical expenses, and drinkable water were not their major concern. Mainly because of higher house renovation costs, the average autonomous adaptation costs required by the urbanized coastal households were clearly higher than the requirements of coastal fishery households. Comparing the adaptation costs of households located in 'near-shore' and 'in-land' villages, it was found that the average costs were not significantly statistically different in fishery coastal communities. This was probably due to the high variation in the amount of adaptation costs (high standard deviation), and the 'in-land' were so close to 'near-shore' villages that the 'in-land' had been impacted or aware of the impacts and thus already adapted.

Some specific lessons learned from this study merit attention. Obviously, local households are self-learning how to autonomously adapt to the impacts. Nonetheless, their own adaptive capacities limit how well they can adapt. This would somehow require external supports in terms of knowledge and financial support on both the international and national levels. According to Chinvanno (2007), adaptations are the multi level: a) collective adaptation, b) national level, and c) the community level. Each of those levels should be linked. In addition to depending on domestic resources, any multilateral adaptation and bilateral Overseas Development Assistance (ODA) from developed countries must be designed strategically to ensure that the assistance reaches the community level of the assisted developing countries. Another lesson learned is that the assessment methodologies of adaptation costs at the household level should be explored more in order to obtain more accurate cost information. Similar to other studies, this study used the interview method to assess the costs. The study could underestimate the real adaption costs taken by households

due to: a) the predetermined adaptive measures used to ask households how much they had spent, and b) the exclusion of costs related to behavioral adaptations. Open ended questions will generate a greater range of actual adaptive measures and associated costs. However, the interviewer must have sufficient experience and adaptation knowledge to obtain concrete information from the respondents. Because they are already accustomed to those adjusted ways of living, these households may not be able to specifically categorize exactly what actions they have taken that might be regarded as adaptations.

Ultimately, the study results provide useful information regarding required adaptation costs at the household level, which can be utilized by any interested party. Examples include: a) the impacted households, or not yet impacted households but located nearby, can use the information to plan their own financial resources for future cost requirements; and b) the use of information by agents at the national or international level to position an appropriate financial scheme to subsidize those impacted households. Another related analysis is necessary whether or not the households in those areas vulnerable to sea level rise impacts have sufficient financial adaptive capacities to cope with those future required costs. How should the households financially prepare for the future, or what are the possible effective and fairness financial schemes or tools applicable for the households, if they do not have a sufficient budget? In addition, to completely analyze a household's adaptive capacity, other factors including: a) demographic structure; b) interconnectivity with high-level processes; c) natural resource dependence; and d) housing quality should be considered (Vincent, 2007; cited in Chambwera and Stage, 2010). The costs information derived from this study can be further applied for estimating the adaptation cost requirements for other and larger areas by adopting the GIS techniques and adjusted with local property data (Michael, 2007). This will support the more optimal plan for local adaptations to the impacts of a rise in sea level at both the national and regional level.

CHAPTER VI
THE APPLICABILITY, FACTORS AFFECTING PARTICIPATION, AND WILLINGNESS-TO-SAVE OF/ TO MICROFINANCE FOR SEA LEVEL RISE IMPACTS

6.1 Overview

The aims of this chapter are to examine two hypotheses that: 1) microfinance can (cannot) be applied as a financial adaptive measure for the impacts of sea level rise; 2) whether or not the factors of risk perceptions, attitudes, social references, microfinance conditions, and demographic influence an individual household's degree of participation and willingness to save to a microfinance designed for adaptation to sea level rise impacts (hereinafter referred to 'microfinance for sea level rise impacts').

Total four hundred households (respondents), required sample size, of six studied villages were interviewed. The villages included Sahakon and Sandap villages in Tambon Phan Thai Norasing, Khun Samut Chin and Khlong Suan villages in Tambon Laem Fapha, and Si Long and Khlong Nang Hong villages in Tambon Khlong Dan. During the interview, in order to introduce the studying subjects to respondents, respondents were firstly asked about their opinions related with risk perceptions to sea level rise impacts, attitudes toward microfinance, and other factors that affect microfinance participation (as shown in Appendix I: designed questionnaire, type B, part II). Likert scaling was used to rate respondent's agreement/ disagreement. Thereafter, a designed hypothetical microfinance for sea level rise impacts including its conditions, study results of Chapter 4, was presented to respondents. Respondents finally were asked, by using part III of questionnaire type B, their intention to participate and amount they were willing to save to such designed microfinance, including other relevant information.

The analysis of the chapter was divided into 4 parts (as shown in section

6.3, results and discussions), which included factors affecting participation, acceptance, intention to participate and willingness to save to the designed microfinance. In analyzing factors affecting participation, potential factors were hypothesized and then statistically tested. Prior the tests, respondents were asked for their opinion on such factors. The acceptance was analyzed by the ratio of acceptance considering the factor of attitudes toward microfinance. To obtain the ratio, summation of value respondents assigned to was divided by summation of maximum possible values of attitude items. The ratio of acceptance will indicate whether microfinance can (cannot) be applied for adaptation to sea level rise impacts. For the intention to participate, it was measured by percentage of respondent's confirmation of their participation to the designed microfinance. The willingness to save was analyzed in range of amounts that respondents maximally were willing to save and minimally were not willing to save to the designed microfinance, using two-way payment ladder method. The two-way payment ladder is a method allowed respondents express uncertainty of good's value in hypothetical market, where no money or goods actually change hands (Mahieu, Riera, and Kristrom, 2010). Microfinance for sea level rise impacts is new and yet hypothetical. Willingness to save of respondents is depended on various affecting factors.

Differentiated from Chapter 5 that the required adaptation costs to sea level rise impacts were analyzed among 'near shore' and 'inland' villages. To microfinance, distances of villages from shore do not affect the degree of participation. Distance that impacts microfinance activities is the distance between microfinance member's household/ village and microfinance institution (Pedrosa and Do, 2006; Oke, Adeyemo, and Agbonlahor, 2007). Reviewing literatures, microfinance participation is depended on, but not limited to, demographic factor and social capital (Togba, 2009), including its terms and conditions (Atieno, 2001). Accordingly, Pearson correlation and stepwise regression analysis were used to analyze the relationships of those affecting factors and microfinance designed for sea level rise impacts. Such statistical tools were used widely to examine: a) the relationship between variables and; b) determine the principle independent variables that can best explain the model/ dependent variable (Hocking 1976). In addition, other related information obtained from interviewing was presented in the chapter to

support relevant analysis. Those included the purposes of microfinance participation, the effect of government subsidization on willingness to save amount, what the optional sources were if respondents were not intend to participate with microfinance for sea level rise impacts. The study results and discussions of the chapter are presented in the following sections 6.3 and 6.4.

6.2 Conceptual Framework of Study

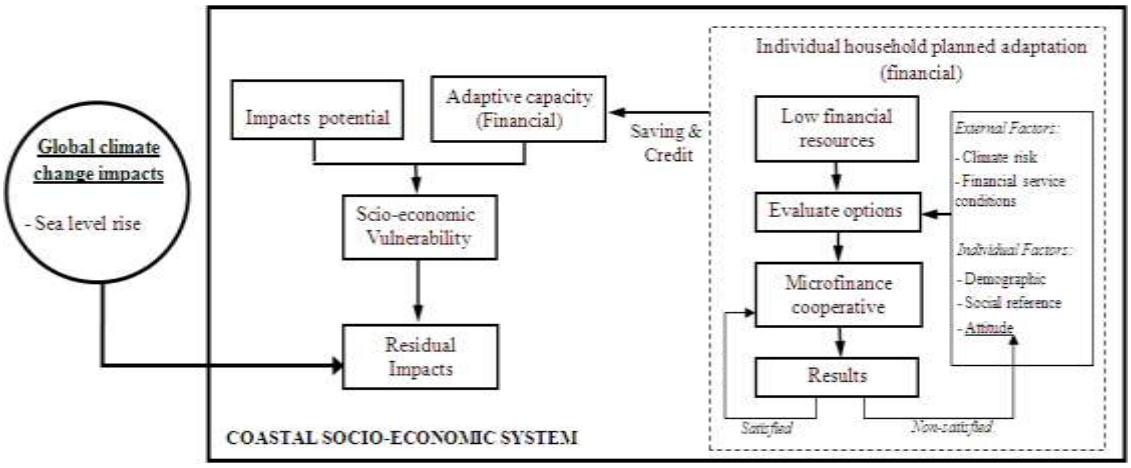

Figure6.1: Conceptual framework of sea level rise impacts, adaptation (using microfinance), and vulnerability of a coastal socio-economic system

This conceptual framework was developed by adjusting vulnerability models of Klein and Nicholls (1999), Mimura and Harasawa (2000; cited in Mclean & Tsyban, 2001), and combining with consumer's behavior model of Engel et al. (1986; cited in Kotler, 1991). The framework demonstrates the linkages between the impacts of sea level rise to, the adaptative capacity via the usage of microfinance, and the vulnerability of a coastal socio-economic system. Vulnerability is the net of impacts minus adaptative capacity (Smit & Pilifosova, 2001). As such, given the impacts, the more community can adapt to the impacts is the less community will be vulnerable. Individual household, in a vulnerable coastal community that has low financial adaptive capacity, seeks the most appropriate financial service options to increase its financial capabilities. In evaluating options, individual factors of

attitudes, social references, and demographic, including other external factors, such as the level of climate risks and the conditions of financial service options influence household's evaluation processes. Microfinance is one of options, in addition to responding household's financial requirements, that can create financial self-services cooperative among members/ households in a community. Microfinance is considered as a planned adaptation due to it is concerned with financial planning for future. The microfinance should be designed and implemented considering localization (fits for community requirements), creation of fairness, and being self-continuity (Churchill, Hirschland, and Painter, 2002). Successful microfinance creates repeating or continuing participations of members, which can enhance financial adaptive capacity of community through the mechanisms of saving and credit. On the contrary, unsuccessful one may cause individual's negative attitude toward microfinance and results to lower financial cooperative and adaptive capacity in community.

6.3 Results and Discussions

6.3.1 Analysis of factors affecting microfinance participation

Factors relevant to 'perceive of risks to sea level rise impacts', 'attitudes toward microfinance', 'social influences', 'facilitating conditions of microfinance', and 'government supports to microfinance' were hypothesized that they affected intention to participate of respondents to microfinance for sea level rise impacts. Eleven subjects/ items then were designed for testing those factors. Prior statistical tests (details shown in section 6.3.3), respondents were firstly asked about their opinions on such items between 'disagree' and 'agree' by providing score in likert scaling 0-6. Some examples required respondent's view were item R1.2 'Does respondent agree that sea level rise impacts induce more health risks', and item A2.1 'Does respondent agree that spouse influence his/ her intention to participate with microfinance for sea level rise impacts'. Results of opinion survey of four hundred households and details of hypothesized factors including items are shown in Table 6.1

Table6.1: Average scores of risk perceptions, attitudes, and other factors affecting the participation of ‘microfinance for sea level rise impacts’ of four hundred respondents from all studied villages

Hypothesized factors[1]			Average score: *Fully disagree* (0) … *Fully agree* (6)
Risks factor	R1: 'Perceive of risks' from the impacts of sea level rise are the protective motivation	R1.1	
		R1.2	
		R1.3	
Microfinance participation affecting factors	A1: 'Attitudes' toward microfinance are predictor of intention to participate	A1.1	
		A1.2	
		A1.3	
	A2: 'Social influences' are predictor of intention to participate	A2.1	
		A2.2	
	A3: ‘Facilitating conditions’ are predictor of intention to participate	A3.1	
		A3.2	
	A4: ‘Government supports’ are predictor of intention to participate	A4.1	

(1) R1.1 House and farmland are currently at risks from various impacts of sea level rise e.g. coastal erosion, inundation, and salt water intrusion.

R1.2 Sea level rise impacts result to more health risks e.g. water borne disease.

R1.3 Family financial status has been deteriorated due to the increasing of required costs to adapt to sea level rise impacts.

A1.1 Microfinance can promote cooperatives of social and economic development in a community

A1.2: Having good experiences from using other microfinance services

A1.3: Microfinance can be applied as a financial adaptive measure for sea level rise

A2.1 Family members (spouse) influence intention to participate with ‘microfinance for sea level rise impacts’.

A2.2 Neighbors influence intention to participate with ‘microfinance for sea level rise impacts’.

A3.1 Services quality and related facilitations of microfinance influence intention to participate with ‘microfinance for sea level rise impacts’.

A3.2 Membership benefits including terms and conditions of microfinance influence intention to participate with ‘microfinance for sea level rise impacts’.

A4.1 Government supports are necessary and influence intention to participate with ‘microfinance for sea level rise impacts’.

The analysis of respondent's view on factors affecting microfinance participation was not done for individual village, but whole studied villages. This was due to, for opinion survey, the study aimed to see broad view of sampled units. Results indicated that respondents agreed with most of items, with average scores above 3, that they might affect respondent's intention to participate with microfinance for sea level rise impacts. For examples, they agreed that neighbors influenced their intention to participate (item A2.2), and services quality of microfinance influenced their intention to participate (item A3.1). However, there were two items (average scores less than 3) that respondents disagreed. They thought sea level rise impacts were irrelevant with their health risks (item R1.2). It was assumed that they had less awareness of impacts of sea level rise, as in fact it could induce more waterborne disease (Charron et al., 2004; Craig, 2010). In addition, they slightly disagreed that they had good experiences with using other microfinance services (item A1.2). Despite such disappointed experiences, they yet had good attitudes toward microfinance as they agreed that microfinance could promote cooperatives of social and economic development in a community (item A1.1). Further investigation 'what key conditions make respondents unsatisfied' will be very useful to promote microfinance market including for successful implementation of microfinance for sea level rise impacts.

6.3.2 Analysis of acceptance of microfinance for sea level rise impacts

Acceptance of microfinance for sea level rise impacts was examined from respondent's attitudes toward microfinance. It could suggest whether microfinance was applicable as (financial) adaptive measure for sea level rise impacts. For attitudes, three items were identified. Those included: 1) microfinance can promote social cooperatives and economic development in a community; 2) obtaining good experiences from using other microfinances; and 3) microfinance can be applied for adaptation to sea level rise impacts. In analyzing acceptance, only attitude factor was selected among hypothesized factors affecting microfinance participation. This is because attitude leads to behavior toward subject being considered, following the theory of reasoned action (Ajzen & Fishbein, 1975, Fishbein & Ajzen, 1980; cited in French et al., 2005). How respondents currently felt about microfinance would

indicate their potential acceptance or rejection of microfinance if it was applied for adaptation to sea level rise impacts. The other factors affecting microfinance participation, which included risk perceptions, social references, facilitating conditions, and government supports, were not considered for analyzing acceptance as they were motives for microfinance participation.

Generally, for any new things to be implemented, it needs to know whether parties concerned will accept. In other words, to ensure the successful implementation of those things, acceptance ratio obtained from parties minimally should be by half. To obtain the acceptance ratio, the study applied below equation 6.1 of Sahu and Gupta (2007). Summation of scores respondents assigned to was divided by summation of maximum possible values of attitudes factor. The results of ratio calculation are shown in Table 6.2.

Table6.2: Ratio of acceptance to 'microfinance for sea level rise impacts', measured from attitudes, of respondents from studied villages

Tambons	Villages	No. of respondents	Acceptance ratios[1]: Attitudes (A1.1 - A1.3) toward microfinance[2]			All Attitudes
			A1.1	A1.2	A1.3	
Phan Thai Norasing	Sahakon	67	0.72	0.39	0.72	0.61
	Sandap	67	0.58	0.33	0.67	0.53
Laem Fapha	Khun Samut Chin	65	0.65	0.46	0.71	0.60
	Khlong Suan	67	0.49	0.29	0.42	0.40
Khlong Dan	Si Long	67	0.61	0.54	0.67	0.61
	Khlong Nang Hong	67	0.60	0.38	0.71	0.56
All villages		400	0.61	0.40	0.65	0.55

(1) Summation of value respondents assigned to, divided by summation of maximum possible values of attitudes factor

(2) A1.1: Microfinance can promote cooperatives of social and economic development in a community

A1.2: Having good experiences from using other microfinance services

A1.3: Microfinance can be applied as a financial adaptive measure for sea level rise impacts

Ratio of acceptance (equation 6.1):

$$Ratio\ of\ Acceptance(V) = \frac{\sum_{i=1}^{N}\left(\sum_{j=1}^{S_V} R_j^i\right)}{N * M * S_V}$$

V = Variable

S_V = Number of Sub-variables of Variable V

M = Maximum Rating

R^i_j = Actual Rating for the j^{th} Sub-variable of the i^{th} Response

N = Maximum Number of Responses

Interviewing four hundred respondents of all studied villages regarding their attitudes toward microfinance, they accepted that microfinance could promote social cooperatives and economic development, including could be applied for adaptation to sea level rise impacts with average acceptance ratios of 0.61 and 0.65 respectively. However, they did not accept that they had good experiences from using other microfinances with average ratio of acceptance at 0.40. Combining those three attitudes, the average acceptance ratio was 0.55. This could be interpreted that applying microfinance as adaptive measure for sea level rise impacts was acceptable in view of respondents.

Analyzing by individual studied village, the result of acceptance ratios to measured attitudes were same direction. Respondents of most villages, except that of Khlong Suan, accepted that microfinance was useful and could be applied for adaptation to sea level rise impacts. However, they had no good experiences with using other microfinances. This raises a point of concern, similar to analysis results of factors affecting participation (section 6.3.1). Despite respondents do not have good experiences on microfinance they yet have had good views on it. Further investigation on what factors discourage respondents in using microfinance services will be a benefit for improvement of existing microfinances including supporting the implementation of new microfinance. It was remarkably, for Khlong Suan village, that its acceptance ratios of all attitudes measured were less than 0.5. Following additional information obtained from interviewing of respondents, most microfinances had not been successfully implemented in such village due to the reasons of poor management of microfinance committee and lack of leadership in

community. This supports a claim by Zaman (2004) that vision and persistence of leaders of microfinance institution are key factors behind the success of the microfinance.

6.3.3 Analysis of intention to participate with microfinance for sea level rise impacts

A hypothetical microfinance for sea level rise impacts including its conditions was presented to respondents. Such microfinance was designed with specific aims to encourage adaptation processes in a community and to support individual household's adaptation practices. Adaptation in view of Thorne, Kantor, and Hossain (2007) is the use of processes, practices and technologies to support vulnerable people in dealing with the impacts of climate change. Respondents then were asked about their intention and purposes of participation with the microfinance. Of the four hundred respondents of all six studied villages, there were one hundred and eighty two respondents intended to participate with microfinance for sea level rise impacts, or equivalent to 46%. The purposes of participation, from most to least desires, were: a) to obtain loan benefits; b) for saving; c) expecting attractive interest rates (both loan and saving); and d) due to lack of other financial sources to provide supports for adaptation, with percentages of 39, 35, 18 and 8 respectively. The study results are shown in Table 6.3.

Analyzing by individual studied village, respondents of Sahakon and Khun Samut Chin villages mainly intended to participate. There were slightly less than half of respondents of Sandap and Khlong Nang Hong villages that intended to participate. For the respondents of remaining two villages, Khlong Suan and Si Long, it was clear that most of them had no intention to participate with microfinance for sea level rise impacts. Similar to analysis result of acceptance ratio, percentage of intention to participate of Khlong Suan village was lowest, at 25%, among other studied villages. It needed to differentiate the analysis of acceptance and analysis of intention to participate. In this study, acceptance was examined at preliminary stage, via respondent's state of feeling, for the possibility of applying microfinance as an adaptive measure to sea level rise impacts. Intention to participate was measured after presenting the designed hypothetical microfinance to respondents. Intention to

participate is aimed for testing market of new product and can be affected by individual factors, social factors, and respondent's prior knowledge (Wang, Dacko and Gad, 2008) during respondent's evaluation processes (see Fig. 6.1: Conceptual framework).

Table6.3: Percentage of intention to participate to 'microfinance for sea level rise impacts', and purposes of participation, of respondents from studied villages

Tambons	Villages	No. of respondents intend to participate	No. of respondents not intend to participate	Percentage of intention to participate	Percentage of purposes to participate(1)			
					1	2	3	4
Phan Thai Norasing	Sahakon	47	20	70%	33%	38%	19%	10%
	Sandap	33	34	49%	27%	38%	27%	8%
Laem Fapha	Khun Samut Chin	35	30	54%	37%	45%	13%	4%
	Khlong Suan	17	50	25%	33%	39%	19%	8%
Khlong Dan	Si Long	18	49	27%	40%	40%	10%	10%
	Khlong Nang Hong	32	35	48%	44%	33%	14%	9%
All villages		182	218	46%	35%	39%	18%	8%

(1) The following purposes of microfinance participation are limited to adaptation for sea level rise impacts.

1- for saving

2- to obtain loan benefits

3- possible attractive interest rates (both saving and loan)

4- no other financial sources to provide financial supports for adaptation

Factors of risks perceptions to impacts of sea level rise, attitudes toward microfinance, social references, microfinance facilitating conditions, and government supports were hypothesized that they could affect respondent's intention to participate with microfinance for sea level rise impacts. Those factors were split into eleven items. Details of factors and items can be seen in Table 6.1. Testing of such hypothesized items was not analyzed for individual village, but as a whole for all six studied villages. This was due to the homogeneity of most respondents that had same occupations, cultures and live in similar environments. Pearson correlation was used to examine the correlations between intention to participate and those affecting items.

Considering four hundred respondents of all villages, with significant 2-tails at 0.05, it was found that respondent's intention to participate was correlated with most of items, except item A1.2 'having good experiences from using other microfinances'. Details of correlation analysis are shown in Appendix J (a). Stepwise regression analysis then was used to determine requisite items that best predicted intention to participate. Stepwise regression is a method for selection large numbers of potential independent variables in order to fine-tuning model predicting dependent variable in multivariate statistical analysis (Maitra and Yan, 2008). It was found that a model containing items A 3.1, A1.3, and R1.1 (ordering from highest correlation) best predict respondent's intention to participate with microfinance for sea level rise impacts (see model results in Appendix J (b)). The items A 3.1, A1.3, and R1.1 were respectively 'services quality and facilitations of microfinance', 'microfinance can be applied for adaptation to sea level rise impacts', and 'house and farmland are at risks from impacts of sea level rise'. Diaphragm of model is presented in the following Fig. 6.2.

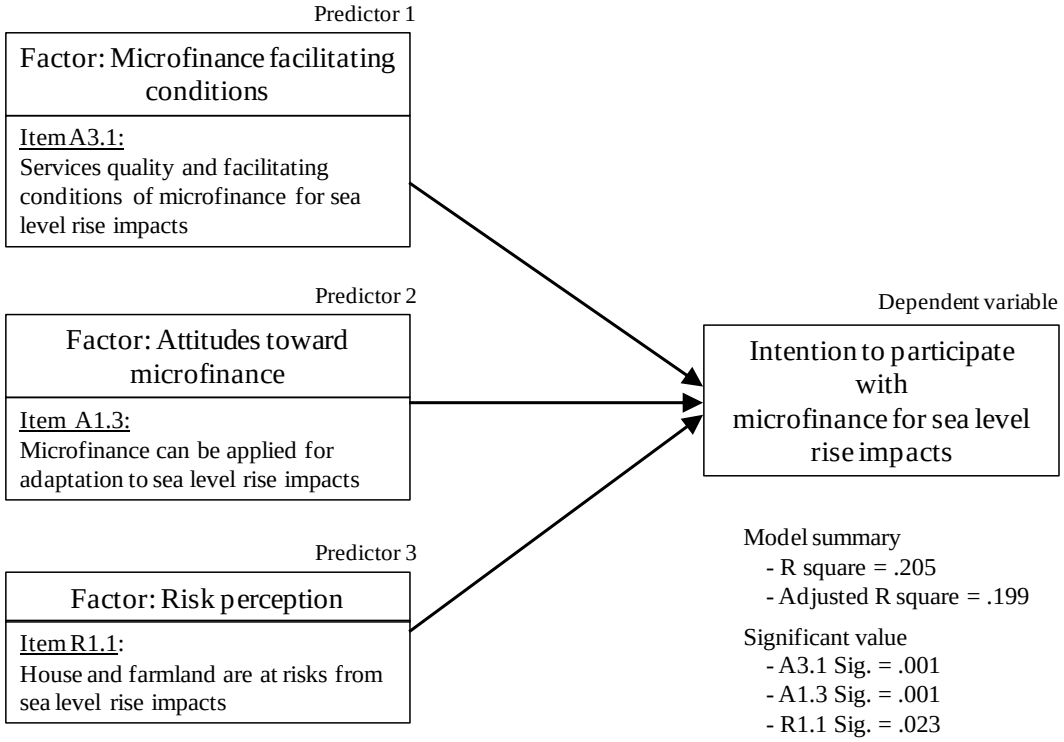

Figure6. 2: Stepwise regression model for prediction of intention to participate with microfinance for sea level rise impacts

The predictor items A3.1, A1.3, and R1.1 were components of separate hypothesized factors of microfinance facilitating conditions, attitudes toward microfinance, and risk perception. There were queries whether others items that were under same factor as, and had high correlation with, predictor items could contribute for more fitness of model. Examples of those other items were: a) item A3.2 'membership benefits and conditions of microfinance influence intention to participate' was highly correlated with item A3.1 at 0.860; and b) item R1.3 'family financial status is deteriorated due to required adaptation costs' was highly correlated with item R1.1 at 0.709. Those others items were additionally entered into the model initially obtained from stepwise regression analysis. New model then was rerun for regression analysis. The results of reanalysis were that R-square of new model was improved (higher than .205 of stepwise model), but the adjusted R-square was reduced (less than .199 of stepwise model). According to Hutcheson (2011) and Gamage et al. (2007), R-square always is increased when new variable added to model. However, adjusted R-square may be reduced indicating that the new variable provide less fitness to the model. This proves that, considering all items and factors affecting microfinance participation, combination of items A3.1, A1.3, and R1.1 are best predictors for the model of intention to participate with microfinance for sea level rise impacts for respondents of all studied villages.

The value of model adjusted R-square at .199 was analyzed. Pursuant to Simpson et al. (2004), the low value of adjusted R-square might be suggestive that there was little relationship of the independent variables to the dependent variable. In other word, the model fitness was poor. This might be due to incorrect form of independent variables e.g. outliers, or errors of independent variables were not normally distributed. However, in view of Macdonell (2010), human behavior differed from physical system. In predicting human behavior, adjusted R-square between .200 - .250 was normal; reaching .400 was considered excellent. Chong and Jun (2005) also suggested that considering only good fitness of a model via high value of adjusted R-square might not guarantee good performance of independent variables selection.

The study also examined the effect of respondent's demographic factors on intention to participate with microfinance for sea level rise impacts. Similarly,

Pearson correlation and stepwise regression analysis were applied on data obtained from four hundred respondents of all six studied villages. Analysis results are shown in Appendix K (a) and (b). It can be concluded that demographic factors are not good predictors for intention to participate with microfinance for sea level rise impacts.

6.3.4 Analysis of willingness to save to microfinance for sea level rise impacts

Continuing after the designed hypothetical microfinance for sea level rise impacts was presented, respondents that had confirmed their intention to participate were further asked for amounts they were willing to save to such microfinance. To obtain respondent's bid amount, an elicitation 'Two-way Payment Ladder (TWPL)' method was used. This method is suitable to detect amount payer willing to pay to unfamiliar goods assuming occurred in hypothetical market (Jones-Lee et al., 1995; Hanley et al., 2009: cited in Mahieua, Rierab, & Giergicznyc, 2010). Sequence of amounts starting from low to high (200, 300,… Thai Baht) were presented to respondents for their confirmation of willingness to save for and stopped when respondents expressed their uncertainty to pay. The highest amount prior uncertainty was respondent's maximum willingness to save amount. Contrary, sequence of amounts starting from high to low (2,000, 1,900,… Thai Baht) were presented to respondents for their confirmation of non-willingness to save for and stopped when respondents expressed their uncertainty to not pay. The lowest amount prior uncertainty was respondent's minimum non-willingness to save amount. With this, a range of amounts that respondents definitely pay, uncertainty to pay, and definitely reject to pay were generated. The study results of respondent's willingness to save to microfinance for sea level rise impacts are shown in Table 6.4.

Table6.4: Average amounts of 'maximum willingness to save' and 'minimum non-willingness to save', including their upper and lower limits at 95% confident level, to 'microfinance for sea level rise impacts' of respondents from studied villages

Tambons	Villages	Mean of maximum willingness to save amount (Baht/ month)			Mean of minimum non-willingness to save amount (Baht/ month)			Standard deviation		n
		Upper 95%	Max WTS	Lower 95%	Upper 95%	Min Non-WTS	Lower 95%	Max WTS	Min Non-WTS	
Phan Thai Norasing	Sahakon	693	553	413	1,086	902	719	491	642	47
	Sandap	632	518	404	945	791	637	334	452	33
Laem Fapha	Khun Samut Chin	391	327	263	683	606	529	193	233	35
	Khlong Suan	507	397	287	869	741	613	231	269	17
Khlong Dan	Si Long	595	478	361	959	811	663	253	320	18
	KNH	607	484	361	922	781	641	355	405	32
All villages		521	469	417	845	780	714	356	453	182

Considering all six studied villages, respondents that intended to participate (one hundred and eighty two respondents) were averagely willing to save at 469 Baht per month as maximum amount, and not willing to save at 780 Baht per month as minimum amount. Analyzing between villages, the results of respondent's willingness to save and non-willingness to save were comparative. Respondents in a village that provided lower (higher) maximum willingness to save amount also provided lower (higher) minimum non-willingness to save amount, comparing with other villages. Averagely respondents who resided in villages of Tambon Laem Fapha (Khun Samut Chin and Khlong Suan villages) were (not) willing to save for amounts lower than that of Tambon Phan Thai Norasing (Sahakon and Sandap villages) and Tambon Khlong Dan (Si Long and Khlong Nang Hong villages). Particularly, respondents in Khun Samut Chin provided the lowest amounts. One assumption of amounts difference was because of limitation of per capita income. According to Community Development Department (2009), per capita income of Tambon Laem Fapha is 49,847 Baht, whereas per capita income of Tambon Phan Thai Norasing and Khlong Dan are 53,756 Baht and 53,669 Baht respectively. The two-sample t statistic tests also were performed to test the differences of means of amount (not) willing to save: a) between villages in same studied Tambons; and b)

between Khun Samut Chin/ Khlong Suan village in Tambon Laem Fapha and villages in other studied Tambons (see results in Appendix L (a) and (b)). It was found that there were no differences of means between villages in same studied Tambons. Comparing mean of Khun Samut Chin/ Khlong Suan village with other village's means, only Khun Samut Chin's one differed from others.

Applying the interval with 95% level of confidence to the average maximum willingness to save amount of 469 Baht per month, if respondents continually contributed their saving to microfinance for sea level rise impacts, they could save annually between 5,004 Baht and 6,252 Baht (417 - 521 Baht, shown in Table 4, multiplied by 12 months). An analysis further is required whether such saving amounts to including associated returns of interest from microfinance are sufficient for respondent's required adaptation costs to sea level rise impacts. If they are not; well designed financing scheme (loan) from microfinance, external subsidization, and more saving from respondents, either or altogether of those should support respondents to meet their adaptation cost requirements. Also, the gap between maximum willingness to save amount (469 Baht) and minimum non-willingness to save amount (780) was noted. This gap, indicating respondent's uncertainty, is potential that saving amounts can be increased if respondent's willingness to save to microfinance is increased. To encourage respondents to save more or to increase respondent's willingness to save, it is subject to various conditions. Examples of those conditions include but not limit to respondent's satisfaction due to the successful implementation of microfinance for sea level rise impacts, more attractive of terms and conditions of microfinance, more respondent's positive attitude toward microfinance, and increasing of respondent's income. Accordingly, Pearson correlation and stepwise regression analysis were used to find relationships between (non-) willingness to save amounts of respondents and factors affecting microfinance participation, demographic factors, including respondent's past and future required adaptation costs. The analysis results are shown in Appendix M (a) - (f). With significant 2-tails at 0.05, there were no statistical relationships found. One of assumptions was because of using payment ladder method determining ranges of (non-) willingness to save amounts, instead of asking for definite amounts, results to high variation of means of dependent variables. Relationships of dependent

variables ((non-) willingness to save amounts) and those testing factors (independent variables) thus could not be found. Another assumption was that microfinance for sea level rise impacts was an initiative and yet hypothetical, respondents plainly stated their (non-) willingness to save amounts at this stage just to have right of participation without particular desires. Therefore, (non-) willingness to save amounts were not correlated with tested factors. However, by all means, the study provides ranges of potential saving amounts to microfinance for sea level rise impacts if it is implemented. Such information is useful for any microfinance implementers e.g. government agents, and community leaders.

6.3.5 Others relevant information

One hundred and eighty two respondents intending to participate with microfinance for sea level rise impacts were further asked whether they would require government to support such microfinance. Most of them confirmed the requirement of government supports. The required types of government supporting to microfinance are shown in Table 6.5 and ranked from most to least desires as: 1) direct financial subsidization; 2) providing governance or management supports; 3) providing free micro-insurances. In addition, those respondents mainly said they would remain their willingness to save amounts to microfinance regardless of government supports.

Table6.5: Requirements of government supports from respondents intending to participate with microfinance for sea level rise impacts

No. of respondents not require government supports	Requirement of government supports			
	No. of respondents require government supports	Percentage of required government supporting types		
		Financial subsidization	Management supports	Provide micro-insurance.
18	164	44%	38%	18%

To respondents (two hundreds and eighteen respondents) who had no intention to participate with microfinance for sea level rise impacts, there was a query raised how they would manage their financial for future adaptation cost requirements.

With reference to their answers (see Table 6.6), there was approximate seventy percent of them preferred to save money by their own. The others, remaining thirty percent of them, would seek financing/ loans from formal institutions or informal sources (private) to support their adaptations.

Table6. 6: Percentage of financial sources that respondents not intend to participate with microfinance planned to use for household adaptations to sea level rise impacts

Own saving	Formal loan	Informal (private) loan
71%	16%	13%

6.4 Conclusions and Recommendations

The study examined two hypotheses: 1) microfinance can (cannot) be applied as an adaptive measure to the impacts of sea level rise; 2) whether or not the factors of risk perceptions, attitudes, social references, microfinance conditions, and demographic influence an individual household's participation and willingness to save to a designed microfinance for sea level rise impacts. With the result of acceptance ratios measured from respondent's attitudes toward microfinance, most of respondents accepted for applying microfinance for adaptation to sea level rise impacts. This was due to they had more good views that microfinance could promote cooperatives of social and economic development including be a financial tool to support adaptations, even though they did not dissatisfied by using services of other microfinances. Regarding factors affecting microfinance participation, of the tested eleven items by statistical analysis tools, three items influenced respondent's intention to participate, but none of items did to their (non-) willingness to save amounts with microfinance for sea level rise impacts. Those three items included: 1) services quality and facilitating conditions of microfinance; 2) attitude that microfinance can be applied for adaptation; and 3) perceive of risk that house and farmland are impacted by sea level rise. For the analysis of respondent's demographic factors, the results showed that there were no significant correlations between those factors and respondent's intention to participate including (non-) willingness to save amounts.

In addition, the study provided a range of willingness to save amounts to microfinance for sea level rise impacts, which were obtained from respondents intending to participate with such microfinance. Those saving amounts were approximate ten percent of respondent's per capita income.

There are few observations from the study merit attention. In a particular studied village (Khlong Suan), where weaken role of community leadership is noticed, respondent's acceptance ratio including percentage of intention to participate with microfinance for sea level rise impacts are lowest among other studied villages. This raises a required further analysis whether lacking of leadership will be one of obstacles for the implementation of microfinance for sea level rise impacts. According to Zaman (2004), leadership generally is one of necessity/ successful factors for microfinance. Another observation is that respondent's (non-) willingness to save amounts to microfinance generally are related with personal values, attitudes, and financial constraints. By some means, such amounts should have been correlated with any of tested factors in this study, especially demographic. Assumptions that correlations are not found include: a) using two-way payment ladder method generating range of (non-) willingness to save amounts results to high variation of dependent variable; and b) microfinance for sea level rise impacts is yet hypothetical that respondents state (non-) willingness to save amounts just to reserve right of participation without particular requirements. Definite single willingness to save amount re-asking from respondents or survey of saving amounts after microfinance implemented may yield correlations found between asked amounts and tested factors. A model for prediction of saving to microfinance for sea level rise impacts then can be developed.

In conclusion, microfinance can be applied as a (financial) adaptive measure to the impacts of sea level rise. The likelihood of successful implementation of microfinance to support adaptations will be increased, if those correlated affecting participation factors are properly addressed by implementer. However, how well microfinance can be an effective mean for adaptation is depended on its performances and how it strengthens and stabilizes individual financial adaptive capacity. According to Zeller, Lapenu, and Greely (2003), performances of microfinance compose of: 1) outreach to client; 2) services adjusted to target clients; 3) building up

client's social responsibilities; and 4) strengthen social and political of community. Sustainability and continuity also are necessity for performances of microfinance (Churchill, Hirschland & Painter, 2002). Particular for the effectiveness of microfinance in view of financial adaptive capacity, it needs further analysis whether the financial services obtained from microfinance for sea level rise impacts are sufficient to adaptation cost requirements. If they are, given the constant impacts of sea level rise, vulnerability of a community will be healed.

CHAPTER VII
ANALYSIS APPROPRIATENESS AND EFFECTIVENSS OF MICROFINANCE FOR SEA LEVEL RISE IMPCTS

7.1 Overview

In this chapter the appropriateness and effectiveness of microfinance as an adaptive measure to sea level rise impacts were analyzed. Due to microfinance for sea level rise impacts is yet hypothetical, all mentioned aspects cannot be analyzed from actual market. Therefore, the appropriateness was reviewed via relevant literatures, and the effectiveness was examined using primary data obtained from households of studied sites. In addition, the implementability of such microfinance was discussed. The appropriateness and implementability were discussed in general considering: application of microfinance for adaptation to climate change impacts; microfinance market environment and government policies toward microfinance in Thailand; including degree of adaptation currently available in Thailand. The analysis of effectiveness was scoped at studied sites and mainly analyzed on financial using study results from previous Chapters 5 and 6. How those aspects are discussed/ analyzed are preliminary summarized herebelow.

- Implementability: The analysis cover how microfinance market and the uses of microfinance are; how degree of adaptation to climate change in Thailand is; measuring implementability of microfinance for adaptation to sea level rise impacts; how to ensure the successful implementation of microfinance for sea level rise impacts; what the roles of Thai government and other stakeholders should be to support the sustainability of such microfinance; and what pros and cons of regulating and non-regulating microfinance for sea level rise impacts are.
- Appropriateness: The analysis cover whether microfinance can be tool to support adaptation; uses of microfinance for adaptation to climate change in developing world and extending it to sea level rise impacts in Thailand;

additional benefit of microfinance as a channel for government subsidization and global adaptation funds to real vulnerable parties; what constraints to access adaptation funds are and what the proper approaches are to overcome for Thailand; and appropriateness of microfinance for adaptation to sea level rise impacts in view of performances, which include fits to community requirements, deep outreach, and strengthen cooperation, social and political of community.

- Effectiveness: The analysis cover whether hypothetical microfinance for sea level rise impacts can strengthen financial adaptive capacity of studied sites; whether loan services of such microfinance are financially sufficient for adaptation cost requirements of studied sites; discuss on proper patterns/ combinations of saving, loan distribution and subsidization to sustain microfinance with operating self-sufficiency; and how to manage and what measurements are for financial performances of microfinance for sea level rise impacts.

7.2 Methodologies

The methodologies used in this chapter are separated from research methodologies in Chapter 3. This is because it mainly focuses on financial analysis. Such methodologies are described as follows:

7.2.1 Literature review for implementability and appropriateness

Relevant literatures were reviewed for the discussion of implementability and appropriateness of microfinance for sea level rise impacts.

7.2.2 Financial analysis for effectiveness

To analysis effectiveness of microfinance for sea level rise impacts, financial models were used to develop possible scenarios of microfinance fund and loan distribution whether they would be enough to adaptation cost requirements (study results from Chapter 5). The following assumed conditions were used in the

analysis.

- Operation period of microfinance for analysis was 30 years.
- Number of microfinance members was 182 (equal to number of households intended to participate to microfinance for sea level rise impacts, a study result from Chapter 6).
- Saving to microfinance was constant at the amount of 469 Baht per month (average maximum willingness to save amount, a study result from Chapter 6).
- There were 3 choices of government subsidization, 0%, 10%, or 25% of member's saving amount.
- Loan interest rate was fixed at 5% per year.
- Earning of microfinance was from loan interest payment only. No dividend payout. All earnings were accumulated to fund and redistributed as loan to members.
- During microfinance was being operated, members could get money from microfinance via loan services only. Net balance of fund (after deduction of outstanding loan), if any remained, would be equally returned to members at the end of year 30th.
- A member generally would require loan 3 times throughout 30 years for investing physical adaptive measure. Required loan amounts were equal to costs of adaptive measure (capital expenditure items), study results from Chapter 5: 80,714 Baht during year 1-10; 108,473 Baht during year 11-20; and 145,779 Baht during year 21-30.
- Loan installment was fixed at 986 Baht per month per member (average amount members can pay, information obtained from interviewed households of all studied sites).
- A household would require averagely 8.50 years to repayment an outstanding loan. The figure was derived from the calculation of determined loan amounts, installment amount, and loan interest rate.
- Microfinance fund was the summation of saving amounts from members, government subsidizations and earnings. Its current balance was depended on allowable account receivable or amount of

outstanding loan. High amount of loan (account receivable) would result to less balance of fund.

From the assumed conditions, the simplified diagram of sources of microfinance fund and allowable fund to loan (account receivable) is drawn in the following Figure 7.1.

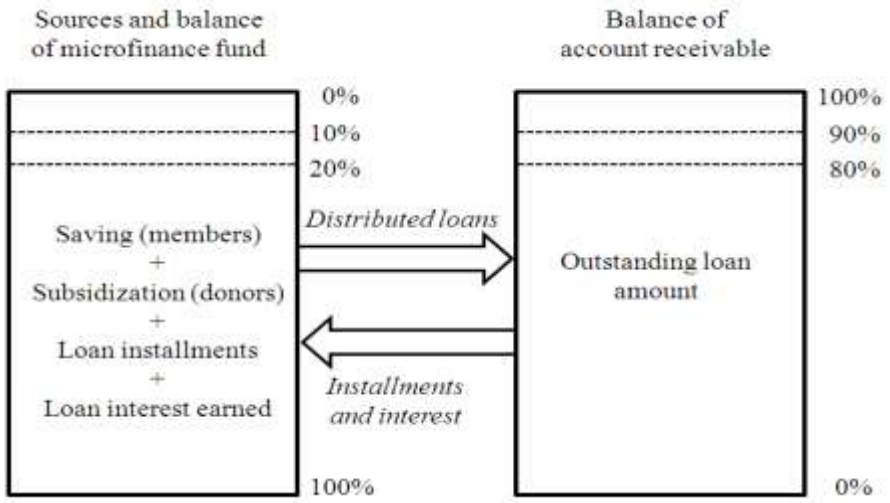

Figure7.1: Simplified diagram of sources of microfinance fund, allowable fund to loan, and balance of fund and account receivable (example: allowable fund to loan 90% means balances of fund and account receivable are 10% and 90% respectively).

a) As microfinance fund comprising of member saving and government subsidization, it needed to identify their combinations that could provide first loan to cover adaptation costs required of all 182 members within the 8.50 years. The 8.50 years was considered as initial operational period of microfinance (time required that a member fully repayment an outstanding loan), prior second loan would be requested by any member. Accordingly, nine options considering combinations of allowable account receivable to total asset ratios (0.8, 0.9, or 1.0) and percentage of government subsidization (0%, 10%, or 25%) were investigated by using financial model in Appendix N to identify which one of them could provide first loan conforming to such requirements. For reference, the account receivable to total asset ratio is interchangeable called as size of account receivable.

b) After initial operational period of microfinance or first loan was fully repayment by any member, loan service of microfinance was assumed to be revolving. Four scenarios of saving and loan distribution patterns then were

developed for those qualified options from 7.2.2 (a), using financial models in Appendix N, to differentiate: 1) number of times revolving loans provided for investing physical adaptive measure; and 2) balance of fund for 30 years operation of microfinance. Those four scenarios were as follows:

- Scenario 1: Members continue constant saving and pay loan installment for 30 years. Microfinance provides loan services with un-limited numbers of revolving loan.
- Scenario 2: Members continue constant saving for 10 years and pay loan installment for 30 years. Microfinance provides loan services with un-limited numbers of revolving loan.
- Scenario 3: Members continue constant saving and pay loan installment for 30 years. Microfinance provides loan services but with limited numbers of revolving loan at 182 (number of microfinance members) at a time.
- Scenario 4: Members continue constant saving for 10 years and pay loan installment for 30 years. Microfinance provides loan services but with limited numbers of revolving loan at 182 (number of microfinance members) at a time.

The purposes of methodology 7.2.2 are to investigate the proper combinations of size of account receivable, government subsidization, and patterns of saving and loan distribution that make microfinance for sea level rise impacts sustainably, and its services are sufficient to adaptation cost requirements.

7.3 Results and Discussions

7.3.1 Discussion of 'implementability' of microfinance for sea level rise impacts

Implementability were discussed in views of the possibility of applying microfinance for adaptation to sea level rise impacts, recommended form of microfinance for implementation, and required supporting parties to ensure successful

implementation. Regulating or non-regulating microfinance for sea level rise impacts providing with advantages and disadvantage, and schemes of such microfinance to incorporate community capacity-building also were examined in the context of implementability.

Development of microfinance in Thailand has long history. Its beginning was started in 1916 (Agricultural and cooperative committee, 2011). Today, there are over 10,000 microfinance institutions in Thailand and one third of them are not regulated by government (Arparkorn, R. et al., 2011). Those non-regulated are saving groups which are established by own community in various communities throughout Thailand. Microfinance in Thailand, in addition to carry out primary objective of microfinance: poverty alleviation (Epstein & Crane, 2005), are designed and used for a variety of specific purposes. Examples of purpose include for agricultural, land settlement, fishery and public transport (Cooperatives Promotion Department, 2007). Applying microfinance or extending its scope to provide financial services for another purpose of adaptations to sea level rise impacts is therefore possible. In addition, it was reconfirmed by factors analysis following study result of Chapter 4 (section 4.2.1), where the implementability of saving cooperative and extending services of existing microfinances for such adaptation purpose were scored above half and respectively 6.83 and 5.83 of maximum 10 . A use of microfinance for mitigating similar impacts in Thailand, recovery of natural disasters from tsunami in 2004, was also recorded *(*Pornprapa, Masahiro, Phattareeya and Wantana, 2007). However such use was reactive to the impacts. Microfinance for sea level rise impacts, in contrary, is designed for proactive approach. The proactive adaptation is necessity and should be more encouraged for those Thailand local communities (Panyakul, 2011).

Implementing of microfinance for sea level rise impacts for a coastal community can be initiated, as saving group at introductory stage, by self-help of community's members. There should be no much concern as many communities in Thailand are familiarized with microfinance operations either in forms of saving group, village fund, or saving cooperative. The difference of those forms are that first one is operated by sole self cooperative of member in a community, whereas the latter two are administrated by government agencies (Arparkorn, R. et al., 2011).

However, as microfinance for sea level rise impacts is rather an inventive, it requires some guidance from parties who know well managing microfinance and adaptations in the context of climate change. Such parties shall provide knowledge, microfinance framework and relevant policies, including monitor operations and performances of microfinance. This is to ensure that the implemented microfinance will be sustained and serve adaptation to sea level rise impacts. Unluckily, there are no parties who have expertise altogether for both items. Main organizations in Thailand that directly deal with climate change adaptation are civil societies, government agencies, and academic and research centers (Greennet, April, 2012). Names of individual organization under each group are shown in Appendix O. None of them have experiences directly with microfinance management. On the other side, according to Cooperatives Promotion Department, government organizations that are in charge of microfinance are: 1) The office of the Registrar of Cooperative Societies (ORSC); 2) The Cooperative Promotion Department (CPD); and 3) The Cooperative Auditing Department (CAD). All of them have little knowledge of adaptation. This gap needs to be filled in by knowledge sharing and dedicating organization(s) to support implementation of microfinance for sea level rise impacts.

Regulating or non-regulating by Thai government is another subject should be considered for implementation of microfinance for sea level rise impacts. There are advantages and disadvantages of them. Regulated microfinance gain better control of operations and thus develop operational and financial sustainability of microfinance, as rules and auditing are governed and provided by government (Haq, Hoque, and Pathan, 2008). It also prevents fraudulent activities, which is a common concern for independent microfinance in Thailand (Banking with the Poor Network, 2010), through increasing transparency in financial accounting and transaction reporting (Meagher 2002, Rhyne 2002; cited in (Haq, Hoque, and Pathan, 2008). In addition, regulated microfinance has right to obtain government subsidization when government funding is available. Subsidizations from either government or donors are necessary for start-up microfinance (Latifee, 2003) and development of microfinance innovations (Lapenu, 2000). However, slow processes of government are expected in regulated microfinance, which eventually will negatively result to services quality of microfinance and create difficulties to obtain

any funds from donors in addition to government subsidization. Non-regulated microfinance has opposite characteristics (advantages and disadvantages) to regulated one. Use of independent party, apex organization, supporting microfinance to balance those pro and cons of regulated and non-regulated microfinance then is recommended. Apex organization is second-tier or wholesale organizations that facilitate the disbursement of donation funds to and develop the sustainable capacity of retailing microfinance institutions (Ming-Yee, 2007). However, in Thailand, role of apex organization has not been clearly defined (Arpakorn, 2011). More details of apex organization are discussed in section 7.3.2. Lastly, from the perspective of government and donor agencies, microfinance risks lie in the capacity of the communities to manage funds effectively. Therefore, schemes of initiated microfinance for sea level rise impacts must incorporate community capacity-building and include a consultative process from control parties with the communities. The rules and regulations of the schemes should also be adjusted to suit the community.

7.3.2 Analysis 'Appropriateness' of microfinance for sea level rise impacts

At first view, the appropriateness of microfinance for sea level rise impacts was examined whether it could be an effective tool to support adaptations. In addition, how well it could be was depended on its performances, which composed of these abilities: 1) outreach to client; 2) services adjusted to target clients; 3) building up client's social responsibilities; and 4) strengthen cooperation, social and political of community (Zeller, Lapenu, and Greely, 2003). According to Malik, Qin, and Smith (2010) a particular institution that can play a major role in autonomous adaptation to climate change in the developing world is microfinance. This is because microfinance can be an effective mechanism channeling resources from local and international assisting parties to the vulnerable groups that are in great needs of adaptations but lack of resource. Assessing by Organization for Economic Co-operation and Development (2012), there are strong linkages between traditional microfinance activities and adaptation needs. Lending portfolio of microfinance focusing on disaster preparedness, irrigation facilities, insurance schemes, and construction of housing can increase the resilience to the impacts of current and future

climate change. Uses of microfinance for adaptation purposes, although are not extensive yet, are recorded or studied in many developing countries. In Nigeria, microfinance is recommended for poor farmers as it enable them to cope with financial requirements for farming to adapt to the weather (Ejiogu and Ejiogu, 2010). In India, while waiting for delayed livelihood support mechanisms for migration/ retreat, microfinance offers temporary liquidity to enable individual households to adapt in ways that suit their own situation (Copestake, 2010). In Bangladesh and Nepal, none of microfinances are particularly designed for sole adaptation, but there are 43% and 37% respectively of all microfinance programs that contribute automatically to adaptation to climate change (Agrawala and Carraro, 2010). Therefore, it is explicit that microfinance is appropriate and effective (financial) tool to support vulnerable individual to adapt to climate change impacts. Certainly, this includes its ability to support coastal households in Thailand that have been impacted from sea level rise. As microfinance is collaboration among individuals/ members of a community, well management of microfinance's performances will enhance as well adaptive capacity of community.

Adaptation funding either from multilateral and bilateral ODA (Overseas Development Assistance, developed countries provide funding to developing countries) is not sufficient and hardly to reach real vulnerable parties e.g. poor people, coastal households. Microfinance can offer an additional delivery channel for those global funds to support adaptation among those vulnerable (Agrawala and Carraro, 2010). Yet, there is a constraint for linkage between microfinance and those funds. Most developing countries, such as Asia-Pacific Nations (inclusive of Thailand), are lack of experts particular from government agencies to prepare sophisticated proposals to apply with fund managers to access existing adaptation funds (The United States Agency for International Development, 2012). There are some political independents, so called apex organizations or wholesale microfinance institutions, which are used as intermediary to deliver funds from donors and government to retailing microfinance (Navajas and Schreiner, 1998; Consultative Group to Assist the Poorest, 2002). They have potential to be developed and utilized as professional to technically assist and distribute adaptation funds to microfinance. Local apex organizations normally have necessary information of all local

microfinances that are qualified, effective and transparent. They engage in the provision of diverse services to promote the development and sustainable of microfinance (Gonzalez, 1998). Those services include, but not limit to: a) wholesaling of loan-able funds; b) disbursement of grants and subsidies on behalf of donors and government; c) screening and certification of microfinance; d) technical assistance and provision of training; and e) regulating and supervision of microfinance. In Thailand, there are some local apex organizations such as Foundation for Integrated Agricultural Management, Local Development Institution, and Rural Friends Association (Sustainable Banking for the Poor, 1995). However, from literature reviews, their roles related with global adaptation funds are not mentioned. The following Figure 7.2 is the landscape of international funding in microfinance (Goodman, 2005 adapted by Ming-Yee 2007). It shows that apex organizations are used by social responsible parties for their donor distribution. Accordingly, using apex organizations in Thailand for assisting qualified microfinance institutions to access to those adaptation funds (social and environment responsible parties) is practical with possibilities of success.

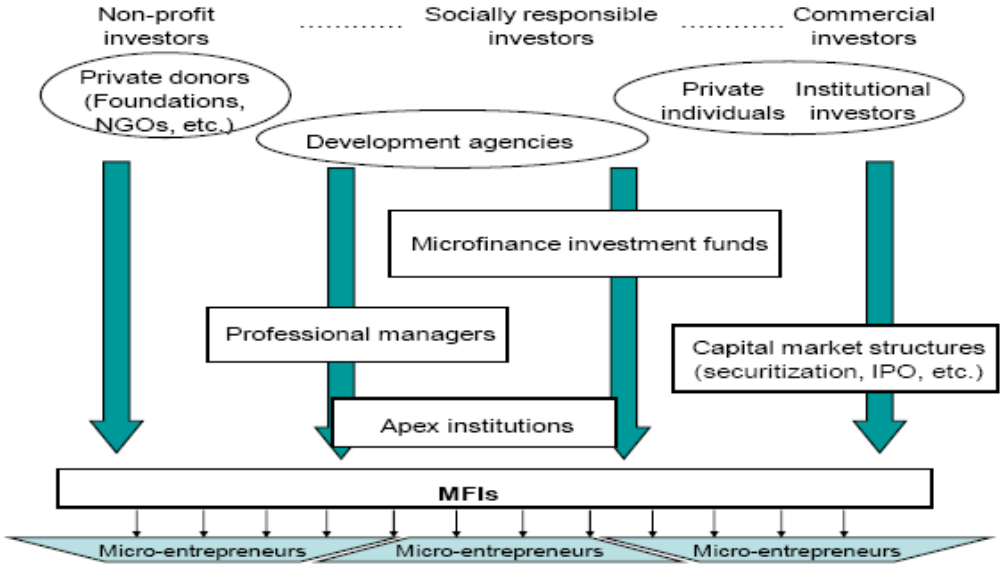

Figure7.2: The landscape of international funding in microfinance

Source: Ming-Yee 2007, adapted from Goodman, P. (2005). Microfinance investment funds: Key features. ADA – Appui au Développement Autonome, Luxembourg.

The appropriateness of microfinance to be applied for adaptation to sea level rise impacts also should be analyzed in term of its performances. However, as microfinance for sea level rise impacts is yet hypothetical, its performances are not able to be measured at this stage. How well it fits to community requirements (community-based), outreach to members, and strengthen cooperation, social and political of community are then theoretically discussed. Following Ritchie (2007) the community based microfinance generally should be designed and implemented by: a) determining the type of microfinance, services and rules suitable to local context; b) empowering members through a participatory process; c) developing effective monitoring system; and d) ensuring that appropriate technical assistance is available from external parties. By this mean, microfinance for sea level rise impacts should be designed suitably to financially support household autonomous adaptations needs, encourage adaptation processes, and be able to link with organizations working on adaptation funds and climate change. Worakul (2006) mentioned the factors contributing to the success of a community-based microfinance in Thailand are similar to Ritchie, except factor of leadership need to be added. A report of United Nations Development Programme (2010) shows that strong leadership is a key success factor of various community based organizations in Thailand.

Another criteria for judging the performance of microfinance is outreach, the degree of microfinance services reach real demand persons e.g. vulnerable or poor persons (Zeller and Meyer, 2002). To fulfill the challenge of deep outreach, it requires a shift of microfinance services from a product orientation to a market orientation (Woller, 2002). The processes of market oriented are to identify member needs and satisfy them through the design, communication, pricing, and delivery of appropriate services. Equally important is another necessity of outreach to ensure microfinance services are properly delivered to poorer segment (Basu and Srivastava, 2005). The drift of microfinance mission of fairness is a common as various pressures to serve richer clients are existed. Group lending (normally used by most microfinance) have more potential for deeper outreach than individual lenders do (Ghamfin, 2007; cited in Adjei & Arun, 2009). This is because they substitute joint liability for physical collateral. A study from Hartaska (2005; cited by Mori and Munisi, 2009) shows that microfinance management committee with a diversity of

stakeholders, members and outsiders (e.g. donor representative), achieve better results of outreach. All of mentioned required factors for outreach need to be considered and properly arranged when design and implementing of microfinance for sea level rise impacts to ensure its performances/ appropriateness. Particular for Thailand, there are evidences from studies of Coleman (2006) and Woradithee (2011) that many microfinance programs yet are not reached the poor as much as the relatively wealthy in some areas.

Last item to be discussed for the appropriateness of microfinance for adaptation is its performance/ ability to strengthen cooperation, social and political of community. Well performance of this item will eventually result to better community's adaptive capacity to climate change impacts. According to V&A Programme (2009), effective implementation of adaptation measures requires active group cooperation and community participation. Developing adaptations in collaboration with community will increase the likelihood of its successful and meaningful to individuals and community (Chapin et al. 2006, Ford et al. 2007, Wolfe et al. 2007; cited in Pearce et al. 2009). In addition, collaboration with a variety of stakeholders e.g. parties outside community is a crucial aspect of successful local adaptation to climate change (Kazmierczak, 2012). Consequently, cooperation is an essential for adaptation. On microfinance side, it provides a way to bring people together, focusing on economic activities and cooperation. Microfinance can also contribute to social and political reconciliation, as it provides a forum for a unified voice for peace, with people cooperating and working towards a shared future (Marino, 2005). It is clearly that microfinance objectives are in line with cooperative requirements for successful adaptation. Applying microfinance for adaptation to climate change e.g. sea level rise including well managing it will certainly strengthen cooperation of community to adapt to the impacts.

7.3.3 Analysis 'Effectiveness' of microfinance for sea level rise impacts

In view of financial, the effectiveness of microfinance for sea level rise impacts was analyzed on the grounds of whether its services could strengthen financial adaptive capacity of the studied sites. Given the impacts of sea level rise, if

microfinance can improve adaptive capacity of a community, such community will be less vulnerable. The analysis was straightforward by assessing loan both amounts and numbers of distribution generated from microfinance services whether they were sufficient to current and future adaptation costs required by microfinance members. Also proper patterns of saving and loan distribution including government subsidization were diagnosed in order to produce adequate loan while maintaining operating self-sufficiency of microfinance (Operating self-sufficiency indicates whether or not earning of microfinance covers well its total costs , which include operational expenses and loan loss provisions (Arunachalam, 2006)). In line with methodologies 7.2.2 and using financial model in Appendix N, results of analyzed combinations of size of account receivable and government subsidization, including patterns of saving and loan distribution are shown in the following Table 7.1 - 7.3. Discussions are inserted between Tables for the continuity of analysis.

Table7.1: Total number of loan distribution (number of members can obtain loan service) within initial operational period of microfinance for sea level rise impacts, first 8.50 years, following combinations of percentage of government subsidization and size of account receivable (AR)

Option	% Government subsidization	Size of AR (AR to total asset ratio)	Total No. loan distributed within first 8.50 years
A	0%	0.8	147
B	10%	0.8	161
C	25%	0.8	184
D	0%	0.9	168
E	10%	0.9	185
F	25%	0.9	211
G*	0%	1.0	191
H*	10%	1.0	210
I*	25%	1.0	239

* Options G, H, and I are too high risk due to their size of account receivable are equal to 1 (Total fund is allowed to loan).

Table 7.1 demonstrates nine options of combination of percentage of government subsidization to fund and size of account receivable of microfinance for sea level rise impacts. With option A, microfinance fund was assumed from member saving only without government subsidization and eighty percent of fund was distributed for loan (size of account receivable = 0.8), total number of loan distributed (number of members obtain loan) within first 8.50 years was one hundred and forty seven. For option B, government subsidization was added by 10% of member saving to fund and size of account receivable was maintained at 0.8, total number of loan distributed was one hundred and sixty one. Subsequent options can be diagnosed in similar manner. Considering all options, it was found that options C, E, F, G, H, and I could be used for starting up operations of microfinance for sea level rise impacts. This was due to those options could generate number of loan distributions more than 182, minimum number of first loan required by all microfinance members, within initial operational period of microfinance. It is to note that microfinance fund solely from member saving without government subsidization may be sufficient for member's requirements of loan on the conditions that total fund must be allowed for loan (size of account receivable = 1), following option G. However, taking option that total fund allowed for loan, during initial operational period, is a risky approach. If any non performing loan is occurred during that period, it may negatively impact to operating self-sufficiency of microfinance including reduce amount of fund to next revolving loan. This means that microfinance will not financially serve well to all of its members for their adaptation requirements to sea level rise impacts. Accordingly, in addition to option G, options H and I are improper for microfinance operations as their size of account receivable also are equal to 1.0. For reference, size of account receivable of a microfinance institution in Thailand is approximately 0.82 (Patrawat et al., 2011). Below Table 7.2 shows numbers of loan distributed each year, during first 8.50 years of microfinance operation, for the remaining proper options C, E, and F.

Table7.2: Numbers of loan distribution each year during initial operational period of microfinance for sea level rise impacts, first 8.50 years, for options C, E, and F.

Year	Option C	Option E	Option F
1	13	13	14
2	14	14	16
3	16	16	19
4	19	19	21
5	21	21	24
6	24	24	28
7	28	28	32
8	31	32	36
8.50	18	18	21
Total	184	185	211

After first loan was provided to all 182 microfinance members, loan was assumed to be revolving. Options C, E, and F then were further analyzed in four scenarios, considering change of patterns of saving (constant saving 10 years vs. constant 30 years) and loan distribution (un-limited vs. limited number of revolving loan). The purposes were to find out how each option with changes in saving and loan distribution patterns generated number of revolving loan and balance of microfinance fund throughout operational period of 30 years. Results of analyzed four scenarios are shown in the following Table 7.3 (a-d).

Table7.3 (a-d): Number of times revolving loan provided to a member and balance of microfinance fund, for options C, E, and F, for 30 years operation of microfinance for sea level rise impacts with:

(a): Scenario 1 - Members continue constant saving and pay loan installment for 30 years. Microfinance provides loan services with un-limited numbers of revolving loan.

Options	No. of times revolving loan provided to a member during 30 years	Microfinance fund, account receivable, and fund balance at end of year 30th		
		Fund	Account receivable	Fund balance
C	5.2	81,037,877	64,830,301	16,207,575
E	5.5	79,333,180	71,399,862	7,933,318
F	6.3	90,151,341	81,136,207	9,015,134

(b): Scenario 2 - Members continue constant saving for 10 years and pay loan installment for 30 years. Microfinance provides loan services with un-limited numbers of revolving loan.

Options	No. of times revolving loan provided to a member during 30 years	Microfinance fund, account receivable, and fund balance at end of year 30th		
		Fund	Account receivable	Fund balance
C	3.3	40,961,465	32,769,172	8,192,293
E	3.6	41,868,487	37,681,639	4,186,849
F	4.1	47,577,827	42,820,044	4,757,783

(c): Scenario 3 - Members continue constant saving and pay loan installment for 30 years. Microfinance provides loan services but with limited numbers of revolving loan at 182 (number of microfinance members) at a time.

Options	No. of times revolving loan provided to a member during 30 years	Microfinance fund, account receivable, and fund balance at end of year 30th		
		Fund	Account receivable	Fund balance
C	3.9	64,249,103	39,026,568	25,222,535
E	4.0	59,651,878	38,985,961	20,665,917
F	4.3	64,575,996	47,755,579	16,820,417

(d): Scenario 4 - Members continue constant saving for 10 years and pay loan installment for 30 years. Microfinance provides loan services but with limited numbers of revolving loan at 182 (number of microfinance members) at a time.

Options	No. of times revolving loan provided to a member during 30 years	Microfinance fund, account receivable, and fund balance at end of year 30th		
		Fund	Account receivable	Fund balance
C	3.0	38,641,703	39,026,568	(384,865)
E	3.1	37,117,366	38,895,961	(1,868,595)
F	3.3	38,968,596	47,755,579	(8,786,983)

Scenario 1 and 3 were assumed that microfinance members continued their saving throughout 30 years of microfinance operational period. A different was that microfinance fund was allowed to provide unlimited revolving loan in scenario 1, whereas fund in scenario 3 provided limited revolving loan at maximum 182 loans at

a time. For scenario 2 and 4, members continued their saving only for first 10 years, and fund was allowed to revolving loan with unlimited and limited respectively. Certainly, scenario 1 generated highest number of revolving loans. The provision of unlimited revolving loan allowed a member to double or even triple loan without a necessity to close his/ her previous outstanding loan (s). A member could loan averagely more than 5.5 times in 30 years, which was much more than the assumed 3 times loan required for a member's household adaptation costs requirement to sea level rise impacts. However, provision of unlimited revolving loan is risky to any lending institution, including microfinance institution, as a result of more potential of non-performing loans. Increase of non-performing loans can create liquidity shock or decrease solvency of financial institution, which finally may end its business operations (Rengasamy, 2012). Member's loan repayment capacity then must be carefully evaluated prior he/she is allowed for double or triple loans. Among other scenarios, scenario 1 generated highest fund and also highest account receivable. Of the option C, as its size of account receivable is 0.8, total fund including earnings from loan interest payments at 81,037,877 Baht was transformed to loan for amount of 71,399,862 Baht (or 80%). Its balance was remained 16,207,575 Baht. For options E and F, fund amounts of 79,333,180 and 90,151,341 Baht were allowed to loan 90%. Therefore, their fund balances were 7,933,318 and 9,015,134 Baht respectively at end of year 30th.

The way of analysis of scenario 2 is same as scenario1. However, there were difference results that fund, account receivable, and fund balance of microfinance at end of year 30th for options C, E, and F of scenario 2 were much less than those of scenario 1. This was due to saving to fund by members including government subsidization (by percentage of member's saving amount) was done for only first 10 years. Size of fund then was slightly increased by loan interest payment only for remaining 20 years of microfinance operational period. This resulted to less amount of fund to loan. Despite of that, with scenario 2, funds of all options were yet sufficient to member's household adaptation cost requirements to sea level rise impacts. Those funds could be generated 3.3 - 4.1 times of revolving loan for a member in 30 years.

For scenario 3 and 4, the numbers of revolving loan were limited by total

number of microfinance members (182) as maximum at a time. This means that, regardless of member's financial capacity, a member cannot make new loan until he/she closes a previous loan by repayment all outstanding loan amount. Among all scenarios of 1 - 4, scenario 3 is the best in views of financial stability of microfinance (ability to enhance economic processes, be continuum, and absorb losses or financial flow fluctuation (Schinasi, 2004)) and fund management, while maintaining supports to adaptation. With scenario 3, members continued their saving throughout 30 years but were limited to have one outstanding loan at a time. This resulted to high amounts of remaining fund (microfinance fund balance) at end of year 30th between 16,820,417 - 25,222,535 Baht depending on option C, E, or F. In addition, fund to loan was yet sufficient to serve 3 times of member's loan requirement for adaptation to sea level rise impacts (numbers of revolving loan generated are 3.9 - 4.3 depending on option C, E, or F). Those fund balances were high saving amounts, which would be equally allocated back to microfinance members. Members may use them for their own family's purpose, or even further adaptations e.g. partially support retreat. For the last one, scenario 4, members saved to microfinance for only 10 years and were limited to have one revolving loan at a time. With this scenario, it was found that fund to loan of all options C, E, or F were not enough for required adaptation costs. To generate 3.0 - 3.3 times of revolving loan provided to a member, during 30 years of microfinance operations, required total loan amounts (account receivable amounts) for all members were 38,895,961 - 47,755,579 Baht, depending on options. External funding was additional needed, as member saving solely could raise fund between 37,117,366 - 38,968,596 Baht.

Thoroughly analyzing those scenarios, in overview, it can be concluded that microfinance is able to strengthen financial adaptive capacity of its member to the impacts of sea level rise. However, the conditions of member's saving amount, size of account receivable, government subsidization, and patterns of saving and loan distribution including their combinations must be properly designed. Without subsidization or grant, microfinance fund from sole member's saving (at the average maximum willingness to save amount) is capable to support adaptations on the condition that total fund must be allowed for loan, or size of account receivable is equal to 1. This approach is not recommended as it is too risky. Business risk is

normally measured by ratio ‘accounts receivable to total assets (fund) (Firth, 1997, cited in Velde and Beelde, 2009). The higher ratio is higher risk. Accordingly, subsidization or start-up funding is preferable to ensure the continuation of microfinance particular during initial operational period (Mallick, 2002). Another justification of subsidization is that households (microfinance members) should receive external supports because they are real vulnerable parties from impacts that they do not create. However, subsidization or grant is negatively related to sustainability of microfinance. It creates noncompetitive environment to microfinance to find its own funding. Thus, long term subsidization can hinder the development of microfinance into efficient and sustainable operations (Bogan, 2009). Subsidization should be provided smartly and short-term.

Continual saving of members throughout microfinance operational period is another favored as it encourages their saving habit and hence their financial stability. However, this can be done depending on member’s financial capacity whether they can save while they are obliged to repay loan outstanding. Limiting one outstanding loan at a time to a member is strongly recommended. This is to ensure provision of loan is better focused on adaptation use, and also to avoid potential non-performing loan as a result of member’s over debt. Non-performing loan deteriorates profitability. Too high amount of non-performing loan ultimately can end any financial institution including microfinance. In addition, loan installment should be properly managed to be in line with amount of loan. Fixed installment whereas amount of loans are increased, following adaptation cost requirements, will result to longer loan period required including increased size of account receivable of microfinance. The longer period of loan creates higher probability of account receivable delinquency and thus defaults (Avouyi-Dovi, Horny and Sevestre, 2012). A loan is delinquent if installments are delayed and in default if one or more installments are never repaid. For microfinance, Srinivasan (2007) has recommended to use non-payment for one year loan cycle to determine account receivable default. As such, managing loan or account receivable is a key concern of any business operations (Leitch and Lamminmaki, 2011). A common goal of accounts receivable management is to ensure debts/ loan installments are collected within agreed terms (Pike and Cheng, 2001, cited in Leitch and Lamminmaki, 2011). This requires both

dedicated microfinance staffs and well loan tracking system for following up and early warning of delinquent loan. Measures to mitigate those non-performing loan then can be placed in time.

7.4 Conclusions and Recommendations

In conclusion, microfinance is an effective mean of adaptation to climate change impacts, whereby sea level rise is included. It is not physical measure, but it provides a (financial) tool to help people obtain or improve for proper adaptations. It strengthens individual and community adaptive capacities, which lead to less vulnerable to a given impacts. Degree of appropriateness and effectiveness of microfinance, if it is applied for adaptation to sea level rise impacts, is depended on how well utilizing it links to external assistances, managing its performances, and maintaining its financial sustainability with sufficient fund/ loan provided for adaptation cost requirements. Initiating a successful microfinance for sea level rise impacts to a community requires community capacity-building and inclusion of consultative and subsidization (if necessary) processes from control or expert parties. The rules and regulations should also be adjusted to suit the community.

Measurement of microfinance performances, after implementation, is an essential to ensure it is sustained with operating self sufficiency. An instruction with indicators provided by Rosenberg (2009), as shown in Appendix P, is a useful for performance measurements. With scenario that rise of sea level is continued, microfinance for sea level rise impacts is a timed program. Its services are well applicable for a member to accommodate and protect his/ her household to impacts. When the impacts are so severe that household has to retreat (relocation), it beyond microfinance's capabilities. Following Hendricks (2003), a timed microfinance program should be designed considering exit-strategy perspective from the onset, particular the ones receiving donation. Supports of donor may not be continued throughout program's life. Accordingly, design of microfinance for sea level rise impacts should incorporate exit strategy. Criteria for exit are either one of these, but not limited to: less number of members than predetermined; consensus from member

meeting to quit; abiding laws and regulations; and damage from sea level rise impacts beyond microfinance's benefits. Liquidation required for closing of microfinance should be predesigned and properly arranged upon actual closure (Office of Nakornsawan cooperative, 2010). Liquidation includes collecting assets, settling all debts, closing all outstand account receivable, and allocation of remained fund/ equity to members. Connecting altogether of mentioned requirements will realize microfinance to support adaptations to the impacts of sea level rise.

CHAPTER VIII
CONCLUSION AND POLICY IMPLICATIONS

This research is an empirical study focusing on autonomous adaptation at household level to climate change impacts. Its overall objective is to study microfinance whether it can be an effective measure to strengthen household financial adaptive capacity to the impacts of sea level rise. Research scopes its study to non-Islamic microfinance (conventional microfinance). This is due to Islamic law prohibits financial services outreach and thus microfinance in Islamic environment requires unique study. Microfinance services are assumed to work well at household adaptation levels of accommodation and protection to sea level rise impacts. When such impacts are so severe that households require retreat or relocate their houses, it is beyond microfinance capability.

To achieve research objectives, it required various tests and studies of subjects relevant to microfinance with vulnerable coastal communities currently or potentially impacted by sea level rise. Thoroughly considering coast physical characteristics of Kingdom of Thailand, sea level rise model and expert recommendations, then six vulnerable coastal villages of three Tambons located in Gulf of Thailand were purposively selected as studied sites. Those villages included Sahakon and Sandap in Tambon Phan Thai Norasing, Khun Samut Chin and Khlong Suan in Tambon Laem Fapha, and Si Long and Khlong Nang Hong in Tambon Khlong Dan. A sample size of four hundreds households was required to statistically represent total target households of all studied villages—these were selected randomly. Current and future household financial adaptation cost requirements to sea level rise impacts of those studied villages were assessed in order to know adaptation cost baseline requirements.

A microfinance institution for adaptation to sea level rise impacts was preliminary designed and called ‘microfinance for sea level rise impacts’. Such microfinance for sea level rise impacts was assumed in hypothetical market as it was

an inventive and not yet implemented in actual market. Applicability and factors affecting participation of the designed microfinance were tested with village members (sampled households). In addition, appropriateness and effectiveness of it were analyzed particularly in views of self-sufficient funding, delivery of microloan, and government subsidization requirements comparing with the assessed adaptation costs baseline. The research provides in-depth discussion and analysis of those studied subjects and describes them in previous Chapters 4 to 7. In this Chapter 8, the key findings of research, studying gaps and limitations, including recommendations for further studying are reiterated and/or elaborated. It concludes with policy discussions.

Studies of adaptation costs associated with climate change impacts are numerous and done in different views. Examples of them include studies of climate change damage costs (impact costs of no taking adaptations), costs for adaptations, indirect and opportunity costs resulting from taking adaptation actions, and costs of damage avoided (benefits from adaptations). In this research, the study is limited to only direct financial costs for adaptations at household level with main purpose for having simplified costs baseline to compare with fund obtaining from the studied hypothetical microfinance.

Research discovered that vulnerable coastal households in the studied villages were adapting their livelihood to the impacts of sea level rise. They spent their money, for autonomous adaptation, mainly for capital expenditure items related to home and farming environments such as house renovation, land improvement, and building physical barrier for house and aquaculture land. Their operating expenditures for adaptation such as maintenance costs, medical expenses, and drinkable water were not the concern.

Research also indicated that average household adaptation costs of near shore villages were slightly higher than that of inland ones. It was apparent that near shore villages were more vulnerable to sea level rise impacts. When considering in view of community type, it was found that houses located in typical coastal communities spent for adaptation costs differently lower than, and could not be comparable with, ones in urbanized communities. This was due to house renovation costs, as materials conditions of houses in urbanized communities were much better. In order to be comparable the degree of adaptation between these two community

types, some adjustments of the adaptation costs such as percentage of property value, could be a better indicator of the adaptation cost. This research did not assess such building costs and land prices. It is therefore recommended to further study by any parties interested in coastal household adaptation contexts.

Use of personal interview technique to assess adaptation costs at household level is referred by few studies. However, it should be applied carefully with proper planning in advance. Household adaptive measures should be identified and categorized beforehand to ease respondents to answer correctly their relevant expenditures. Many people cannot remember well their past expenditures, or they may inform their expenditures irrelevant to concern adaptations. Interview technique is also important. Interviewer must have basic knowledge of adaptations and climate change impacts. He/ she must always scrutinize interviewee's response with studying subjects during the interview. This research stringently applied said personal interview techniques assessing household adaptation costs to the impacts of sea level rise. Yet some outliers occurred. They were trimmed out to minimize bias. Further standard deviation analysis (not done in this research) will confirm more reliable of cost results. For the additional future adaptation costs required by those vulnerable households, as long as impacts of sea level rise are to be persisted, they are unavoidable. This was confirmed by the figures of short and long term future adaptation costs estimated in the research. The short term was forecast from households (respondents) expectation, and the long term was done by using financial formula. All estimations were done by given that degree of sea level rise impacts was maintained. Households have to start planning for their saving well for future expenditures if they are willing to continue staying on their current homelands.

To financially support adaptations to climate change impacts, there are globally numerous adaptation funds. Those adaptation funds are mainly available for national adaptation, which nations will have to ensure their own support mechanism to communities. Considering community level or real vulnerable sector, there are few funds to support households in community. High income households (inclusive of communities), who have sufficient financial capacity, can adapt to the impacts using their own saving or through financial services obtaining from formal institutions, e.g. commercial banks. On the contrary, low income households are lack of sufficient

financial resources. A household may seek financial supports from informal sources in order to adapt its livelihood to climate change impacts. With that, it is individual struggle.. Microfinance is an alternative mechanism that can fill in such gaps. It is set up on collaboration and self-help basis of individuals in a community with control mechanisms. Successful microfinance, through its financial services delivery, can strengthen financial adaptive capacities of households including communities to the impacts of climate change.

In Thailand, there are various types of microfinance institutions (a formed organization/ working group to manage financial self-services of microfinance) such as credit union, saving cooperative, and village fund. They are used to serve different purposes of many communities e.g. agricultural, and fishery. Nonetheless, none of them are used to directly support household adaptations to sea level rise, one of climate change impacts. Research applied multi-criteria factors analysis and focus group interview, with representatives of studied villages and government agencies, to identify respectively a proper type of institution and requisite conditions of microfinance for sea level rise impacts. It was found that the most proper microfinance institution was saving cooperative (regulated) or saving group (non-regulated). The typical conditions of saving cooperative could be adopted, but specific purposes must be emphasized on saving and knowledge sharing for household adaptations to sea level rise impacts. Some other interesting points from respondent views also were discovered. Microfinance committee chairman should be from election, not village leader by default. In case homeland of microfinance members were impacted by sea level rise at same period how to allocate fund to adequately support their adaptation needs become a critical question. This might require financial capacity the communities have with their funds. This raised the necessity of external subsidization, particular during initial operating period of microfinance when its fund yet was low.

Research designed a simplified prototype of microfinance for seal level rise impacts. Such designed microfinance then was assumed in hypothetical market and proposed to respondents/ sampling units of six studied villages for their acceptance, intention to participate and willingness to save. Factors relevant to perception of risks, attitudes toward microfinance, social influences, conditions of

microfinance, and government supports were hypothesized that they affected intention to participate and willingness to save of respondents to microfinance. Eleven subjects/ items then were identified for testing those factors. In addition, respondent's demographic including required household adaptation costs (results from research) were tested to detect their statistical relationship with the designed microfinance in similar manners. Unlike adaptation costs analysis, the analysis relevant to microfinance in this research was not differentiated for near-shore and inland villages, but as a whole of all studied village. This was due to distances to shore were assumed no effects to most factors of microfinance participation, except risk perception. Degree of people's participation including saving were depended mainly on their belief in benefits of microfinance.

Study results indicated that majority of respondents had positive attitudes toward microfinance that it could promote cooperatives of social and economic development in their community. They also accepted that microfinance was applicable for their adaptation to the impacts of sea level rise. Based on a regression model, their intentions to participate to the designed microfinance were depended on three items: 1) services quality of microfinance; 2) attitude that microfinance can be applied for adaptation; and 3) perceive of risk that house and farmland are impacted by sea level rise. Those three items were derived from stepwise regression analysis of the tested eleven subjects affecting microfinance participation. Willing/ non-willing to save amounts of respondents to microfinance for sea level rise impacts also was obtained. Surprisingly, statistical tests showed that there were no relations between such amounts and factors affecting microfinance participation, required household adaptation costs, and demographic factors. Some factors, particular personal income, were commonly understood that they should have been correlated with saving amounts. Possible explanations that correlations were not found included: a) using two-way payment ladder method generating range of (non) willing to save amounts resulted to high variation of dependent variable; and b) microfinance for sea level rise impacts was yet hypothetical that respondents stated (non) willing to save amounts just to reserve right of participation, or for their preference, without actual capacity and particular requirements. Cross-checking actual amounts that some respondents currently save with other microfinances will justify the latter

explanation whether they are capable to save as they state. This will make research results more valid regarding willingness to save to microfinance for sea level rise impacts.

In this research, analysis and discussions of appropriateness and effectiveness of microfinance for sea level rise impacts were done. Due to such microfinance was yet hypothetical some aspects were discussed through literatures review and some were analyzed using data of research results. Referring various academic studies and government reports, microfinance plays a major role in autonomous adaptation to climate change impacts particular for developing countries. There is no doubt that it is one of proper tools for adaptation. However, its appropriateness, as a measure to support household adaptations to the impacts of sea level rise, is dependent on how well utilizing it links to external assistances (e.g. government subsidization, financial supports of global adaptation funds), managing its performances, and maintaining its financial sustainability with sufficient fund/ loan provided for adaptation cost requirements. Performances of microfinance, for adaptation purposes, should be measured on these views: a) fitness to households/ community adaptation requirements; b) outreach to all community members; and c) strengthening cooperations of community.

In view of effectiveness of microfinance for sea level rise impacts, research analyzed sufficiency of microloan comparing with required adaptation costs for assumed thirty years operational period. It was considered effective if provision of loan was minimally meet adaptation cost requirements. Microloan was derived from microfinance fund, which was the sum of total respondent's willing to save amounts and government subsidization. Options composing of combinations of percentages of government subsidization and size of account receivable (percentage of fund allowed to loan) were analyzed to detect which options could generate sufficiency of microloan. Considering all options, to meet required adaptation costs, it was recommended that microfinance for sea level rise impacts somehow needed external subsidization particular during its initial operational period. Funding from sole member saving could generate sufficiency of loan on the conditions that all funds must be allowed to be loaned. Options that all fund allowed to be loaned, however, were too high risk as there were no buffer for any potential bad debt. Government/

external subsidizations to coastal households (microfinance members, via microfinance for sea level rise impacts) for adaptations are sound justified. This is due to the physical adaptative measures of coastal household decrease some impacts of sea level rise to further inland households. Adaptations costs of coastal household incur indirect benefit, positive externality in economic terms, to other parties. Such costs therefore should be subsidized. Sources of subsidization may be from various national funds or global adaptation funds.

Analyzing all data obtained from respondents, microfinance is able to strengthen household/ community financial adaptive capacity of the studied villages to the impacts of sea level rise. However, the conditions of microfinance member's saving amount, size of account receivable, external subsidizations, and patterns of saving and loan distributions including their combinations must be properly designed and managed. With scenario that rise of sea level is continued, microfinance for sea level rise impacts is a timed program. Its services are well applicable for a member to accommodate and protect his/ her homeland to the impacts. However, when the impacts are so severe that a household has to retreat (relocation), it beyond microfinance's capabilities. As such, it is recommended to incorporate exit strategy at the beginning, during the design of microfinance for sea level rise impacts. Exit strategy includes justifications and measures to exit microfinance program. Examples are the required criteria to exit, how to close loan outstanding, and how to allocate fund balances back to members.

All studying objectives of research are fulfilled. Those include assessment of coastal household adaptation costs, tests of applicability, appropriateness and effectiveness of microfinance for sea level rise impacts. Research provides thoroughly statistical analysis related with acceptances, intention to participate, factors affecting participation and willingness to save to such microfinance. Yet, there are some key limitations of such analysis. The microfinance for sea level rise impacts is an ideal. All tests related with it, in this research, are assumed in hypothetical market. Therefore, obtained study results are generated from previous and current attitudes toward microfinance, including knowledge of adaptations and climate change impacts, of respondents/ village members. A pilot study (actual use of microfinance for sea level rise impacts in a test

environment/ sites) will provide more accurate results and thus essential keys for successful implementation of microfinance for sea level rise impacts. Research is lack of public and private sector analysis. Microfinance is rather a public service, as it supplies services to any or all members of a community. Its effectiveness should be more analyzed other than household adaptation costs fulfillment (private cost), as sole test in this research. An example is its potential lower discount/ loan rate than private loan (informal source), as a result of lower risks. In addition, its benefit should be viewed in term of total damage avoided costs of whole community instead of sum costs of individual household. There are some common or public areas of a community can be avoided from household adaptations. This is an interesting area for any further study. Last limitations in the research that should be mentioned is the limit of responsive group. Research focuses its study mainly with vulnerable parties, coastal village members. Expanding study to broader group of other stakeholders e.g. government agency, and climate change organizations will provide different views and more useful information to apply microfinance for adaptation to sea level rise impacts.

Conclusively, research indicates that microfinance is an effective tool for autonomous adaptation of studied villages to sea level rise impacts. Well managing microfinance together with its proper terms and conditions can strengthen (financial) adaptive capacities of village/ microfinance's members to such impacts. Results of research can be brought to practices or real implementations as research studies with real vulnerable parties who are using microfinance services and impacted by sea level rise. In addition, as global assisting funds are limit, microfinance can be a potential channeling mechanism to facilitate those funds flow to real vulnerable groups that lack of financial resources. Although results and methodologies of the research are particularly for studied sites, they are valuable references for broaden uses. Any parties concern at national and regional can utilize them to support their local adaptation planning by adjusting with local conditions. Those results and methodologies are relevant to future coastal household adaptation cost requirements, applicability of microfinance for adaptations and affecting factors of participation, and scenarios of managing microfinance to provide sufficient funds for adaptations. To adjust to climate change impacts as a result of global warming, developing

countries should accelerate and enhance more its local adaptation programs. As microfinance has been extensively used in most developing countries, applying it to support their communities adapt to the impacts is appropriate and practical.

This research contributes new knowledge related with the application of microfinance for adaptation purpose particular to sea level rise impacts. Research will be worthless if none adopts its study results for further development of microfinance and adaptations. To step moreover from theoretical and become real implementation of microfinance for sea level rise impacts, required additional items that should be established/ studied include but not limit to building awareness of climate change risks, improving attitudes toward microfinance, and development of relevant framework, policies and regulations of such microfinance. As microfinance for sea level rise impacts is rather inventive, all of those items should be administrated or technically supported by dedicated local authorities/ experts especially during initial phase. This will ensure the successful implementation of microfinance and local adaptation objectives are met. Lastly, it is a proud that this research somehow can help real vulnerable parties living better with the impacts of climate change.

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สหกรณ์ รายงาน เสนอต่อ ชุมนุมสหกรณ์ออมทรัพย์แห่งประเทศไทย จำกัด กรุงเทพ, สถาบันวิชาการด้านสหกรณ์ คณะเศรษฐศาสตร์ มหาวิทยาลัยเกษตรศาสตร์)

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APPENDICES

APPENDIX A

Aspects of coastal climates and their biogeophysical effects due to global warming.

Aspects of Coastal Climates	Change Direction	Potential Biogeophysical Effects
Sea level	Increase	Inundation and displacement of wetlands, coastal erosion, increased storm flooding and damage, salinization, rising water tables and impeded drainage.
Sea water temperature	Increase	Increased coral bleaching, increased algal blooms, northerly migration of coastal species, and decreased incidence of sea ice at higher latitudes.
Precipitation intensity	Increase	Increased flood risk in coastal lowlands.
Wave (swell, height)	Increase	Changed cross-shore and long-shore sediment transport, and hence patterns of erosion and accretion. Destruction of coastal wetland ecosystems.
Storm frequency	Regional variation	Changed occurrence of storm flooding and damage
Run-off	Regional variation	Changed sediment supply from rivers to the coast
Atmospheric CO_2	Increase	Increased productivity in coastal ecosystems.

Source: Klein and Nicholls (1999)

APPENDIX B

Overview of common microfinance institutions (MFIs), their typology and conceptual works

(1) Saving and credit cooperatives:

Saving and credit cooperative is a non-profit, cooperative financial institution owned and operated by its members. Its objectives are to promote saving, credit, and others financial self-help among members. The main role and importance of savings and credit cooperatives according to DGRV (2005) are poverty reduction and strengthen cooperatives. Cooperative principles are inferred as being the purpose of this microfinance institution.

(2) Credit union

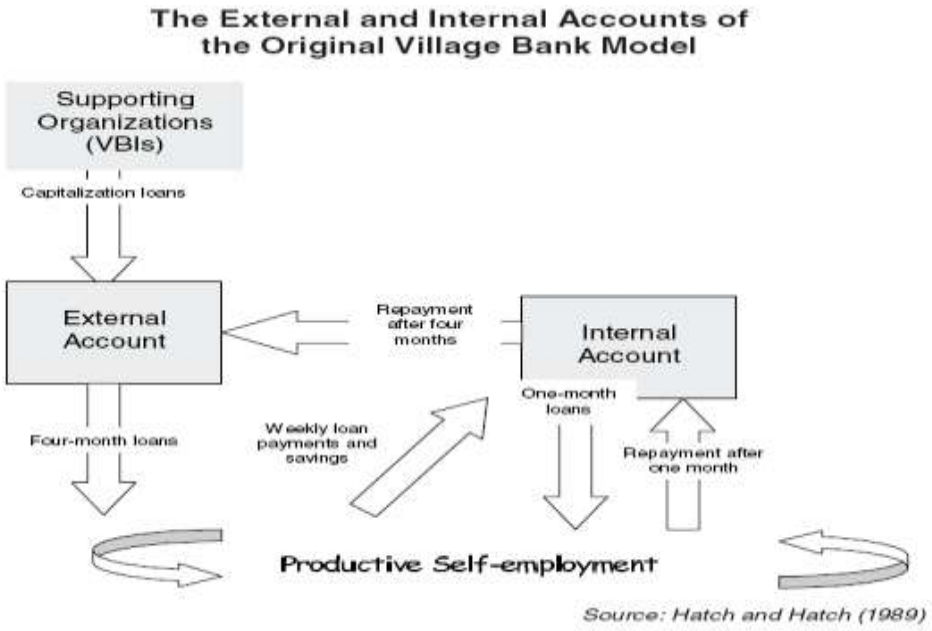
According to Credit Unions Online (2009, Nov 13) a credit union is a non-profit cooperative financial institution, with similar management as saving and credit cooperatives. Credit unions provide their members with a safe place to save and borrow at reasonable rates. Credit unions differ from saving and credit cooperatives in the sense that it is more focus on providing loan services (Berthoud and Hinton, 1989 cited in Ann-Marie Ward & Mckillop, n.d.).

(3) Village banking

Village banking is built on the features of informal rotating savings and credit associations (ROSCAs) and peer lending. Groups of families in a community comes together to provide and guarantee loans to individuals in the group. If one borrower cannot repay the loan, the other people in the group must compensate. The typical model's operations are that a VBI (Village Banking Institution)'s field agents select groups of women and train them to manage their own financial transactions (there was a study showed that the key to get VBI successful was the women (Butterfield, 2001)). The group will disburse loans, collect loan and savings payments, record transactions, and decide how to invest their savings. A key feature of the village-banking is the managing of those internal transactions

account. In certain years, village banks are expected to accumulate sufficient savings to capitalize their portfolios and become autonomous. A below village bank model of Hatch & hatch (1989, cited in Churchill, Hirschland, & Painter, 2002) shows the interactions of internal and external transactions.

The external and internal accounts of the Original Village Banking Model



Source: Hatch & hatch, 1989

(4) Financial NGO

Financial NGO is the non-regulated microfinance institution managed by non-government organization (NGO). The objectives of financial NGO are similar to other types of microfinance institution, which include encourage saving and provide lending services. Financial NGO can be transformed from non-regulated to regulated microfinance institutions, but with some particular implication concerns (Hishigsuren, n.d.). Doing that there will be a marked shift from group lending to individual lending. As such, the group activities and dynamics will be reduced, which will have implications for the less of social mission.

(5) Micro-insurance

Micro-insurance is the protection of low-income people against specific perils in exchange for regular premium payments proportionate to the likelihood and cost

of the risk involved. Specific perils can be death, funeral expenses, small-scale assets, and damage to livestock and crop (Pierro, 2007). However, insufficient market education is a major obstacle to the expansion of micro-insurance to those low-income people (Micro-insurance network. 2009, April). People who do not know what insurance is, how it works and why it might be good for them are less likely to spend money on insurance. As such, social funds can be a particularly viable platform for delivering micro-insurance services more effectively to poor households (Maleika & Kkuriakose, 2008).

APPENDIX C

Advantages and disadvantages of formal (regulated), semi-formal, and informal (non-regulated) microfinance institutions

	Formal		Semi-formal		Informal	
	Advantage	Disadvantage	Advantage	Disadvantage	Advantage	Disadvantage
Deep outreach		Higher costs, wider range of services, and profit making may limit deep outreach.	Profit maximizatio n is less concern, can focus on serving poorer markets		Able to reach women, or whoever that may not be comfortable interacting with formal institutions	
Large scale	Have greater potential to access financial resources needed to finance large-scale growth.			without access to commercial Capital, it may be insufficient to serve significant numbers.	Promoting village banks with relatively little overhead costs.	Each group's unique systems, portfolio and savings management, complicate to link them all into a larger system.
Sustainability	Driven by profits, the owner create incentives to increase efficiencies and lower costs.	Interest rate ceilings can inhibit sustainability.	Donations can occasionally be a more stable source of income than operating revenues.	The MFI organization may not be transparent and the board may not provide sufficient oversight.		Groups are vulnerable to covariant risks. Donor support is strongly required for promoting
Client focus	Regulated often review client needs for offering voluntary savings services.	regulations demand more systems, staff time, reserves, or taxes, and may increase costs to clients if	These VBIs are able to change policies to favor clients without government interference.	Semiformal VBIs usually do not have the legal status to offer savings accounts.	Interest income remains with the group.	Flexibility and range of products may be severely limited by organizational capacity.
Culture of innovation		May be curtailed by ill-conceived regulations that restrict products and delivery systems.	Not constrained by regulations, and often highly innovative		Free of regulation and an MFI superstructur e, groups can test varied systems and approaches.	

Source: Churchill, Hirschland, & Painter (2002)

APPENDIX D

Examples of inter/intra household and individual autonomous adaptation measures related to climate stress in Southeast Asia

Countries	Climate stress	Adaptation practices
Cambodia	Flood, windstorm, seawater intrusion	Reinforcement of housing structures, increasing household food stock, increasing feedstock for animals, move to new areas, switching to flood resistant crop varieties.
Indonesia	Tidal flooding, sea level rise, coastal inundation	Constructions of protective structures e.g. dike and small dams, movement to new areas, reinforcement of housing structures.
Laos PDR	Flood	Movement to new areas, diversification of food sources, acquiring loans from informal sources at higher rates,
Philippines	Tropical cyclone, coastal erosion, sea level rise, saltwater intrusion	Reinforcement of housing structures, constructions of protective structures e.g. dike and sandbags, more use of bottle water, obtain loan at lower rates from social network or higher rates from informal sources, temporary migration to seek alternative incomes, change planting schedule and switching to flood resistant crop varieties
Thailand	Coastal erosion, sea level rise, coastal inundation	Constructions of protective structures e.g. dike and breakwater, move to new area, reinforcement of housing structures, claim for financial assistance from government, obtain loan from social network or financial institutions.
Vietnam	Coastal erosion, windstorm, flood	Strengthening protective structures, move to government temporary shelters, adjustment of aquaculture cycles, obtain financial from social network or family members.

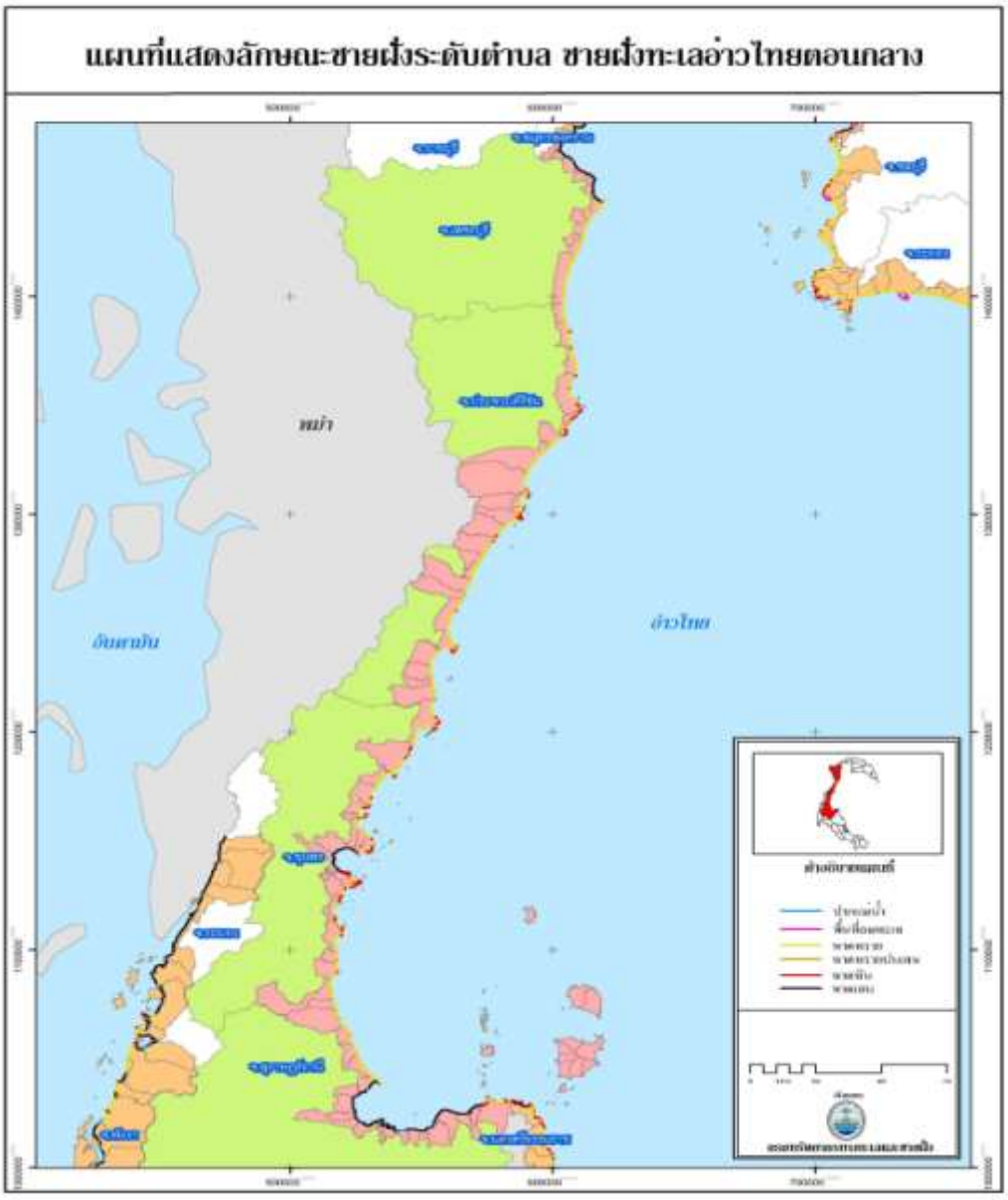
Source: Resurreccion, Sajor, & Fajber (2008).

APPENDIX E

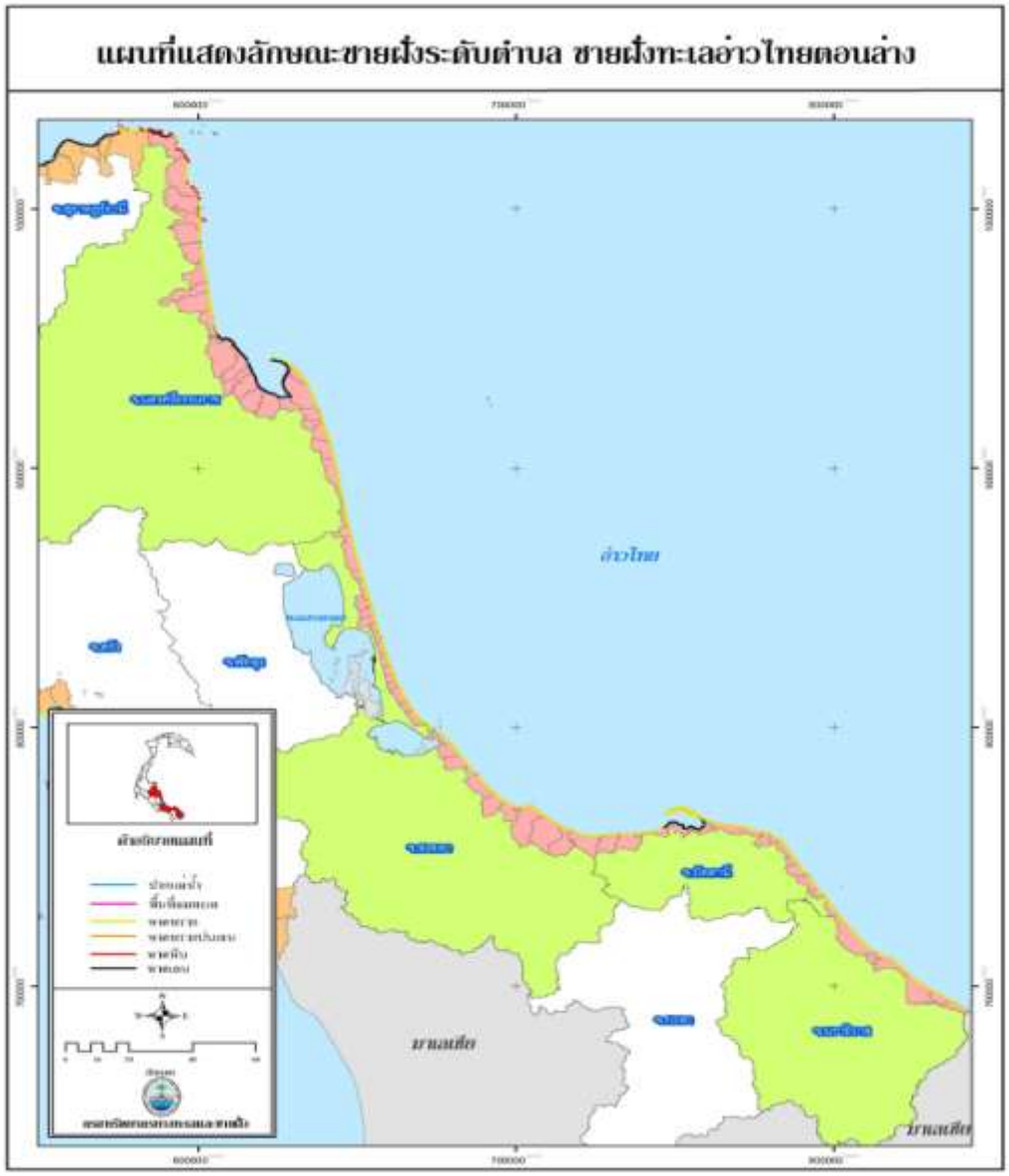
Thailand coastal map based on coastal characteristics: Upper Thai Gulf

Thailand coastal map based on coastal characteristics: Eastern Thai Gulf

Thailand coastal map based on coastal characteristics: Middle Thai Gulf



Thailand coastal map based on coastal characteristics: Lower Thai Gulf



APPENDIX F

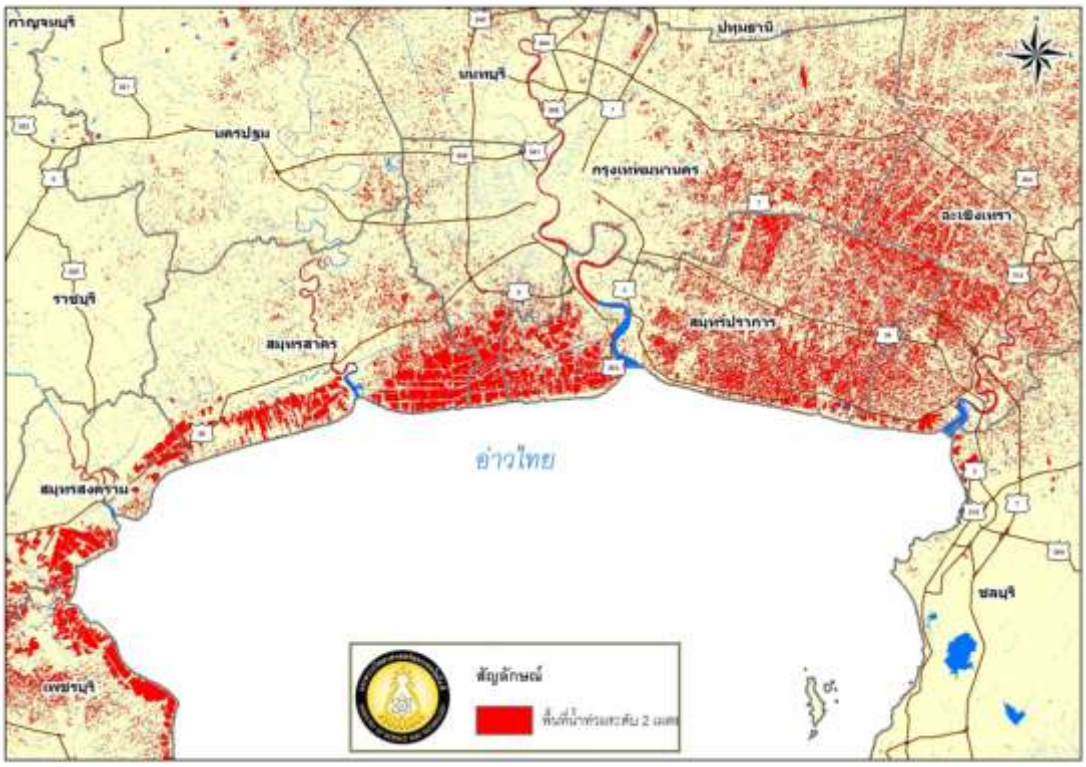
Thailand coastal provinces: vulnerability analysis based on coastal characteristics excluding topographic and tide information.

Province	Coastal characteristics	Vulnerability
Upper Thai Gulf		
Samutprakarn	Mostly mudflat	Very high
Samutsongkhram	Mostly mudflat	Very high
Samutsakorn	Mostly mudflat	Very high
Petchaburi	Sand and mudflat	High
Chachengsao	Mostly mudflat	Very high
Bangkok (1)	Mostly mudflat	Very high
Eastern Thai Gulf		
Cholburi	Sand, rock, and mudflat	Moderate
Rayong	Mostly sand, some rock	Moderate
Chandburi	Mostly sand, some rock	Moderate
Trad	Sand and mudflat	High
Middle Thai Gulf		
Prachuabkirikhan	Mostly sand, some rock	Moderate
Chumporn	Sand, rock, and mudflat	Moderate
Suratthani	Mostly mudflat, some sand	Very high
Ranong (Andaman)	Mostly mudflat	Very high
Pangnga (Andaman)	Sand and mudflat	High
Phuket (Andaman)	Sand and rock	Moderate
Krabi (Andaman)	Sand and mudflat	High
Lower Thai Gulf		
Nakornsrithammarat	Sand and mudflat	High
Pattalung	Mostly sand	Moderate
Songkhla	Mostly sand	Moderate
Trang	Mostly sand	Moderate
Pattani	Mostly sand, some mudflat	Moderate
Narathiwas	Mostly sand	Moderate
Yala	No coast	N/A

Note: (1) Bangkok has only 5 kilometers of coastal line.

APPENDIX G

High risk area in Upper Thai Gulf if sea level rise 2 metres



Source: Climate Change Information Management Center, Department of Science and Technology, Thailand. Updated 13th December 2009 (ศูนย์จัดการความรู้ด้านการเปลี่ยนแปลงภูมิอากาศ, สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ, กระทรวงวิทยาศาสตร์และเทคโนโลยี. การสร้างองค์ความรู้เพื่อการพัฒนาพื้นที่ชายฝั่งอ่าวไทยในบริบทของการเปลี่ยนแปลงภูมิอากาศระยะยาว, ปรับปรุงล่าสุด 13 ธันวาคม 2552)

APPENDIX H

Identified high risk coastal Tambons to sea level rise impacts (in Provinces: Samutprakarn, Samutsongkhram, Samutsakorn, Chachengsao, and Bangkok) following model of 2 metres seal level rise in Upper Thai Gulf

Tambons	Amphurs	Provinces	Potential risk to sea level rise	Per capita income (*)
Klongkon คลองโคน	Mueng เมือง	Samutsongkhram สมุทรสงคราม	high	39,048.19
Nakok นาโคก	Mueng เมืองสมุทรสาคร	Samutsakorn สมุทรสาคร	high	34,295.28
Bangkrachao บางกระเจ้า	Mueng เมืองสมุทรสาคร	Samutsakorn สมุทรสาคร	high	34,743.86
Bangyapraek บางหญ้าแพรก	Mueng เมืองสมุทรสาคร	Samutsakorn สมุทรสาคร	high	53,035.85
Phan Thai Norasing พันท้ายนรสิงห์	Mueng เมืองสมุทรสาคร	Samutsakorn สมุทรสาคร	high	53,756.11
Smaedam แสมดำ	Bangkunthien บางขุนเทียน	Bangkok กรุงเทพมหานคร	high	no info
Takam ท่าข้าม	Bangkunthien บางขุนเทียน	Bangkok กรุงเทพมหานคร	high	no info
Naklue นาเกลือ	Prasamutrjedi พระสมุทรเจดีย์	Samutprakarn สมุทรปราการ	high	42,128.49
Laem Fapha แหลมฟ้าผ่า	Prasamutrjedi พระสมุทรเจดีย์	Samutprakarn สมุทรปราการ	high	49,847.76
New Bangpoo บางปูใหม่	Mueng เมืองสมุทรปราการ	Samutprakarn สมุทรปราการ	high	no info
Bangpoo บางปู	Mueng เมืองสมุทรปราการ	Samutprakarn สมุทรปราการ	high	no info
Khlong Dan คลองด่าน	Bangbor บางบ่อ	Samutprakarn สมุทรปราการ	high	53,669.06
Songklong สองคลอง	Bangpakong บางปะกง	Chachengsao ฉะเชิงเทรา	high	49,448.32
Bangpakong บางปะกง	Bangpakong บางปะกง	Chachengsao ฉะเชิงเทรา	high	45,294.54

(*) Source of incomes: Community Development Department, Ministry of Interior, Thailand, 2009. (ที่มารายได้: ข้อมูลความจำเป็นพื้นฐาน (จปฐ) ปี 2552 คณะกรรมการอำนวยการงานพัฒนาคุณภาพชีวิตของประชาชน, กรมพัฒนาชุมชน, กระทรวงมหาดไทย)

APPENDIX I

Designed questionnaires

This questionnaire is a part of the research

"Coastal households adaptation to sea level rise using financial self-service cooperative (microfinance)"

By Mr. Amornpun Kulpraneet

Ph.D. ENER/D 5237310

Faculty of Environmental and Resource Studies, Mahidol University

Type A: Evaluate options of microfinance institution and design of hypothetical microfinance for sea level rise impacts using focus group interview

Part I: Evaluate microfinance institution options

You are presented the available microfinance institutions and their advantages and disadvantages. Please evaluate those microfinance institutions that are appropriate for coastal household adaptation to sea level rise impacts, by scoring each of them considering the following factors. The scoring numbers and their meanings are: high = 10, potential high = 8, moderate = 6, potential low = 4, low = 2.

- Implementability: applicable, ability and ease of setup
- Community based: build up cooperatives, serve particular needs to the community.
- Continuity: can be networking, self administrate and sustained, and continuation with less dependency from outside.
- Fair/ Equity: fair services, treat members of equally, and good governance administration.
- Deep outreach: services outreach to all community members regardless poor or non-poor

	Implement -ability (0-10)	Community base (0-10)	Continuity (0-10)	Fair/ Equity (0-10)	Deep outreach (0-10)	Weighted total score
Weighted (%)	20%	20%	20%	20%	20%	100%
Credit unions						
Financial NGO						
Saving cooperative						
Village banking						
Extended existing microfinance						

Scoring: high = 10, potential high = 8, moderate = 6, potential low = 4, low = 2

Part II: Design of microfinance for sea level rise impacts

Please provide your opinions freely to formulate the appropriate terms and conditions of hypothetical microfinance required as an adaptive measure to sea level rise impacts.

- Objective of microfinance: financial preparation for adaptation to sea level rise impacts, provide adaption knowledge, etc
- Source of fund: from members, external supports from government and oversea, etc
- Loan policy: specific purpose, maximum amount, payment or installment policy, etc
- Investment policy of microfinance: stock, bond, etc
- Membership: roles of members, benefit of membership, etc
- Management: management committee, chairman, functions, etc.
- Accounting and auditing
- Government support: continuity, relevant government authorities, etc

Type B: Personal interview for coastal household's adaptation cost requirements, risk perceptions, acceptance, factors affecting participation, and willingness to save to microfinance for sea level rise impacts.

The questionnaire is composed of 4 parts

1. Assessment of coastal household's current problems, adaptation cost requirements and adequacy of adaptation budget for sea level rise impacts
2. Evaluation of household risk perceptions and test of acceptance and factors affecting participation to microfinance for sea level rise impacts.
3. General queries for microfinance participation and estimation of household willingness to save to microfinance for sea level rise impacts.
4. Interviewee's personal and household information

Interviewee's name.....

Address.....
.....
.....
.....

Telephone.....
.....

Distance between house and coast

□ Less than 100 M □ 101 – 500 M □ 501 – 1,000 M □ Over 1,00

Part I Assessment of coastal household's current problems, adaptation cost requirements and adequacy of adaptation budget for sea level rise impacts

1.1 Have you ever had problems regarding sea level rise impacts e.g. coastal erosion, inundation to your house and agriculture/ aquaculture areas?

□ Yes we have □ Not yet have, but will be in …….years □ will never have

(if answer 'yes', please continue 1.2, and otherwise go to 1.3)

1.2 If you are currently facing with such sea level rise problems to your house, how is the degree of impact?

□ Severe/ continuous □ moderate/ occasional □ neglecting

1.3 How much do you forecast your household adaptation costs requirement (Baht per month, or Baht per year) for sea level rise impacts will be in the next 5 years?

□ We will require adaptation cost at amount …….. Baht/ year □ We won't require any adaptation cost

In case you require adaptation costs, please specify costly activities related:

□ buy/ build water tank storage □ build small dam □ land improvement

□ buying new crops □ house renovation □ Others, please specify.....

1.4 Do you family have adequate budget for household adaptation to sea level rise impacts?

□ Yes, we have adequacy □ No, we have not adequacy □ We are not sure

1.5 What sources of financial services is your family currently using (can choose more than one) for household adaptation?

□ Commercial bank □ Saving cooperatives □ Informal institutions □ Own saving □ Other, please specify.....

1.6 If your family is currently using financial services from informal institutions, please specify the source

□ Neighbor □ Relatives □ External parties □ Other, please specify..... □ Never use

1.7 Are you looking for financial instruments to support the required adaptation costs for your current home, farmland, occupation, etc due to the threats of sea level rise impacts?

□ Yes □ No

1.8 Please identify your household investment adaptation cost during the last 5 years for sea level rise impacts

Mark 'X' if related	Items	Details (size, volume, quantity, etc)	Amount (Baht)	When (Year)
	Increase water tank storage capacity for general use			
	Dam or any physical protection construction for irrigation			
	Introduction of new crops easily grow in sea water flood			
	House renovation to accommodate sea level rise			
	Improvement of landuse and landscape			
	Contruction of flood or erosion barrier			
	Improve sanitation, water supply, electrical systems			
	Others, please specify			

Unable to identify amount invest by item: Please mark 'X" for all related items and estimate total amount

1.9 Please identify your Increment household annual adaptation costs (routine/ maintenance expenses) during last 5 years for sea level rise impacts

Mark 'X' if related	Items	Details (size, volume, quantity, etc)	Amount/ year (Baht)
	Buy more drink bottle water for consumption		
	Changes in fertilizer use and soil fertility maintenance		
	More medical expenses for water borne disease		
	More expenses for household equipment and miscellaneous		
	Mainenance expenses for investment adaptation items		
	Flood and disaster insurance		
	Others, please specify		

Unable to identify amount invest by item: Please mark 'X" for all related items and estimate total amount

Part II: Assessment of household risk perception and the test of acceptance and factors affecting participation to microfinance for sea level rise impacts

Hypothesis of risk factors and factors affecting microfinance acceptance

Hypothesis		
Risk factors	R1	'Perceive of risks from the impacts of sea level rise are the protective motivation
Microfinance acceptance/ participation affecting factors	A1	'Attitude toward/ or perceive of usefulness' is a predictor of acceptance and intention to participate
	A2	'Social influence' is a predictor of intention to participate
	A3	'Facilitating condition' is a predictor of intention to participate
	A4	'Government support' is a predictor of intention to participate

Please score the following questions between 'fully disagree' and 'fully agree', after you are presented the hypothetical microfinance for sea level rise impacts

Hypothesis and questions		Fully disagree						Fully agree
		0	1	2	3	4	5	6
R1	Your home and farmland are at risks from the sea level rise impacts: coastal erosion, inundation, etc.							
R1	Sea level rise impacts increase more health risks e.g. water borne disease to you and your family members							
R1	Your family financial status has been deteriorated and are (may be) at risks due to the increasing of required adaptation costs to the sea level rise impacts.							
A1	Do you agree with the applying of microfinance as a financial adaptive measure to sea level rise impacts?							
A1	You have ever had good experiences from using other microfinance services or being a microfinance member							
A1	Do you agree that the 'hypothetical microfinance for sea level rise impacts' will							

	be useful, can financially support the household adaptation requirement, and can promote cooperatives of social and economic development in your community?							
A2	You will participate with the 'hypothetical microfinance for sea level rise impacts only your family (spouse) has agreed.							
A2	You will participate with the 'hypothetical microfinance for sea level rise impacts, if your neighbors has participated							
A3	You will participate with the 'hypothetical microfinance for sea level rise impacts', if such microfinance has provided good services quality and facilitating conditions.							
A3	You will participate with the 'hypothetical microfinance for sea level rise impacts', only after you have known the benefits and conditions of membership.							
A4	You will participate with microfinance that is supported by the government only.							

Part III: General queries for microfinance participation and estimation of household willingness to save to microfinance for sea level rise impacts

After you are presented the hypothetical microfinance for sea level rise impacts, please answer the following questions.

3.1 Having known the benefits and conditions of 'hypothetical microfinance for sea level rise impacts', are you willing to participate (become membership)?

□ Yes, I will participate *(continue to answer all other questions in part III until finish)*

□ No, I don't want to participate *(answer only question 3.2, then finish)*

3.2 What are the sources of money for your future household adaptation costs, if there is no 'hypothetical microfinance for sea level rise impacts'?

□ Own saving

□ Sell own properties to get money

□ Lending from informal institutions

□ Lending from formal institutions e.g. commercial banks

□ Others, please specify……

3.3 What are your reasons of participating with such 'hypothetical microfinance for sea level rise impacts'?

□ Want to save for future household adaptation to sea level rise impacts

□ Need loan benefit for household adaptation to sea level rise impacts

□ Expect for good interest rates

□ I cannot obtain money from other financial sources for household adaptation to sea level rise impacts

□ Others, please specify…….....

3.4 If you participate with such 'hypothetical microfinance for sea level rise impacts':

a) How much maximum amount per month will you **willing to save** for the next 5 years? Please mark 'Correct' sign (✓) for the amount you are definitely 'willing to save' starting from 200 Bath and continue with incremental amounts, until you find any amounts that you are 'uncertainty' please mark 'Hyphen' sign (–) instead. *(Remark: The beginning amount is started at 200 Baht by using the reference of the daily minimum labor wages in the central part of Thailand: Bangkok, Samutprakarn, Samutsongkhram, which are about 205 – 206 Baht daily in year 2533).*

b) How much minimum amount per month will you **unwilling to save** for the next 5 years? Please mark 'Cross' sign (**X**) for the amount you are definitely 'unwilling to save' starting from 2,500 Bath and continue with decrement amounts, until you find any amounts that you are 'uncertainty' please mark 'Hyphen' sign (–) instead.

Saving amount (Baht per month)	(✓) (–) (X)
200	
300	
400	
500	
600	
700	
800	
900	
1,000	
1,200	
1,400	
1,600	
1,800	
2,000	
2,500	

In case the maximum amount per month you are **willing to save** for the next 5 years is less than 200 Baht, please specify amount_____

3.5 What kind of activities will you spend your money saving in the 'hypothetical microfinance for sea level rise impacts' for?

□ Construct dam, irrigation and barrier for home, farmland, etc
□ Introduction of new crops easily grow in sea water flood
□ House renovation to accommodate sea level rise
□ Improve land use, landscape, sanitation, water supply, electrical systems
□ Increase water tank storage capacity for general use
□ Changes in fertilizer use and soil fertility maintenance
□ More expenses for household equipment and miscellaneous
□ Others, please specify…….

3.6 Do you want government to provide support to the 'hypothetical microfinance for sea level rise impacts'?

□ No, I don't want

□ Yes, I want. Please identify the required format of support

□ Management support □ Funding support

□ Insurance support □ Others, please specify……..

3.7 If government supports such hypothetical microfinance as you have required in 3.6, will you change your Willingness-to-Save amount as you have specified in 3.4?

□ No, I won't. I am willing to save same amount as aforementioned

□ Yes, I will. I will change amount saving to be ……

3.8 What is the repayment (installment) period that you think it is the most appropriate to get loan from the 'hypothetical microfinance for sea level rise impacts'?

□ Less than 6 months

□ 6 - 12 months

□ 13-24 months

□ More than 24 months

3.9 What is the installment frequency that you think it is most appropriate?

□ Once a week

□ Every 2 weeks

□ Every 3 weeks

□ Once a month

3.10 How much maximum amount are you able to repay to loan per month?

□ Please specify.....

3.11 What kind of approach do you want to use for selection of the management committee for 'hypothetical microfinance for sea level rise'?

□ Equally vote by members

□ Selection by community leader

□ Other, please specify.....

3.12 In your view, what kind of traits should microfinance management committee have?

□ Honesty or integrity

□ Seniority or maturity

□ Rich or wealthy

□ Other, please specify.....

3.13 Are insurances for disasters e.g. flood insurance necessity for your family?

□ Necessity □ Not necessity

3.14 To mitigate the damage risk of your properties from the disasters, what kind of below choices will you choose?

□ Insure property, but want to see the (low price) premium first

□ Not insure. Repair after damage occurred is better

□ Not insure, because having no enough money

Part IV: Interviewee's personal and household information

4.1 Personal information

Sex □ Male □ Female

Age □ below 25 □ 25 – 35 □ 35 – 45 □ 45 – 55 □ over 55

Occupation

□ Fishery □ Agriculture □ Livestock

□ Labor □ Employee □ Business

□ Other, please specify……..

Education

□ Primary school □ High school □ Bachelor □ higher than Bachelor

4.2 Household information

Total household income per month (Baht)

□ Below 10,000 □ 10,001 – 30,000 □ 30,001 – 50,000 □ Over 50,001

How long do your family live in this area?

□ Less than 3 years □ 3 - 5 years □ 5 – 10 years □ over 10 years

Total number of family members……Number of working members……..

Size of house area.....Rai/ Square Wah

Size of agriculture/ aquaculture area.....Rai/ Square Wah

APPENDIX J

Statistical analysis intention to participate with microfinance for sea level rise impacts and factors affecting participation

(a) Pearson correlation analysis for individual village and all villages: Intention to participate with microfinance for sea level rise impacts and factors affecting participation

Villages	n		Risk and attitude factors **										
			R1.1	R1.2	R1.3	A1.1	A1.2	A1.3	A2.1	A2.2	A3.1	A3.2	A4.1
Sahakon	67	Correlation	.185	.132	.238	.314*	-.002	.514*	.446*	.122	.542*	.596*	.419*
		Sig. (2-tailed)	.134	.287	.052	.010	.985	.000	.000	.325	.000	.000	.000
Sandap	67	Correlation	.197	-.066	.297*	.238	-.009	.369*	.067	.143	.305*	.421*	.308*
		Sig. (2-tailed)	.109	.596	.015	.052	.941	.002	.589	.250	.012	.000	.011
Khun Samut Chin	65	Correlation	.248*	.128	.194	.042	.143	.151	.236	.132	.179	.202	.184
		Sig. (2-tailed)	.046	.308	.121	.738	.255	.229	.058	.294	.153	.107	.142
Khlong Suan	67	Correlation	.440*	.283*	.445*	.384*	.062	.496*	.417*	.456*	.496*	.463*	.339*
		Sig. (2-tailed)	.000	.021	.000	.001	.620	.000	.000	.000	.000	.000	.005
Si Long	67	Correlation	.316*	.118	.379*	.233	.207	.290*	.330*	.346*	.494*	.388*	.380*
		Sig. (2-tailed)	.009	.341	.002	.058	.093	.017	.006	.004	.000	.001	.002
KNH	67	Correlation	.261*	.023	.244*	.336*	.143	.386*	.376*	.141	.424*	.413*	.274*
		Sig. (2-tailed)	.033	.854	.047	.005	.249	.001	.002	.254	.000	.001	.025
All villages	400	Correlation	.301*	.132*	.301*	.294*	.076	.398*	.285*	.176*	.409*	.402*	.339*
		Sig. (2-tailed)	.000	.008	.000	.000	.128	.000	.000	.000	.000	.000	.000

* Correlation is significant at the 0.05 level (2-tailed).

** R1.1: Home and farmland are currently vulnerable from the impacts of sea level rise.
R1.2: An impact of sea level rise is the increasing of health risk e.g. water borne disease.
R1.3: The financial status of family has been deteriorating due to more expenses required to adapt to the impacts of sea level rise.
A1.1: Microfinance can promote social cooperatives and economic developments in a community
A1.2: Having obtained good experiences from using other microfinance services
A1.3: Microfinance can be applied as a financial adaptive measure for sea level rise impacts (called microfinance for sea level rise)
A2.1: Family members (spouse) influence the decision to participate with microfinance for sea level rise
A2.2: Neighbors influence the decision to participate with microfinance for sea level rise
A3.1: Service levels of microfinance influence the decision to participate with microfinance for sea level rise
A3.2: Terms and conditions of microfinance influence decision to participate with microfinance for sea level rise
A4.1: Government supports/ contributions influence the decision to participate with microfinance for sea level rise

(b) Stepwise regression analysis for all villages: Intention to participate with microfinance for sea level rise impacts and factors affecting participation

Independent variables entered with Forward (Criterion: Probability-of-F-to-enter <= .050). Dependent variable is microfinance participation

Stepwise regression model summary

Model	R	R Square	Adjusted R Square	Std. error of the estimate
1	.409[a]	.167	.165	.456
2	.441[b]	.195	.191	.449
3	.453[c]	.205	.199	.446

a. Predictors: (Constant), A3.1
b. Predictors: (Constant), A3.1, A1.3
c. Predictors: (Constant), A3.1, A1.3, R1.1
Dependent variable: Microfinance participation

Model 3: Excluded variables

Model	Excluded variables	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
3	R1.2	.022	.464	.643	.023	.871
	R1.3	.025	.358	.721	.018	.412
	A1.1	.028	.450	.653	.023	.504
	A1.2	.026	.548	.584	.028	.927
	A2.1	.091	1.350	.178	.068	.444
	A2.2	.101	1.893	.059	.095	.694
	A3.2	-.093	-.970	.333	-.049	.218
	A4.1	-.006	-.089	.929	-.004	.395

APPENDIX K

Statistical analysis intention to participate with microfinance for sea level rise impacts and demographic factors

(a) Pearson correlation analysis for all villages: Intention to participate with microfinance for sea level rise impacts and demographic factors

Villages	Sample size		Gender	Age	Occupation	Education	Income	Year-live
All villages	400	Correlation	.092	.221*	.084	-.041	.008	.015
		Sig. (2-tailed)	.067	.000	.094	.412	.876	.769

* Correlation is significant at the 0.05 level (2-tailed).

(b) Stepwise regression analysis for all villages: Intention to participate with microfinance for sea level rise impacts and demographic factors

Model Summary

Model	R	R Square	Adjusted R Square *	Std. Error of the Estimate
1	.221[a]	.049	.046	.487

a. Predictors: (Constant), AGE
Dependent variable: MFS participation

* Positive correlation between intention to participate and age is found. However, adjusted R square is too low for a good prediction model

APPENDIX L

Test of difference of two Means (Two-sample t test) of maximum willingness to save amount and minimum non-willingness to save amount

(a) Test of difference of two Means (Two-sample t test) of maximum willingness to save amount and minimum non-willingness to save amount between villages in the same studied Tambon

Tambon	Compared villages(1)	t-score Max WTS	t-score Min non-WTS	Degree of freedom	t-value α/2 (0.025)	Mean differences
Phan Thai Norasing	Sahakon - Sandap	0.3797	0.9095	78	+/- 1.990	-
Laem Fapha	Khun Samut Chin - Khlong Suan	(1.0796)	(1.7765)	50	+/- 2.008	-
Khlong Dan	Si Long - Khlong Nang Hong	(0.0762)	0.2872	48	+/- 2.010	-

(b) Test of difference of two Means (Two-sample t test) of maximum willingness to save amount and minimum non-willingness to save amount between 'Khun Samut Chin', 'Khlong Suan', in Tambon Laem Fapha and villages in other studied Tambons

Tambons	Compared Villages(1)	t-score Max WTS	t-score Min non-WTS	Degree of freedom	t-value α/2 (0.025)	Mean differences
Laem Fapha-Phan Thai Norasing	Khun Samut Chin-Sahakon	(2.8746)	(2.9179)	80	+/- 1.990	Difference
	Khun Samut Chin-Sandap	(2,8670)	(2.1069)	66	+/- 1.990	Difference
	Khlong Suan-Sahakon	(1.7182)	(1.4093)	62	+/- 2.000	-
	Khlong Suan-Sandap	(1.5008)	(0.4856)	48	+/- 2.010	-
Laem Fapha-Khlong Dan	Khun Samut Chin-Si Long	(2.2147)	(2.4166)	51	+/- 2.007	Difference
	Khun Samut Chin-KNH	(2.2250)	(2.1485)	65	+/- 1.99	Difference
	Khlong Suan-Si Long	(0.9862)	(0.7012)	33	+/-2.03	-
	Khlong Suan-KNH	(1.0386)	(0.4134)	47	+/- 2.011	-

(1) Villages near shore: Sahakon, Khun Samut Chin, Si Long
Villages are further inland: Sandap, Khlong Suan, and Khlong Nang Hong

APPENDIX M

Statistic analysis of (non-) willingness to save amounts to microfinance for sea level rise impacts, demographic, and factors affecting microfinance participation

(a) Pearson correlation analysis for all villages: Maximum willingness to save amount to microfinance for sea level rise impacts and factors affecting microfinance participation

Villages	n		Risk and attitude factors *										
			R1.1	R1.2	R1.3	A1.1	A1.2	A1.3	A2.1	A2.2	A3.1	A3.2	A4.1
All villages (Max-WTS)	182	Correlation	-.106	-.014	-.032	.062	.089	.051	.103	.052	.124	.106	.114
		Sig. (2-tailed)	.154	.846	.670	.404	.233	.493	.167	.488	.096	.155	.125

Note: No correlations found

* R1.1: Home and farmland are currently vulnerable from the impacts of sea level rise.
R1.2: An impact of sea level rise is the increasing of health risk e.g. water borne disease.
R1.3: The financial status of family has been deteriorating due to more expenses required to adapt to the impacts of sea level rise.
A1.1: Microfinance can promote social cooperatives and economic developments in a community
A1.2: Having obtained good experiences from using other microfinance services
A1.3: Microfinance can be applied as a financial adaptive measure for sea level rise impacts (called microfinance for sea level rise)
A2.1: Family members (spouse) influence the decision to participate with microfinance for sea level rise
A2.2: Neighbors influence the decision to participate with microfinance for sea level rise
A3.1: Service levels of microfinance influence the decision to participate with microfinance for sea level rise
A3.2: Terms and conditions of microfinance influence the decision to participate with microfinance for sea level rise
A4.1: Government supports/ contributions influence the decision to participate with microfinance for sea level rise

(b) Pearson correlation analysis for all villages: Maximum willingness to save amount to microfinance for sea level rise impacts and demographic factors

Villages	Sample size		Demographic factors					
			Gender	Age	Occupation	Education	Income	Year-live
All villages (Max-WTS)	182	Correlation	-.062	-.121	.041	.077	.119	-.066
		Sig. (2-tailed)	.407	.104	.579	.300	.109	.378

Note: No correlations found

(c) Pearson correlation analysis for all villages: Minimum non-willingness to save amount to microfinance for sea level rise impacts and factors affecting microfinance participation.

Villages	n		Risk and attitude factors **										
			R1.1	R1.2	R1.3	A1.1	A1.2	A1.3	A2.1	A2.2	A3.1	A3.2	A4.1
All villages (Min Non-WTS)	182	Correlation	-.021	.086	.015	.077	.128	.080	.158*	.118	.164*	.146*	.104
		Sig. (2-tailed)	.779	.251	.842	.302	.085	.283	.033	.111	.027	.049	.163

* Correlation is significant at the 0.05 level (2-tailed).

** R1.1: Home and farmland are currently vulnerable from the impacts of sea level rise.
R1.2: An impact of sea level rise is the increasing of health risk e.g. water borne disease.
R1.3: The financial status of family has been deteriorating due to more expenses required to adapt to the impacts of sea level rise.
A1.1: Microfinance can promote social cooperatives and economic developments in a community
A1.2: Having obtained good experiences from using other microfinance services
A1.3: Microfinance can be applied as a financial adaptive measure for sea level rise impacts (called microfinance for sea level rise)
A2.1: Family members (spouse) influence the decision to participate with microfinance for sea level rise
A2.2: Neighbors influence the decision to participate with microfinance for sea level rise
A3.1: Service levels of microfinance influence the decision to participate with microfinance for sea level rise
A3.2: Terms and conditions of microfinance influence the decision to participate with microfinance for sea level rise
A4.1: Government supports/ contributions influence the decision to participate with microfinance for sea level rise

(d) Pearson correlation analysis for all villages: Minimum non-willingness to save amount to microfinance for sea level rise impacts and demographic factors.

Villages	Sample size		Demographic factors					
			Gender	Age	Occupation	Education	Income	Year-live
All villages (Min Non-WTS)	182	Correlation	-.120	-.112	.013	.148*	.075	-.022
		Sig. (2-tailed)	.105	.133	.857	.046	.313	.769

* Correlation is significant at the 0.05 level (2-tailed).

(e) Stepwise regression analysis for all villages: Minimum non-willingness to save amount to microfinance for sea level rise impacts and tested factors

Independent variables entered with Forward (Criterion: Probability-of-F-to-enter <= .050). Dependent variable is minimum non-willingness to save amount

Model Summary

Model	R	R Square	Adjusted R Square *	Std. Error of the Estimate
1	.164[a]	.027	.022	448
2	.223[b]	.050	.039	444

a. Predictors: (Constant), A3.1
b. Predictors: (Constant), A3.1, Education
Dependent variable: Min non-willingness to save amount
* Adjusted R square is too low for a good prediction model

(f) Pearson correlation analysis for all villages: (Non-) willingness to save amounts and adaptation cost requirements

Villages	Sample size		Future adaptation costs	Past adaptation costs
All villages (Max WTS)	182	Correlation	-.005	-.097
		Sig. (2-tailed)	.946	.191
All villages Min Non-WTS	182	Correlation	.038	-.042
		Sig. (2-tailed)	.606	.574

Note: No correlations found

APPENDIX N

Scenario of saving, government subsidization, loan, and number households obtain loan services to/ from microfinance for sea level rise impacts

A scenario of saving, government subsidization, loan, and number households obtain loan services (unlimited revolving loans) to/ from microfinance for sea level rise impacts

Parameters:

Saving amount	469	Baht/member/month
Gov. subsidization	10	%
I (loan interest rate)	5	%
No. of members	182	
Account receivable	0.9	
Installment	986	Baht/member/month
Avg. loan period	8.50	years

Required loan amount (capital expenditures): year 1-10 = Baht 80,714; year 11-20 = Baht 108,473; year 21-30 = Baht 145,779

Unit: Baht (for column a - i)

Year	Saving from member (a)	Gov. subsidi-zation (b)	Earning from loan (c)	Total accum. fund (d)	Size of account receivable (e)	Available fund for new loan (f)	Loan installment (g)	Net available fund for new loan (h)	Loan balance (i)	No. new HH can obtain loan (j)	No. loan due (k)	Total No. HH obtain loan (l)
1	1,024,296	102,430		1,126,726	1,014,053	1,014,053		1,014,053	1,014,053	13		13
2	1,024,296	102,430	50,703	2,304,154	2,073,738	1,059,685	97,949	1,157,634	2,073,738	14		27
3	1,024,296	102,430	108,584	3,539,464	3,185,517	1,111,779	209,766	1,321,545	3,185,517	16		43
4	1,024,296	102,430	174,662	4,840,851	4,356,766	1,171,248	337,415	1,508,664	4,356,766	19		62
5	1,024,296	102,430	250,095	6,217,671	5,595,904	1,239,138	483,139	1,722,277	5,595,904	21		83
6	1,024,296	102,430	336,209	7,680,606	6,912,545	1,316,641	649,496	1,966,137	6,912,545	24		108
7	1,024,296	102,430	434,515	9,241,847	8,317,662	1,405,117	839,407	2,244,524	8,317,662	28		135
8	1,024,296	102,430	546,742	10,915,314	9,823,783	1,506,121	1,056,208	2,562,329	9,823,783	32		167
9	1,024,296	102,430	674,858	12,716,898	11,445,208	1,621,425	1,303,707	2,925,132	11,445,208	36		203
10	1,024,296	102,430	821,115	14,664,738	13,198,264	1,753,056	1,586,249	3,339,305	13,198,264	41	(13)	232
11	1,024,296	102,430	937,377	16,728,841	15,055,957	1,857,693	1,810,848	3,668,540	15,055,957	34	(14)	252
12	1,024,296	102,430	1,365,396	19,220,962	17,298,866	2,242,909	1,613,286	3,856,195	17,298,866	36	(16)	271
13	1,024,296	102,430	1,469,403	21,817,091	19,635,382	2,336,516	1,736,176	4,072,692	19,635,382	38	(19)	290
14	1,024,296	102,430	1,571,662	24,515,478	22,063,930	2,428,549	1,857,000	4,285,549	22,063,930	40	(21)	308
15	1,024,296	102,430	1,670,209	27,312,413	24,581,172	2,517,241	1,973,439	4,490,681	24,581,172	41	(24)	325

16	1,024,296	102,430	1,762,627	30,201,766	27,181,589	2,600,418	2,082,636	4,683,053	27,181,589	43	(28)	340
17	1,024,296	102,430	1,845,957	33,174,449	29,857,004	2,675,415	2,181,094	4,856,509	29,857,004	45	(32)	353
18	1,024,296	102,430	1,916,605	36,217,779	32,596,001	2,738,997	2,264,568	5,003,566	32,596,001	46	(36)	363
19	1,024,296	102,430	1,970,227	39,314,731	35,383,258	2,787,257	2,327,925	5,115,182	35,383,258	47	(41)	369
20	1,024,296	102,430	2,001,598	42,443,055	38,198,750	2,815,492	2,364,992	5,180,484	38,198,750	48	(34)	383
21	1,024,296	102,430	2,077,196	45,646,976	41,082,279	2,883,529	2,454,314	5,337,843	41,082,279	37	(36)	384
22	1,024,296	102,430	2,799,349	49,573,051	44,615,746	3,533,467	1,744,777	5,278,244	44,615,746	36	(38)	383
23	1,024,296	102,430	2,789,593	53,489,370	48,140,433	3,524,687	1,738,697	5,263,384	48,140,433	36	(40)	379
24	1,024,296	102,430	2,764,792	57,380,887	51,642,799	3,502,366	1,723,238	5,225,604	51,642,799	36	(41)	374
25	1,024,296	102,430	2,724,317	61,231,930	55,108,737	3,465,938	1,698,011	5,163,949	55,108,737	35	(43)	366
26	1,024,296	102,430	2,667,833	65,026,488	58,523,839	3,415,102	1,662,806	5,077,908	58,523,839	35	(45)	356
27	1,024,296	102,430	2,595,391	68,748,605	61,873,744	3,349,905	1,617,654	4,967,559	61,873,744	34	(46)	344
28	1,024,296	102,430	2,507,550	72,382,881	65,144,593	3,270,848	1,562,905	4,833,753	65,144,593	33	(47)	330
29	1,024,296	102,430	2,405,519	75,915,125	68,323,613	3,179,020	1,499,311	4,678,331	68,323,613	32	(48)	314
30	1,024,296	102,430	2,291,329	79,333,180	71,399,862	3,076,249	1,428,138	4,504,387	71,399,862	31	(37)	309

Remark:

(a) Saving amount (469 Baht) x No. of members (182) x 12 months
(b) 10% of member's saving amount
(c) Required loan amount x total number HH obtain loan (l) x loan interest rate (5%)
(d) = (a) + (b) + (c)
(e) Size of account receivable (0.9) x total accumulate fund (d)
(f) Account receivable amount of year (N) - amount of year (N-1)
(g) (Total number HH obtain loan (l) x Yearly loan installment (986 Baht x 12 months)) - (c)
(h) = (f) + (g)
(i) = summation of (h) - summation of (g)
(j) = Net available fund for new loan (h)/ required loan amount
(k) No. loan due started at year 10th = No. new HH obtain loan of year N-9
(l) = summation of (j) + summation of (k)

A scenario of saving, government subsidization, loan, and number households obtain loan services (limited revolving loans at 182) to/ from microfinance for sea level rise impacts

Parameters:

Saving amount	469	Baht/member/month
Gov. subsidization	10	%
I (loan interest rate)	5	%
No. of members	182	
Account receivable	0.9	
Installment	986	Baht/member/month
Avg. loan period	8.50	years

Required loan amount (capital expenditures): year 1-10 = Baht 80,714; year 11-20 = Baht 108,473; year 21-30 = Baht 145,779

Unit: Baht (for column a - i)

Year	Saving from member (a)	Gov. subsidi-zation (b)	Earning from loan (c)	Total accum. fund (d)	Size of account receivable (e)	Available fund for new loan (f)	Loan installment (g)	Net available fund for new loan (h)	Loan balance (i)	No. new HH can obtain loan (j)	No. loan new/ renew (k)	No. loan due (l)	Total No. HH obtain loan (m)
1	1,024,296	102,430		1,126,726	1,014,053	1,014,053		1,014,053	1,014,053	13	13		13
2	1,024,296	102,430	52,464	2,305,915	2,075,324	1,061,271	101,352	1,162,623	2,075,324	14	14		27
3	1,024,296	102,430	108,964	3,541,605	3,187,445	1,112,121	210,500	1,322,621	3,187,445	16	16		43
4	1,024,296	102,430	173,536	4,841,867	4,357,680	1,170,235	335,240	1,505,475	4,357,680	19	19		62
5	1,024,296	102,430	250,214	6,218,806	5,596,926	1,239,246	483,370	1,722,616	5,596,926	21	21		83
6	1,024,296	102,430	334,964	7,680,496	6,912,447	1,315,521	647,092	1,962,613	6,912,447	24	24		107
7	1,024,296	102,430	431,821	9,239,043	8,315,139	1,402,692	834,203	2,236,895	8,315,139	28	28		135
8	1,024,296	102,430	544,821	10,910,590	9,819,531	1,504,392	1,052,499	2,556,891	9,845,497	32	32		167
9	1,024,296	102,430	673,964	12,711,280	11,440,152	1,620,621	1,301,980	2,922,601	9,754,231	36	15		182
10	1,024,296	102,430	734,500	14,572,506	13,115,255	1,675,103	1,418,924	3,094,027	9,384,593	38	13	(13)	182
11	1,024,296	102,430	734,500	16,433,731	14,790,358	1,675,103	1,418,924	3,094,027	9,484,294	29	14	(14)	182
12	1,024,296	102,430	987,106	18,547,563	16,692,807	1,902,449	1,166,318	3,068,766	10,053,548	28	16	(16)	182
13	1,024,296	102,430	987,106	20,661,395	18,595,256	1,902,449	1,166,318	3,068,766	10,948,222	28	19	(19)	182
14	1,024,296	102,430	987,106	22,775,227	20,497,704	1,902,449	1,166,318	3,068,766	12,059,842	28	21	(21)	182
15	1,024,296	102,430	987,106	24,889,059	22,400,153	1,902,449	1,166,318	3,068,766	13,496,883	28	24	(24)	182
16	1,024,296	102,430	987,106	27,002,891	24,302,602	1,902,449	1,166,318	3,068,766	15,367,816	28	28	(28)	182
17	1,024,296	102,430	987,106	29,116,723	26,205,051	1,902,449	1,166,318	3,068,766	17,672,641	28	32	(32)	182
18	1,024,296	102,430	987,106	31,230,555	28,107,500	1,902,449	1,166,318	3,068,766	18,133,422	28	15	(15)	182
19	1,024,296	102,430	987,106	33,344,387	30,009,949	1,902,449	1,166,318	3,068,766	18,377,257	28	13	(13)	182
20	1,024,296	102,430	987,106	35,458,219	31,912,397	1,902,449	1,166,318	3,068,766	18,729,565	28	14	(14)	182
21	1,024,296	102,430	987,106	37,572,051	33,814,846	1,902,449	1,166,318	3,068,766	19,895,710	21	16	(16)	182
22	1,024,296	102,430	1,326,589	40,025,365	36,022,829	2,207,983	826,835	3,034,818	21,838,675	21	19	(19)	182
23	1,024,296	102,430	1,326,589	42,478,680	38,230,812	2,207,983	826,835	3,034,818	24,073,198	21	21	(21)	182
24	1,024,296	102,430	1,326,589	44,931,994	40,438,794	2,207,983	826,835	3,034,818	26,745,057	21	24	(24)	182
25	1,024,296	102,430	1,326,589	47,385,308	42,646,777	2,207,983	826,835	3,034,818	30,000,032	21	28	(28)	182

26	1,024,296	102,430	1,326,589	49,838,622	44,854,760	2,207,983	826,835	3,034,818	33,838,124	21	32	(32)	182
27	1,024,296	102,430	1,326,589	52,291,936	47,062,742	2,207,983	826,835	3,034,818	35,197,972	21	15	(15)	182
28	1,024,296	102,430	1,326,589	54,745,250	49,270,725	2,207,983	826,835	3,034,818	36,266,263	21	13	(13)	182
29	1,024,296	102,430	1,326,589	57,198,564	51,478,708	2,207,983	826,835	3,034,818	37,480,333	21	14	(14)	182
30	1,024,296	102,430	1,326,589	59,651,878	53,686,690	2,207,983	826,835	3,034,818	38,985,961	21	16	(16)	182

Remark:

(a) Saving amount (469 Baht) x No. of members (182) x 12 months
(b) 10% of member's saving amount
(c) Required loan amount x total number HH obtain loan (l) x loan interest rate (5%)
(d) = (a) + (b) + (c)
(e) Size of account receivable (0.9) x total accumulate fund (d)
(f) Account receivable amount of year (N) - amount of year (N-1)
(g) (Total number HH obtain loan (l) x Yearly loan installment (986 Baht x 12 months)) - (c)
(h) = (f) + (g)
(i) = summation of (h) - summation of (g)
(j) = Net available fund for new loan (h)/ required loan amount
(k) No. loan new or renew that make total no. of loan below or equal to 182
(l) No. loan due started at year 10th = No. loan new or renew (k) of year N-9
(m) = summation of (k) + summation of (l)

APPENDIX O

Name of organization in Thailand deal with adaptation

1) Adaptation programs to climate change, Earth Net Foundation
2) Civil societies
   - Thai Climate Justice - TCJ
   - www.ThaiClimate.org
   - Northern Climate Change Network (NCCN)
   - Asian Cities Climate Change Resilience Network (ACCCRN)
3) Government agency
   - Thailand Greenhouse Gas Management Organization (Public Organization)
4) Academic and research centers
   - Southeast Asia START Regional Center
   - Thailand Reserach Fund's Reserearch and Development and Co-ordination Center for Global Warming and Climate Change - T-GLOB
   - โครงการผลกระทบของสนธิสัญญาและมาตรการต่างประเทศ ที่เกี่ยวข้องกับการลดและแลกเปลี่ยนสิทธิการปล่อยก๊าซเรือนกระจก ต่อการค้าและสิ่งแวดล้อมของประเทศไทย
   - MEAs Think Tank
   - Regional Climate Change Adaptation Knowledge Platform for Asia

APPENDIX P

Indicators to measure performances of microfinance institution

Performance	Explanations	Ratios/ Indicators	Remarks
Breadth of outreach	How many clients are being served?	Number of active clients at a time	
Depth of outreach	How levels/ classes are the clients?	Level of loan or savings clients at a point in time	
Loan repayment (portfolio quality)	How well is the lender collecting its loans? Any measurement of loan repayment, delinquency, default, or loss.	1) Portfolio at risk (PAR: X days) (Outstanding principal balance of all loans past due more than X days)/ (Outstanding principal balance of all loans)	- In microfinance, 30 days is a common breakpoint - Require loan tracking system
		2) loans at risk (LAR: X days) (Number of loans more than X days late)/ (Total number of outstanding loans)	Simplicity (use when cannot calculate PAR)
Financial sustainability (profitability)	Is the MFI profitable enough to maintain and expand its services without continued injections of subsidies?	1) Return of asset (ROA) (After-tax profits)/ (Total assets)	Common indicators for institutions that do not receive subsidies.
		2) Return on equity (ROE) (After-tax profits)/ (Total equity)	
		3) Financial self-sufficiency (Revenue excluding grants)/ (Total expenses + CFA) *CFA = Cost of fund adjustment = Actual interest paid after subsidies deduction*	- Indicator adjusted with subsidy - Often used by donor NGO - FSS below 100 % means not achieved financial breakeven.
		4) Subsidy dependence index (Annual subsidy received)/ (Average annual outstanding loan X Weighted average loan interest earned)	- SDI above zero % means microfinance still needs subsidy to operate, and not achieved financial sustainability
Efficiency	Does microfinance operate with cost effectiveness?	Operating expense ratio (OER) (Personnel and administrative expense)/ (Period-average loan outstanding)	- focus on nonfinancial operating expenses

(adopted from Rosenberg, 2009)

BIOGRAPHY

NAME	Mr. Amornpun Kulpraneet
DATE OF BIRTH	8 November 8 1965
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Chulalongkorn University, 1984-1988 Bachelor of Economics Thammasat University, 1991-1994 Master of Business Administration Mahidol University, 2001-2003 Master of Science (Environment Management)
RESEARCH GRANTS	Research Assistant Scholarship, Mahidol University
HOME ADDRESS	1332/75 S-Condo Sukhumvit 50, Sukhumvit Rd., Prakanong, Klongtoey, 10260 Tel.02-7414125
EMPLOYMENT ADDRESS	PTT Exploration & Production Plc. 555 Vibhavadi ransit rd., Chatuchak, Bangkok, Thailand 10900 E-mail: amornpunk@pttep.com
PUBLICATION	Coastal household adaptation cost requirements to sea level rise impacts, in *Mitigation and Adaptation Strategies for Global Change* on 4 April 2012