Climate Change Adaptation in Ben Tre Province, Vietnam: The Potential of Mobile Phones in Information Provision and Knowledge Exchange

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By
Chu Thi Hong Minh
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Supervisor: Loes Witteveen
Submitted by: Chu Thi Hong Minh

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Abstract

The objective of this research is to explore the potential of mobile phone in strengthening information provision and knowledge exchange to and between farmers to support the adaptation strategy in the context of climate change vulnerability in Ben Tre province. The field study was conducted in Giong Trom District and Ba Tri District in Ben Tre province. The study sample comprised thirty farmers, three extension workers and three leaders of Farmers Association living in three agronomic zones (fresh water, brackish water, and salinity water) and several key informants from Ben Tre Provincial People's Committee and the Department of Agriculture and Rural Development. Data were collected through questionnaire, and key informant interviews. Farmers were interviewed and asked to describe verbally any long-term changes in temperature and rainfall pattern and salt water intrusion in their local areas, any measures they had taken to adapt as well as the sources of information for their adaptation activities. The study analyzing data on farmers' perceptions of climate change, their adaptation activities as well as analyzing barriers of sources of information linked to farmers' characteristics to reveal the potential of using mobile phones supporting to strengthen the sources of information.

The study suggests that climate change and related stressors are posing an increasing challenge to livelihoods of farming communities in Ben Tre Province. Farmers need to develop the strategies to adapt to climate change impacts. Access to information is the key to help farmers become aware about the climate change and its external input to be able to make decisions about their future activities. However, farmers in the province are still facing the challenges in terms of access to information and knowledge for climate change adaptation

The study finds that mobile phones are increasingly accessible farming communities of Ben Tre while there is the continued absence of other ICTs infrastructure. Mobiles offer a relatively affordable and accessible option to farmers, compared to other ICTs. Mobile phones can contribute to livelihood adaptation strategies for farmers by enhancing their ability to access information of forecasts, appropriate technology and management practices. Mobile phones can contribute to improve incomes of farmers to deduce general vulnerability. Besides, mobile phones can play the role in diversified sources of information and communication for climate change adaptation and strengthen local empowerment. Farmers can access to the sources of information not only in local areas but also in other places. With the information farmers could have planning, preparedness and decision for their livelihood strategies in future.

The adoption and use of mobiles for access to information and knowledge sharing for climate change adaptation in the province is still a relatively new phenomenon. Although there is quite a lot of excitement for the potential of mobiles to have a positive effect to improve the sources of information to farmers in the province, there are still only few public interventions that would help to strengthening the effect of this ICT system. Besides, study have emphasized that the high cost of mobile phones and the farmer's relatively low income serve as major barriers for adoption by farmers.

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Table of Contents

Acronyms

CPC: Commune People's Committee

DARD: Department of Agriculture and Rural Development

FA: Farmers Association

ICTs: Information and Communication Technologies

MARD: Ministry of Agriculture and Rural Development

PPC: Provincial People's Committee

RMD: River Mekong Delta

WU: Women Union

TV: Television

1. INTRODUCTION

Nowadays, the Information and Communication Technologies (ICTs) have become increasingly integrated into the dissemination and exchange of information to farmers in developing countries, and it has become more prevalent in agricultural advisory service provision (Ballantyne et al, 2009). Radio and TV programmes feature agricultural information. Rural telecentres provide information on educational, agricultural and health issues and equip rural citizens with skills on how to use computers and provide basic literacy. However, availability of emerging technologies to address the complex issues of the twenty-first century like climate change is still limited, particular among the low-income populations. Climate change is negatively impacting livelihoods of already vulnerable community whose socio-economic system are heavily dependent on ecosystem service and products (Pant and Heeks, 2011). The effects from climate change have potential to intensify existing vulnerability dimension, while placing further constrains on their ability to adapt and achieve development outcomes. Stresses include the effects from heavy rainstorms, cyclones, sea level rise, intensive of flooding or drought, changing patterns of temperature and rainfall. Although recognizing the emergency of the problem, knowledge about climate change has been well established by experts, impacts of climate change on their livelihood, knowledge about existing and potential adaptation strategies are still emerging. Therefore, it is necessary to enhance the insight of people, particularly people living in the rural areas. It is also necessary to enhance adaptive capacity to climate change at the community level to reduce vulnerability to future climate change (Pant and Heeks, 2011).

Yap (2011) argued that ICTs can contribute to reduce or to cope with the impacts of climate-related events through rapid access to reliable and accurate data and the capacity to analyse and integrate information from varied sources which can support a community on their decision-making. However, in practice, particularly technology among vulnerable communities, ICT's potential has been limited by the divide in the coverage, uptake and use of digital. The ability of telecentres to contribute to adaptive capacity-building has been limited by their uncertain economic viability, technical problems, skill shortcomings including digital illiteracy, and social, economic, cultural, political and psychological barriers to accessing and using ICTs in such centres. (Pant and Heeks, 2011). In parallel with the limitation of the telecentre model, there has been a widespread availability and use of mobile phones, voice and SMS solutions should find more use as they offer easy accessibility in poor communitie**s**; and these must therefore be central to any consideration of ICTs' role for climate change adaptation.

1.1 Back ground information and environmental issues of Ben Tre province

According to the World Bank's 2008 Global Monitoring Report, Vietnam ranks eighth in the ten most vulnerable countries in East Asia to weather extremes. Staggeringly, 70 per cent of the country's population lives in areas subject to water-related natural disasters. There has been an annual temperature rise of 0.1 degrees C per decade between 1931 and 2000, and of between 0.4 and 0.8 degrees C in the country's three main cities from 1991 to 2000. The sea level has risen between 2.5 to 3.0cms per decade in the last 50 years, but with regional variations (Oxfam, 2008). Mekong Delta, one of the biggest rice producing area which led Vietnam to become the world's second-largest rice exporter, is the most affected area on climate change in Vietnam. Forty five percent of the Mekong's land could be under water. Research estimates on climate change in Vietnam for three main factors like temperature, rain fall and sea level rise in three periods 2010, 2050, and 2070 showed that there has been an annual temperature rise of 0.3; 1.1; 1.5 degrees C sequentially. Rain fall would rise

from 0-5% in 2050 and 2070. Sea level would rise 9cm in 2010, 33cm in 2050 and 45cm in 2070 (AAP, 2010). In recent years, seawater has penetrated part of the 13 provinces of Mekong Delta. Salt water has penetrated as far as 60km into the region, while the annual flood has not recurred (Oxfam, 2008).

Ben Tre is a coastal province, located at the end-stream of the Mekong River with four rivers run through which is the very low-lying area of Mekong River Delta. The province has a natural land area of 2,360.2 square kilometers and a population of 1.4 million (AAP,2010). Ben Tre has a diverse structure of crops such as orchards, rice fields, coconut, sugar cane, etc. Livestock breeding and aquaculture are other main activities in this province. Beside all these, there are quite a lot of other annual crops such as vegetables, beans, tobacco, rush, etc. According to Agriculture – Aquaculture Plan report of the DARD Ben Tre province in July 2010, the province is leading of the 13 provinces in the Mekong Delta about coconut economic and livestock breeding; second leading about orchard and aquaculture is in the third. The majority of rural households are small holder farmers in terms of farm size. They combine commercial crops like cash crops and fruit trees. Livestock and fish have integrated gradually in farming due to the variations in landform, and soil and water conditions. Rice and annual crops and fruit orchards are main agricultural products in fresh water areas; aquaculture, coconut in salinity water areas; and combination of aquaculture coconut, sugarcanes, fruit orchards and rice crop in brackish water areas.

Because of the geography features - located at the end-stream and very low-lying area, Ben Tre province is one of the most affected areas by salinity intrusion in Mekong Delta. Changing in weather pattern is other issue in Ben Tre in recent years. There has been more rainfall in the rainy season and more droughts in the dry season, the seasons have been starting earlier, and the rainfall is becoming less predictable. More rainfall in the rainy season is causing a rise in the water levels in the province. In the last five years the greater volume of river water combined with the high tide has resulted in a rise in the water level of about 15cm-20cm above the average level compared to previous years (Oxfam, 2008). Moreover, the dry season also causes the biggest problem: the invasion of salt-water leading to the shortage of fresh water for production and clean water for living activities.

Agricultural sector contributes large proportion to GDP (60-65%) in Ben Tre province, of which cultivation and livestock account for 92% of total agricultural value (AAP, 2010). However, in recent years, agriculture has been susceptible to influences which are seen as impacts of climate change such as rising of sea level cause salinity intrusion, changing rainfall patterns and changing in weather. It has far-reaching impacts on economy and farmers' livelihood, reducing food availability because of a reduction in agricultural production. In a few parts of the province near the coast, the concentration of salt in the water has already reached 30 parts per thousand (ppt) which makes growing most agricultural products virtually impossible. The combination of more drought in the dry season (usually from December to April in Ben Tre) and the sea water travelling higher up the rivers has combined both to increase the amount of salt in the water and to carry the salted water into areas not previously affected by salinisation (Oxfam, 2008).

Given its characteristics mentioned above of Ben Tre province such as being located in the affected area of climate change with diversify crop pattern the province was selected as the site for field study. The result of study can be applied to other provinces with similar characteristics.

There is increasing evidence that farm households in the MRD are developing adaptation strategies (Herminia et al., 2008). One kind of adaption measures in dealing with the impacts of climate change in Ben Tre Province is that the farmers adopt technologies such as using alternative crops or modern varieties, changing planting date, or farmers construct and maintain of small scale irrigation systems or embank to protect their farmlands from

floods. These measures are usually taken by individual farmers rather than community or national level (Oxfam, 2008). From the government of Vietnam, having recognized emergency of the climate change issues and its potential impacts to agriculture sector, on 5 September 2008, the Ministry of Agriculture and Rural Development (MARD) also circulated its own Action Plan for Climate Change Adaptation. Decision no: 2730 /QD-BNN-KHCN about "Issuance of the Action Plan Framework for Adaptation to Climate Change in the Agriculture and Rural Development Sector Period 2008-2020". The main tasks of the plan includes conduct of communication and information programme to disseminate knowledge and experiences to enhance awareness of climate change impacts and adaptation and mitigation activities; develop human resources to respond to climate change; develop a policy system, organisational structure institutional capacity to implement the plan (APF-ARDS, 2008). However, communication from the government to rural area is still largely done by top-down approaches. Activity for dissemination information about climate change adaptation to rural community and awareness of farmers is still limited. So farmers in the province are still constrained in terms of access to information and knowledge for climate change adaptation.

1.2 Problem statement

Addressing the complex issue of climate change impacting on agriculture sector in Ben Tre province is still a challenge for the government in Vietnam. In this context, the Information and Communication Technologies (ICTs) are supposed to play an important role on providing information and knowledge sharing for farmers for adaptation process. Using internet, television, radio, mobile phone, telephone etc., people may access to locally relevant information about weather forecast, early-warning information to prepare for preventive actions to reduce risk and vulnerability. ICTs can also play a role on network establishment for experience exchange to disseminate good practices and strengthening the voice of farmers within decision making process. In 2005–2006, Vietnam's ICT growth rate was double the average in Asia and triple the world average expansion rate (Tran and Nguyen, 2010). However, although Government has conducted programmes of ICTs development for the 64 provinces of the country, it was mostly for government organizations, universities, schools. Most of efforts concerning ICTs use in rural area have been focusing principally on improving telecom facilities (Vu, 2004) resulting to explosive increase on the availability and use of mobile phone in rural communities**.** These must therefore be central to any consideration of mobile phone's role for climate change adaptive capacity.

The objective of this research is to explore the potential of mobile phone in strengthening information provision and knowledge exchange to and between farmers to support to adaptation strategy in the context of climate change adaptation in Ben Tre province.

1.3 Outline of the report

This report consists of six sections:

- The first section provides an introduction to the report which includes the background, research problem and objective of the research;
- The theoretical concepts and conceptual framework related to the study are presented in Section two;
- Section three describes the research area and methodology used to achieve the research objectives;
- Section four discusses the results of the fieldwork;
- Section five is focused on the discussion of the findings;
- And section six presents the conclusion of the study which includes some recommendations.

2. LITERATURE REVIEW

Farmers are likely to deal with variations in the climate by making preparations based on their resources and their knowledge accumulated through past weather patterns. For time being, they shape their own skills to cope with climate change in order to reduce its negative impacts. This process is called adaptation. It would be useful to know what climate change adaptation is in the context of pursuing a strengthening of information provision and knowledge exchange to and between farmers.

Climate change is defined by IPCC (2007) as “a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This definition differs from the definition in the United Nations framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.”

Adaptation can be defined as “adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts.”(IPCC, 2001: 881) The purpose of the adaptation is to reduce potential damages or to take advantage of opportunities associated with changes in climate. In the United Nations framework Convention on Climate Change, they define “adaptation is a process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes” (UNFCCC, 2007).

For this study, in the context of pursuing a strengthening of information provision and knowledge exchange to and between farmers, adaptation means any private investment to mitigate the negative impacts of climate change. Normally, adaptation process takes place in two steps: (i) first, farmers themselves perceive that climate is changing; the need to adapt; perceived climate risk; (ii) given the existing resources, they will find the best ways to reduce the adverse effects of climate change (Pham, 2011).

2.1 Climate change impacts and livelihood adaptation strategy

Many people in the world are affected by climate change, but it does not affect everyone equally. Pettengell (2010) argued that, people in different geographic location are affected in different levels; some areas are more affected than others through their physical characteristics and the interaction between local climate systems. The ability of some communities to cope with climate change impacts is different caused by a variety of factors, such as inequalities in resources, capabilities, and opportunities. Population whose socio-economic system is heavily dependent on ecosystems services and products like agriculture and fisheries are particularly vulnerable to any changes in climate conditions. Countries with limited human, institutional, and financial capacity to plan and respond to the direct and indirect impacts of climate change are also particularly vulnerable.

Because of the complex and multidimensional nature of climate change impacts and livelihoods, this study utilizes the Sustainable Livelihood Framework (Fig. 2.1), which served as an important reminder and a checklist of climate change impacts and livelihood issues that were considered in the study. In its simplest form, the Sustainable Livelihood Framework describes the operation of farming communities in a Context of Vulnerability, within which they have access to livelihood Assets. From this model, there is a component that is not climate-related hazards but affects adaptive capacity of populations to respond

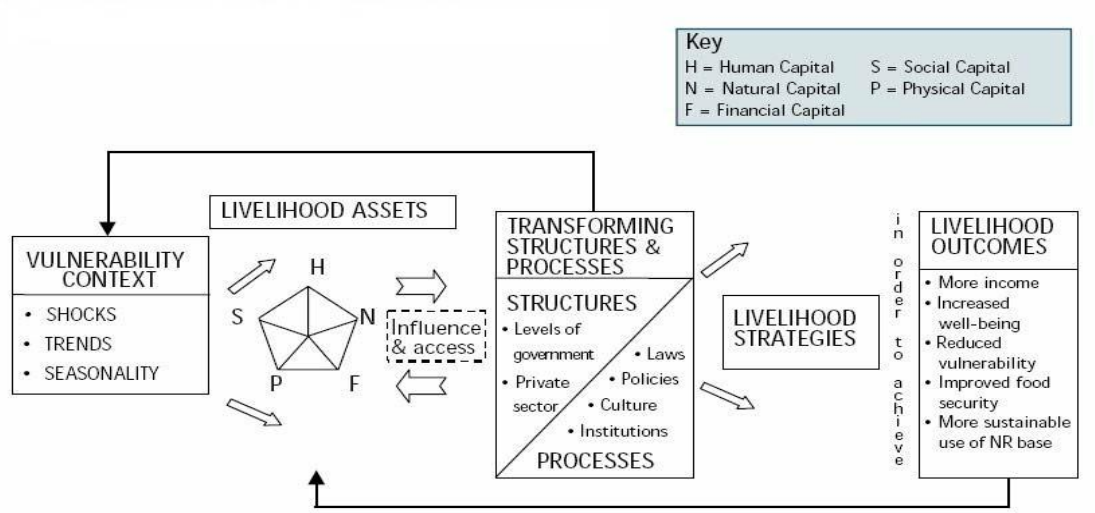


Figure 2.1: Sustainable Livelihoods Approach (DFID, 1999)

and adapt to the effects of climate change that are social, economic and political component. This aspect of vulnerability and adaptive capacity are therefore two sides of the same coin: as one rises the other falls. This context decisively influences the Livelihood Strategies that are open to people in pursuit of their self-defined beneficial Livelihood Outcomes (DFID, 1999).

Assessing the potential of ICTs contributing to livelihood strategies of farmers by facilitating access to information, it requires understanding of such livelihoods which captures their needs, capabilities, adaptability, vulnerabilities and their relationship to the social, legal and institutional environments in which they live (Grimshaw and Kala, 2011). In this context, ICTs can allow farmers devising appropriate coping strategies; enhancing their ability access to livelihood assets; adopting and undertaking diverse livelihoods strategies; and better understanding of institutions, organizations, policies and legislations that shape their livelihoods by increasing the flow of information as well as by facilitating the confluence of relevant actors and policies that affect rural livelihoods.

The vulnerability-adaptation framework (figure 2.2) introduced by Ospina and Heeks (2010), shows a chain of causality affecting the various vulnerability dimensions that developing countries are subject to. Vulnerability to climate change can reduce the ability of households to cope with impacts and recover from shock. Households can be vulnerable to climate change in terms of their finances, health, food security, water supply, habitat and livelihood. The effect on the different vulnerability dimensions may vary depending on conditions and circumstances. Those vulnerability dimensions determine processes of adaptation but in turn also being impact by these processes.

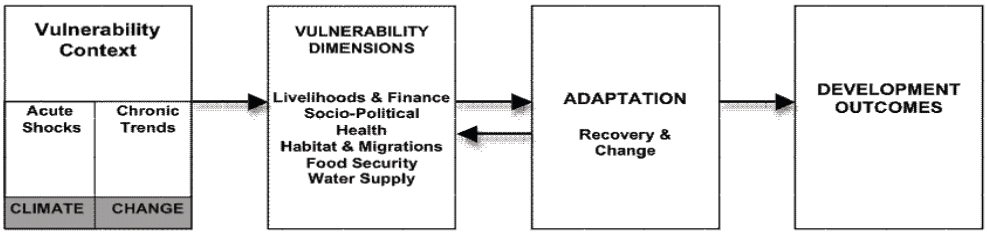


Figure2.2: Vulnerability and Adaptation to Climate Change (source: Ospina and Heeks, 2010)

adaptation is often seen as choice between reducing general vulnerability such as by improving people's incomes or by diversifying their livelihood strategies, and preparing to cope with specific hazards (Pettengell, 2010). Adapting rural livelihoods will require a range of investments, policies, planning and information, including the following:

- Access to forecasts: changes in weather pattern such as changing rainfall patterns and changing seasons are negative affecting farming cycles in many areas in the world. Rainfall pattern is being concentrated into lower; the seasons have been starting earlier, more extreme events, or the delayed onset of rainy seasons. Farmers who rely on traditional knowledge need interventions to help them plan and prepare since their farming calendars are becoming less reliable. For example they can be assisted in adjusting planting techniques such as varying planting or harvesting dates based on weather forecasts.
- Access to appropriate technology: to cope with impacts of climate change in many areas such as salinity intrusion, flooding, or droughts, farmers will need access to set of activities such as growing a number of different crops to reduce the risk of crop failure or using several varieties for crops that are more salt-, flood-, and drought-tolerant. Developing these varieties is one part of the solution, but so is ensuring that they are widely available where they are needed most, and that access is not hampered by a lack of information, expense, or intellectual property rights.
- Changing management practices: includes activities such as changing the use of capital, labor, chemicals, and fertilizers, or increasing the use of water conservation techniques to ensure that critical growth stages do not coincide with uncomfortable climate conditions.

Adaptation processes also require effective governance and management structures as they entail the steering processes of change through institutions, in their broadest sense. The vulnerabilities will be more severe if their livelihoods highly depend on weak social protection structures. In order to cope with climate-related disturbances, it requires that the structure has its own resilience to confront with these changes. Both institutions and structures, therefore, play a key role in determining access to resources, mediating the effects of hazards, and enabling the decision-making frameworks required for adaptation processes to occur (Ospina and Heeks, 2010).

Local coping strategies and traditional knowledge need to be used in synergy with government and local interventions. National governments have a specific role in establishing the policy and regulatory environment to encourage adaptation by individuals, households and private sector businesses. The choice of adaptation interventions depends on national circumstances. Communities can strengthen the knowledge base about climate change by enable access to early warning information of climate change such as trends, seasonal forecasts and weather alerts from satellites to national radio stations to local rattles and megaphones and cell phones (Ospina and Heeks, 2010). Besides, local actors are the key to achieving real impact on the communities. From dynamic local governance, the international donors, agencies and national governments can prove their role in establishing

effective enabling environments and channeling resources and technical support, ultimately effective adaptation (IFRC, 2009).

2.2 Role of Information and knowledge exchange for climate change adaptation

Successful adaptation means people becoming increasingly able to make informed decisions about their lives and livelihoods in a changing climate. According to Pettengell (2010), access to information is the key to help farmers to be well aware about the climate change and the external inputs to be able to make decisions about their future activities. The sources of information in communities whose agriculture is very dependent on nature climate is limited. Farmers base their crop and other production decisions on local knowledge systems, developed from years of observations, experiences, and experiments. Thus, the key to the success is educating farmers about the impacts of climate change and linking them to sources of weather and climate information; enhance their engagement with other communities to share experience and to advocate for change. Interventions are required that span the range of what is known and unknown about climate change in a specific location. This range starts with addressing the current hazards, increased variability, and emerging trends, and extends through to managing risk and uncertainty of impacts where the direction and scale are uncertain (Macauley,2010).

Kalas and Finlay (2009) argued that climate change adaptation for rural poor communities is facing a number of challenging developmental facts. The poor are last to be informed about the potential impact of climate change on their livelihoods. They are the most vulnerable with the least resources to adapt to climate change and the voices of those most affected by climate are not sufficiently included in the policy debate. Therefore, adaptation strategy for climate should focus on capacity development, raising basic awareness, knowledge sharing among communities and searching for solutions and informed decision making and increase community preparedness for disasters associated with climate change. Coping solutions and adaptation strategies need to be localised and decentralised with grassroots interventions to be initiated. In individual level, more detailed, accurate and relevant climate change information will take; adaptation strategies will be more effective.

Adaptation largely occurs at community's level so there cannot be a denial of the role of local knowledge and local experiences for climate change adaptation processes. Farmers understand about the nature systems stress and know how to cope with it by their own knowledge that is acquired through accumulation of experiences, and experiments over years. Besides, the process of adaptation is a cyclical process involving information, planning, implementation and evaluation. Local knowledge can contribute to several phases of that process include vulnerability assessment, priority setting process, preliminary selection and evaluation of adaptation measures, designing implementation methods for various adaptation strategies, and integration with other adaptation and mitigation strategies (Srinivasan, 2004).

Social networks can facilitate farmers in the exchange of information about possible climate change effects and can play a role in diffusing of adaptation innovations. It also helps to promote sharing of experiences of adaptation options and increase people's awareness of climate change and its effects. In rural communities, relationships between farmers can be considered as informal extension service agents in which each farmer act as an extension agent to the neighboring farmers (Pham, 2011). From this agent, farmers can access to variety information relate to climate change adaptation such as difference varieties, changing crop season, weather forecast etc.

Knowledge, information, data, and the social and physical infrastructures that carry them are widely recognized as key building blocks for more sustainable agriculture in the context of

vulnerability of climate related hazard. Through investments in e-Science infrastructure and rapid developments in digital devices and connectivity in rural areas, agricultural knowledge is being transformed and sharing among scientists, specialists and rural communities. Therefore, the role of ICTs for climate change adaptation in agriculture is discussed in following section.

2.3 Information and Communication Technologies (ICTs) for climate change adaptation

ICTs and potentials on communication

According to Chapman and Slaymaker (2002) ICTs are an expanding assembly of technologies that can be used to collect, store and share information between people using multiple devices and multiple media. Those technologies can be used to interlink information technology devices such as personal computers with communication technologies - for example the personal computer and laptop with e-mail and Internet - or telephones and their telecommunication networks. They also define ICTs as a range of electronic technologies embodying complex hardware and software which when converged in new configurations are flexible, adaptable, enabling and capable of transforming organisations and redefining social relations. The devices can be linked to others to share and exchange information and allow it to be used in such a way that they can also be categorized as ICTs. Thus, digital cameras, digital video cameras and players, personal digital assistants, slide projectors and mobile telephones are also compatible with more traditional media such as radio and television.

The basic communication form takes place without technological devices as it involves physical presence of people such as face to face communication that can be enhanced by the rapid development of ICTs such as computer and mobile devices. ICTs potential play a role to link between basic communication and traditional media (farm journals, newspapers, radio and TV). Mass media can potentially reach a large audience, however through this channel it is difficult to establish relationship of trust with them and get their involvement; while telephone, computers with communication technologies can potential reach large audiences and create a network for interactive communication between the senders and receivers. However, whether or not ICTs can play a potential on enhancing communication depend on many factors such as the interest of people involved, time, equipment, skills, knowledge and financial. Depending on the availability of those resources, different categories of people may have more or less access to specific categorized of ICTs (Leeuwis, 2004).

In developing countries, ICTs are still lagging behind developed countries in overall ICT usage and applications while there has been a rapid growth of mobile phone networks in developing countries in recent years. This diminishing mobile divide is regarded as a more accessible and less expensive means to close the digital divide. Besides, there is a trend that in the developing world, countries have skipped landline infrastructure and leaped directly into mobile technology. Therefore the average number of mobile phones has risen rapidly and has become the predominant mode of communication in the developing world. At the beginning of the twenty-first century, the average number of mobile phones per 100 inhabitants in Asia has risen by 100-400% compare to last five years (Rashid and Elder, 2009).

ICTs and climate Change Adaptation strategy

Kalas and Finlay,(2009) argued that ICTs contribute tangibly to climate change adaptation strategies by offering tools for natural disaster prevention, preparedness and risk management and they are also as information communication system and empowerment channel for grassroots people. Firstly, in a role of natural disaster prevention, preparedness and risk management, ICTs are used for a range of technical interventions, from high-level satellite weather mapping to scientific research. They offer tools relevant for data analysis, satellite imaging and vulnerability assessment, coordination of emergency efforts, and dissemination of locally specific and relevant information. For example, through telecentres or mobile phones, meteorological information for preparedness can reach remote villages, hence enhancing the effectiveness of early-warning systems for disaster prevention and risk reduction. Secondly, ICTs can fundamentally empower rural communities through access to relevant information and knowledge which can raise awareness and knowledge sharing to develop coping strategies to reduce risk and vulnerability. The voice of the poor can be strengthened and carried to the level of decision makers in order to demand action from the leaders and political accountability. ICTs also facilitate of networking among communities, individuals and institutions to create multi-stakeholder partnerships to identify and share good practices and coping strategies.

Ospina and Heeks (2010) point to the key connection of ICT and climate change adaptation as follows: ICTs can help strengthen institutions and organisations needed for the system to cope with climatic events, including the support of social networks and the facilitation of coordinated action through enhanced communication within those networks; ICTs can also improve the links between local systems and the macro level organisations that play a key role in the provision of enabling environments for adaptation by access to extended social networks; ICTs can increase the scale of available assets by combining the distant and the proximate; Mobile applications have improved the breadth of structural access by enabling integration of local producers like small entrepreneurs and farmers into regional and global supply chains, which also broadens the scale of asset availability, typically in terms of financial and physical capital.

In developing countries, mobile phones are increasingly being examined to more advanced applications, including agriculture, capacity building and climate change adaptation information/applications through connection to mobile broadband technology. In the context of ICT and agriculture, environment related information ranks high in the needs of the rural populations in developing countries. At the farmer level mobile phones are likely to remain the key information medium. Mobile phones have been used to provide agricultural advice in the form of voice and text messages (Karanasios, 2011).

Potential of mobile phone for information provision and knowledge exchange by farmers for climate change adaptation strategy

There are several reasons why mobile phones are considered as a tool used for information provision and knowledge exchange to farmers for climate change adaptation:

Due to the falling costs of investment, there has been a steady increase of communications infrastructure around the world which specially invests directly into mobile technology due to their unique characteristics. Physical infrastructures such as roads and phone wires are not needed, and base-stations can be powered using generators in places where there is no electrical grid. Even in the poorest countries, cell phone and its devices for Internet networks such as wired and wireless carrying both voice and data are being applied, and with time will be expanded to cover most rural areas (Ballantyne et al, 2009).

High desires for ICT in rural areas in Asia in order to improve access to knowledge and information has been criticized for failing to deliver benefits to poor people. Most evidences about changes of the availability of technology directed at mobile phone because of the ability of enabled access to information for a wide range of rural people due to falling costs, easy-to-use interfaces and only require basic literacy (Grimshaw and Kala, 2011). Beside basic connectivity, mobile phones offer benefits of mobility and security to owners. In addition to voice communication, some technical advantages of mobile phones allow for the transfer of data, which can be used in the context of applications for the wide range of purposes such as weather forecast, education, commerce, governance (Rashid and Elder, 2009)

As mobile phone using rates increase rapidly in developing countries, there has also been an increase in the extent of research on mobile phone usage. In general, studies have focused on different aspects of the adoption and use of mobile phones and evidence of the role of mobile phones in climate change adaptation is still emerging. As illustrated by Ballantyne et al. (2009), there are some trends and opportunities associated with the use of ICTs in agricultural science for development that can reveal the potential of using mobile phone for adaptation process. People are increasingly making use of a wide range and various types of devices and platforms to access to the information and share agricultural knowledge: from the Web to mobile phone, SMS messaging, television and radio. There are lot of evidences about farming communities, probably using different devices, especially the widespread use of mobile phones by farmers and others to get market and weather information. There are increasingly accessible public data and information held by institutions by devices which can be accessible from any location, across different devices and across boundaries. There is a broader trend to make publicly funded data, software, and information more open than before which mainly focuses on scientific literature. Besides, there is an increasingly of interconnected tools of knowledge bases and scientific data and information. The local knowledge base will be a key feature of future science. Farmers in different communities are starting to connect and share their knowledge with each other and increasing attention to innovation systems approaches in agricultural development among others. Much wider and more diverse actors involved in science and research, such as farmers, traders, and politicians so it can enhance such innovation processes by connecting these actors.

Ospina and Heeks (2010) pointed out that mobile phone can contribute towards an adaptation strategy as follows: Mobile applications have improved the breadth of structural access by enabling integration of local producers like farmers into regional and global supply chains, which also broadens the scale of asset availability, typically in terms of financial and physical capital; Mobile-based telecommunications networks allow rapid communication of information, thus improving the speed of disaster warning, response and recovery; Mobile phone can play a role in identification of diverse action possibilities arising from the sharing of knowledge by enhancing the social contacts that provide access to tacit knowledge; and by enhancing access to the explicit knowledge.

There are several examples about using mobile phones as a tool that help farmers on information provision and knowledge exchange for their livelihood activities. They demonstrate the way in which capacity can be built by integrating local and external data. They do not have a specific focus on climate change but they show how generic mobile phone can address climate change issues and enhance adaptation strategies. Those examples will reveal the potential of using mobile phones for climate change adaptation.

- ***Kenya: access to external information and knowledge.*** In Kenya, a project of the Local Language Speech Technology called NAFIS, provides the information about crops, livestock, market prices, inputs and other general agricultural information through using text farmers' mobile phone. Besides farmers are able to place their queries with

the electronically generated voice information service, which then reads the answer back to the farmers (Khalif, 2011)

- ***Vietnam: using local information for anticipatory adaptation and strengthen local empowerment.*** Mobile phone also supports beneficiaries in the use of local information for anticipatory adaptation. In Mekong River Delta, Vietnam, the flood warning project use mobile phone to collect data for the flood warning project and forward to central early warning system. The villagers have been provided mobile phones and flood markers and are trained to record water level in their areas and report the information to weather agencies via SMS. The data will be analysed by the experts and convert them into flood forecast figure and send back to the community (Pant and Heeks, 2011). Through this example we can see that by enhancing participation, monitoring and exchange between community members and broader networks, the use of mobile phone can help to 'give a voice' to groups and individuals that could be, otherwise, excluded. It can strengthen local empowerment and the ability to self-organise in response to external climatic disturbances

- ***India: two way exchange information and knowledge***. Lifeline – India project is using the telephone as a primary medium for information access for farmers in rural India. The technology platform comprises of an interactive voice response system (IVRS), an intelligent call manager and a unified messaging server integrated with a web-enabled application hosted on a configuration of web server, database server and exchange server. Farmers call through mobile phones for their query and request for advice. A well-defined technology assisted process enables a response to his/her query within 24 hours, and also enhances Lifelines knowledge-base at the same time (OneWorld, 2010). In this example we can see this project was providing two-way communication connecting the local community and the external level like district, national or even international level. The farmers are advised for their issues and from those issues government also coming to long term or short term solution strategies. This interactive communication can help to bridge the gap between researchers, advisers and farmers and strengthening the links between scientific and traditional knowledge.

- ***Vietnam, Kenya: support to decision making process.*** Mobile phones potentially play a role in decision making of farmer related to climate change which helps farmers transition from short-term to long-term planning. In the example of the flood warning project in Mekong River Delta in Vietnam or NAFIS project in Kenya mobile phone device can contribute to the identification of future and emerging risks and opportunities by provide the information about weather forecasting, crops, livestock, market prices, inputs and other general agricultural information. From that information, farmers can have decision for their alternative scenarios, and the diversification of livelihoods. Farming practices, or skill sets required to deal with change can be considered as a part of long-term planning.

Challenges of using mobile phone by farmers for climate change adaptation

Although mobile phones are increasingly accessible to farmers in developing countries, the cost of a mobile phone is still an constraining issue and low incomes remain the major barrier for adoption (Rashid and Elder,2009). In addition to the cost of the phone itself, maintenance factors such as cost of recharging the phone are also important considerations for farmers. The use of SMS services, a cheaper alternative to phone calls, is mediated by other factors such as illiteracy and lack of knowledge. The extent of SMS usage by farmers is even lesser which may be due to high rate of illiteracy and other technology-related factors such as the stated complicated nature of SMS, very small displays and less functional user. This underscores the importance of finding out the optimal technical applications to be adopted by users.

In rural areas in developing countries, mobile phone is mainly used to communicate with family and friends. Relationship maintenance or social purpose is the most important use of mobile phones in the south Asian study. The symbolic factors such as fashion and improved social status are what motivate the people to use mobile phones. Mobile telephony is highly valued by the people as a tool for strengthening social ties and for increased personal security. Evidence of the role of mobile phones in disaster situations like climate change is still emerging (Rashid and Elder,2009).

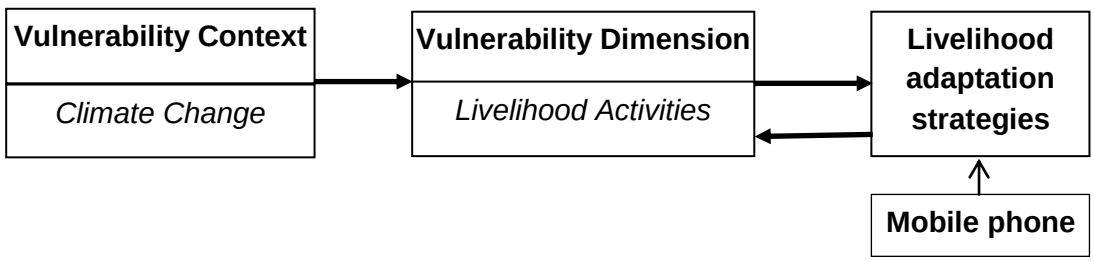
To cope with global issue like climate change, mobile phone and farmers themselves cannot solve that problem. It requires public interventions at the household, community or national level and properties which interact to create the adaptive capacity of the system (Ospina and Heeks, 2010).

2.4 Conceptual framework

This study will utilize the vulnerability-adaptation framework introduced by Ospina and Heeks (2010), with some modification to highlight the specific elements that it intends to discuss. In the framework below (Figure 2.3), the vulnerability context refers to impacts related to climate change specifically salt water intrusion and weather changes. Vulnerability to climate change can reduce the ability of households to cope with impacts and recover from shock. Households can be vulnerable to climate change in terms of their finances/economic, health, food security, water supply, habitat and livelihood. The effect on the different vulnerability dimensions may vary depending on conditions and circumstances. For this study, the impacts of climate change on livelihood strategies or activities will be given emphasis. This study also utilizes the Sustainable Livelihood Framework, which served as an important reminder and a checklist of climate change impacts and livelihood issues. The framework helps to describe the operation of farming communities in a Context of Vulnerability.

After describing the effect of climate change on the vulnerability dimension on livelihood, the next step is to examine adaptation strategies of households or communities so as to reduce the negative effects of climate change, in particular on their livelihoods. The experiences by the households/communities to adapt to climate change shall be described so as to gain understanding on measures that will reduce the vulnerability of livelihood systems to the effects of climatic variations and events. The analysis on adaptive measures may reveal the potential of using mobile phones for livelihood adaptation strategies.

Figure 2.3: Conceptual framework for this study (Source: base on vulnerability-adaptation framework of Ospina and Heeks (2010))



To achieve the research objective, the following general research question is formulated in order to understand the potential of mobile phone in the context of climate change adaptation in Ben Tre Province, Vietnam:

What is the potential of using mobile phones in information provision and knowledge exchange by farmers supporting to climate change adaptation strategy in Ben Tre Province?

The answer to the main research question will be explored through the following sub-questions:

1. How do the farmers in Ben Tre perceive climate change?
2. What are the livelihood activities of farmers in Ben Tre for climate change adaptation?
3. What are the sources and situations of information approach for adaptation strategies of farmers in Ben Tre?
4. How do farmers in Ben Tre use mobile phone for livelihood activities?
5. What are the existing structures and processes in the province that will facilitate the adoption of mobile phones for information provision and knowledge exchange by farmers related to climate change adaptation?

3. RESEARCH STRATEGY

This section presents methods and tools used to obtain research objectives and describe of research area.

3.1 Research area

Ben Tre is a coastal province which is known as leading producer of coconut economic, livestock breeding, orchard and aquaculture among the 13 provinces in Mekong Delta. The province is representative of the areas most affected by climate change in recent year in Vietnam. Agriculture sector has been susceptible to climate change impacts such as rising of sea level cause salinity intrusion, changing rainfall patterns and changing in weather. It has far-reaching impacts on economy and rural communities' livelihood, reducing food availability because of a reduction in agricultural production and narrowing the land area used for cultivation. Interviews was conducted in three ecological areas in Ben Tre province due to the variations in landform, and soil and water conditions – in fresh water area, salinity water area, and brackish water condition area. Giong Trom and Ba Tri districts were chosen for field work because the two districts have characteristics of three ecological areas which are as follows: fresh water area, brackish water area and salt water area.

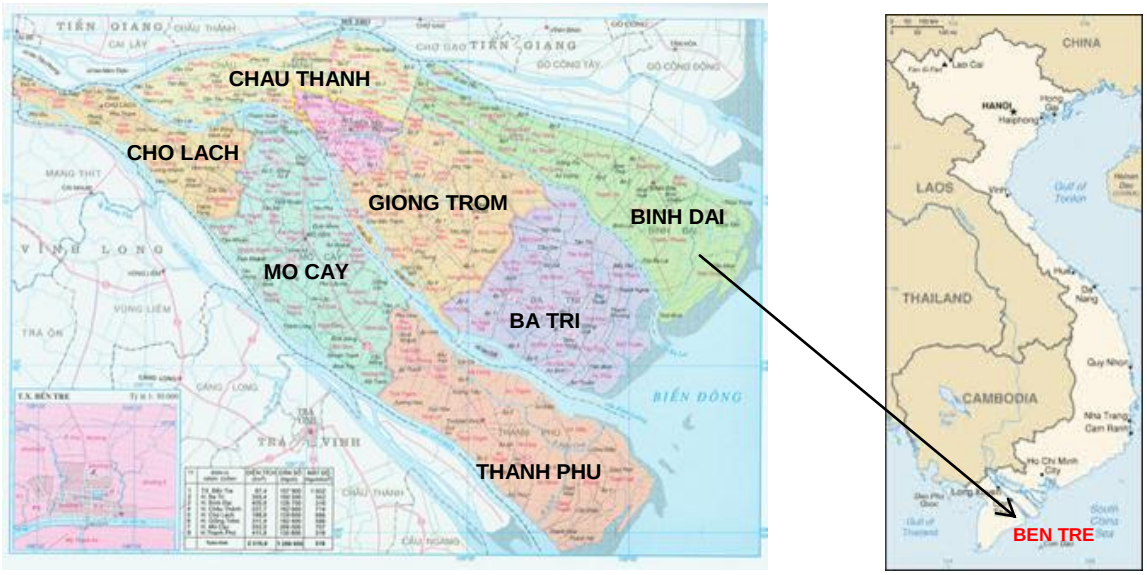


Figure 3.1: Administrative map of Ben Tre Province
(Source: VIETEC, 2003 and UTEXAS, 2011)

3.2 Research methodology

Qualitative approach was applied on this study. The research involved both desk study and field work.

Desk study

The desk study focused on theoretical concepts related to climate change adaptation; livelihood strategy of adaptation and its effect components; role of information and

knowledge for adaptation strategies of farmers; ICTs and its link to climate change adaptation. It tried to reveal examples of using mobile phone of farmers in the field to indicate the potential emerging technologies of awareness raising and knowledge sharing in the climate change adaptation. Literatures and documents were reviewed from various offices in Vietnam such as Ministry of Agriculture and Rural Development, and local People's Committee to collect information about social – economic target and economic development strategy of Ben Tre province; the existing structures and processes in the province that will facilitate the adoption of mobile phones for information provision and knowledge exchange by farmers related to climate change adaptation; national policies and future plans to enhance accessing to information for climate change adaptation of farmers in Vietnam.

Field work

In the field work, interviews conducted in three ecological areas in Ben Tre province: fresh water area, salinity water area, and brackish water area to make sure that the participants represent the different conditions. The respondents were farmers, key persons of Farmers Union and extension workers. In selecting the interviewees who are farmers, purposive sampling was used to make sure that the interviewees represent diversified agricultural activities. The participants were identified with the help of the Farmers Association officers who supplied the names of members who meet the above criteria (people in different ecological areas and difference agricultural activities).
Duration of the field work was three weeks. In the first week, most of the time was used for observation; talking to key persons of Farmers Union and extension workers and secondary data collection to explore the current status of farming system, livelihood characters as well as mobile phone infrastructure status in the province. In second and third week discussions to farmers, key persons of Farmers Association and extension workers were conducted. Likert scales and open questions were used in the questionnaires to look at the perception of farmers about climate change; their activities for adaptation; sources of information for decisions, and networks that household participate in, the integration to local agriculture extension services of government in coping and adapting. Questions about using mobile phone for accessing to difference source of information for adaptation process were also discussed. The sources of data collection are represented as follows (table3-1):

Table 3-1: Participation, tools, methods and topics for study data collection

Participation	Method and tools	Topics
Department of Agriculture and Rural Development in Ben Tre Province Ben Tre Province People's Committee	Secondary data study and interview	Collect information and the documents related to: - Agricultural production activities - Impact of climate change to agriculture - Extension service activities for climate change adaptation - Policies and plan for climate change adaptation - Telecommunication infrastructures
Three Farmers Association leaders in three ecological study areas	Interview	- Climate change impacts - Perception of farmers about climate change - Adaptive activities of farmers - Social, networking - Information sources approach - Mobile phone infrastructure and potential
Three extension workers in three ecological study areas	Interview	- Climate change impacts - Perception of farmers about climate change - Adaptive activities of farmers - Social, networking - Information sources and approach - Mobile phone infrastructure and potential
Ten famers in fresh water area Ten famers in salinity water area Ten famers in brackish water condition area	Interview	- Perception of farmers about climate change - Climate change impacts - Adaptive activities of farmers - Social, networking - Information sources and approach - Potential of using mobile phone for climate change adaptation discussion

4. RESULTS AND INTERPRETATION

In this section, the results from the field study are presented. The first part provides an introduction of rural livelihood in Ben Tre Province. The description follows the framework of Sustainable Livelihoods Approach and describes the vulnerability context, the livelihood assets, institution, policies and structures, and farming systems of the province. The general information of the selected interviewees is also described in this section. Then the results about the impact and perceptions of climate change to livelihood and adaptive measures of farmers in Ben Tre province will be presented. Results about the organizations, institutions, policies and structures supporting farmers in sources of agricultural information for adaptation activities will be mentioned next. Finally, to understand about the potential of mobile phone support to information provision and knowledge exchange for farmers, mobile phone infrastructure in Ben Tre, and mobile phone using status by farmers will be presented.

4.1 Rural livelihood in Ben Tre Province

4.1.1 Vulnerability context

Salt water intrusion: According the Agriculture – Aquaculture Plan report of Ben Tre (2010), sea level would rise 9cm, 33 cm, and 45 cm in years of 2010, 2050, and 2070, respectively in the Mekong River Delta. Under scenario of high emission, 45% of the area of the Mekong Delta will be under water by 2070 (AAP, 2010). Among affected areas, Ben Tre is the most affected area due to the low-land feature. At the present, the impact of sea level rise is already occurring in coastal provinces. Salt water intrusion has been more intensive and last longer in Ben Tre province in recent years. Normally, the salinity of water is about 4ppt[1], and salinity intrusion has penetrated toward the inland up to 40km and increase to 50km in March and as far as 60km from April to June. In this time 1ppt of high salinity of salt water penetrates all part of the province while some areas has never previously affected. Extension service officials in Ba Tri district say that the salty water covered about two-thirds of the province at the end of the dry season (May-June) and increasing penetrated into the region about 10 km compare to the last five years. Figures according to the agriculture department in the province report that as a result of increased salinization, in 2003, Ben Tre lost VND12billion (USD750 thousand) and lost VND570 billion (USD3,700 thousand) in 2005 due to loss of agriculture productivity of rice fields, orchard, coconut and sugar cane. Besides, the combination of more drought in the dry season (usually from December to April) and the sea water travelling higher up the rivers has combined both to increase the amount of salt in the water

Farmers in aquaculture are also affected by lack of brackish water for shrimp farming. In regularly, salt content suitable baby prawn is about 15ppt and 10ppt for mature prawns but in recent years the saline content is higher made prawn farming more difficult. According to statistic number of agriculture and aquaculture development of DARD in Ben Tre, Binh Dai, Ba Tri and Thanh Phu district is seen as a particularly suitable area for prawn farming with the combination of fresh, brackish and sea water within its boundaries. The area for aquaculture has increased rapidly in period 2001-2005 which account for 7.7% per year (in which area for prawn farming increase 33.8% per year in that period). The main reason for the rapid switch from cultivation to prawn farming was the boom in international demand for prawns, particularly in US and European markets and the profits from prawn farming were

[1] ppt: part per thousand

about ten times compare to those of rice farming. Another reason many small farmers changed from rice to prawn farming has been the increasingly brackish quality to the water, which is good for breeding prawns but not for rice.

Salt water intrusion has also affected the water resource in the province. It caused shortage of fresh water and water sources pollution. Some communities in coastal areas are not enough fresh water for drinking, people have to use salt water to do their washing. In dry season, some of communities have to buy water for drinking.

Variability in weather patterns: The study revealed that the weather in Ben Tre Province has changed and shown a complicated trend in recent years. It has become very difficult to predict and more prone to extremes due to increasing in the intensity of rainfall when it rains and unpredictability of the rainy season, the seasons have been starting earlier. According to AAP report in 2010 of DARD, a prediction about temperature, rainfall in the region in three periods 2010, 2050, and 2070 showed that there has been an annual temperature rise of 0.3; 1.1; 1.5 degrees C sequentially. Rainfall would rise from 0-5% in 2050 and 2070. A research about annual temperature rise from 1977 to 2007 showed that average temperature has risen from 0.05 -0.15/decade in the 20 century (figure 4.1).

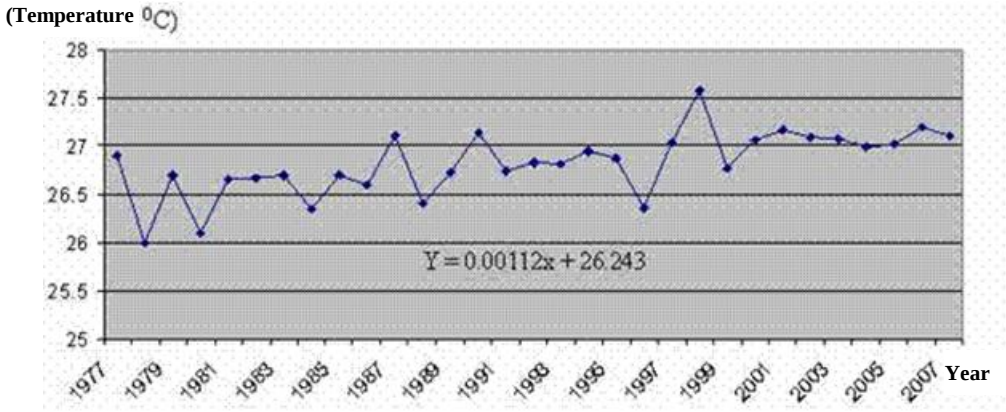


Figure 4.1: Average temperature has risen from 0.05 -0.15/decade in the 20 century in Ben Tre
Source: DNRE, (2009)

Usually Ben Tre has a rainy season roughly from May to November, followed by a dry season from December to April the following year. Farmers Association leader in Ba Tri said that the rainy season did start unusually in 2006-2007 it started in March and end in November while in 2009-2010 it came late. Last year, local farmers bred seed later more than one month compare to every year because waiting for raining to reduce salinity in water and the changing of rainy season is making the timing of planting more difficult. When it rains the rainfall was very high which cause a rise in the water levels in all of rivers and canals of the province. According to the DARD, the water level has risen about 15-20cm above the average level in the last five years as the result of the greater volume of river water combined with the high tide.

4.1.2 Livelihood assets

Nature capital: Ben Tre is a coastal province at 9o48' to 10o20' North altitudes and 106o48' West to 105o57' East longitudes, located at the end-stream of Mekong River and faces to the East sea with 65 km of seashore. The province has a natural land area of 2,360.2 square kilometers. It has a flat terrain and there are almost no woodlands here. The main land is surrounded with rivers and sea waters with Tien river in the north and Co Chien river in the south. It is also divided longitudinally by Ba Lai and Ham Luong rivers into three main islands: An Hoa, Bao and Minh. The entire province is criss-crossed with a network of smaller rivers that is long about 300 km in total. This water system is very useful in terms of

irrigation, water transportation, fishery and aquaculture economic, but it is also a limit in making the saline infection more severe in dry season when the sea water enters further into main land. Ben Tre province is also located in the subequatorial zone, affected by monsoon climate. The weather is divided into two clear seasons: the rainy season last from May to November and the dry season last from December to April. The average surface temperature fluctuates around 26oC and 27oC. Annual precipitation is around 1.250 - 1.500 mm (AAP, 2010).

Physical capital: In some areas along with the river the dykes are being strengthened or heightened for prevent salt water intrusion. A 600m dam across the Ba Lai River was built in Binh Dai District, Ben Tre Province. It aims to stop the infiltration of salt water and provide fresh water for daily life. However, the system still is not complete so many areas in the province still affect by salt water. The proportion of mechanism in farming practices of farmers in Ben Tre is not high. Farmers cannot purchase tractor and/or mowing-machine for their own uses; however they rent the machine for harvest. Most of areas conducted in the study can be irrigated. Only few areas cannot access to irrigation.
Financial capital: According to Ben Tre Agriculture – Aquaculture plan report 2010 of Ministry of Agriculture and Rural Development, GDP of the province increased from VND 5,417 billion ($271m) in 2000 to VND 9,941billion($497m) in 2005 and estimated about VND 21,511 billion ($1075m) in 2010. The average annual growth rate is 9.1% for period 2000-2005 and 9.4% for period 2006-2010. Agriculture, aquaculture and fishery make highest contribution (about 60-65%) to total GDP of the province, in which cultivation accounts for 71% for period 2000-2010; aquaculture is 28%; and forestry is 4.6%. The income per capital in agriculture sector in 2010 is 435USD.

Human capital: Population of Ben Tre is 1.36 million (2005). Eighty-two percent (82%) of the total population in the province derives their income from the agricultural sector in 2000. This percentage tends to decline in recent years which estimated about 69% of the total population in the province in 2010. Labor force accounts for 64.5% of the population in 2009. Literacy rate of the province is 98%; however only 2.5% of population in the labor force obtains educational level of college or university.

Social capital: Traditional Vietnamese society is organized around family relations and neighborhoods, and the family plays a central role in social life. This network is the most cited relation in interpersonal communication networks. The networks also play a significant role in household decision-making. Some agricultural techniques quickly found popularity in the area because they were seen as solutions for current problems from their relatives or neighbors.

4.1.3 Institution, policies and structures

The province is administratively divided into seven districts and one town including Cho Lach, Mo Cay, Giong Trom, Ba Tri, Binh Dai, Chau Thanh, Thanh Phu and the provincial town is also named Ben Tre.

In province level, Department of Agriculture and Rural Development (DARD) is the main government department supporting to farmers dealing with climate change issue in Ben Tre Province. The Official Agro-Forestry Extension Center (OA-FEC) is representative for DARD to organize and implement the programmes, projects and activities in local level. The center responds to select the technical information used for extension activities, and processing the extension materials. At community level, each extension worker is assigned to one or two communes. S/he is responsible for organizing training courses, monitoring of innovation adoption, and epidemic/pest control.

Besides, mass organizations are initiated and directed by government and divide into different social groups such as the Farmers Union, Women Union, War Veteran Group, and the Youth Union. Main function of those organizations is to assist farmers in agricultural production through technology transfer, production diversification and organize in coordination with the official extension system, disseminate and promote state policies.

National or foreign funded programs which include research and development projects, NGOs are also important institutions supporting to local farmers in agricultural activities by coordination with the mass organizations and Official Agro-Forestry Extension Center.

Responding to climate change issue, The Minister of Agriculture and Rural Development promulgated Decision No. 2730/QD-BNNKHCN dated September 05, 2008 to approve "Action Plan Framework on climate change adaptation and mitigation of the agriculture and rural development sector in period 2008- 2020". The main tasks of the plan includes: conduct a communication and information programme to disseminate knowledge and experiences to enhance awareness of CC impacts and adaptation and mitigation activities; develop human resources to respond to climate change; develop a policy system, organisational structure institutional capacity to implement the plan.

4.1.4 Farming system and livelihood strategy

The total land area in the province is 2,360km^2, of which 1,368 km^2 reserve for agriculture (58.04%). The agricultural land is divided into annual-crop area (514 km^2), perennial crop area (853.9 km^2), and the remaining area for aquaculture (362.94 km^2), forest (64.2 km^2) and salt farm. Agricultural area is classified to three groups due to variations in landform, soil and water conditions: fresh water area (accounted for 14.4% of total agriculture area) locates in Cho Lach, Chau Thanh, Giong Trom and north of Mo Cay district; salinity water area (31%) locates in Binh Dai, Ba Tri and Thanh Phu district; and brackish water condition area (55%) locates in East of Chau Thanh, North of Mo Cay, Giong Trom, and East of Binh Dai.

Ben Tre has a diverse structure of crops such as orchards, rice fields, coconut, sugar cane, etc. Livestock breeding and aquaculture are other main activities in this province. Beside all these, there are quite a lot of other short-term crops such as vegetables, tobacco, beans, rush, etc. According to Agriculture – Aquaculture Plan report of Ben Tre in July 2010, the province is leading of the 13 provinces in the Mekong Delta about coconut economic and livestock breeding; second leading in orchard; and aquaculture is in the third. The majority of rural households are smallholder farmers who combine commercial crops such as cash crops and fruit trees, livestock and fish have integrated gradually in farming due to the variations in landform, and soil and water conditions. Rice, annual crops and fruit orchards are main agricultural products in fresh water area; aquaculture, coconut in salinity water; and combination of aquaculture coconut, sugarcanes, fruit orchards and rice crop in brackish water condition.

In recent years, there has been a change in the structure of land used for cultivation. According to the DARD's report of the province, there was an estimate that 14.5km^2 of land used for cultivation switch to aquaculture in period 2001-2010. Even land used for cultivation purpose was having many important changes. The cultivation scheme was moving toward the reduction of low-yield rice fields, switching to sugar cane crops and fruit trees. Since 2000 to 2010, the rice field area declined 2.2% per year and fruit trees area was up 0.3% per year, meanwhile changes in coconut tree and sugar cane areas increased relatively up to 3.1% per year.

4.2 General profile of selected interviewees

Table 4.1 shows the general profile of the farmers in the study area. The interviews sample was more dominated by male (66.67%) than female (33.33%). The interviewees' educational level shows that 40% of the interviewees have finished primary level education, 43.33% have secondary level, 13.33% have high school level and 3.33% had their education above high school. In terms of type of agricultural activities, the combination of various kinds of crop and livestock accounted for 43.33%; the combination of orchard and livestock accounted for 23.33%; and the combination of orchard, crop and livestock accounted for 16.67%. Only small numbers of farmers have taken crop or orchard or aquaculture only as the main occupation. The majority of the farmers in this study own their farms, sizes of which range from several hundred to several thousand square meters.

Table 4.1: General profile of 30 selected farmers in three ecological areas

Types of farmers	No. of households studied in the areas			%. Of households studied in the areas			% of total households
	Fresh water area	Brackish water area	salinity water area	Fresh water area	Brackish water area	salinity water area	
1 Age of interviewee							
Young(20-35years)	1	-	-	10%	-	-	3.33%
Middle(36-50year)	5	6	-	50%	60%	-	36.67%
Old(51 and above)	4	4	10	40%	40%	100%	60%
2 Gender							
Male	7	5	8	70%	50%	80%	66.67%
Female	3	5	2	30%	50%	20%	33.33%
3 Education							
Up to primary	3	3	6	30%	30%	60%	40.00%
Secondary school	6	3	4	60%	30%	40%	43.33%
High school	1	3	-	10%	30%	-	13.33%
Above high school	-	1	-	-	10%	-	3.33%
4 Family members/Household							
1-3	-	1	1	-	10%	10%	6.67%
4-6	9	8	9	90%	80%	90%	86.67%
7-10	1	1	-	10%	10%	-	6.67%
5 Main occupation agriculture activities							
Crop	-	-	2	-	-	20%	6.67%
Orchard	1	-	-	10%	-	-	3.33%
Crop and orchard	1	-	-	10%	-	-	3.33%
Orchard and livestock	4	3	-	40%	30%	-	23.33%
Crop and live stock	1	5	7	10%	50%	70%	43.33%
Crop, orchard and livestock	3	2	-	30%	20%	-	16.67%
Crop and aquaculture	-	-	1	-	-	10%	3.33%
6 Other income							
Service	-	5	5		50%	50%	33.33%
Business	2	-	3	20%		30%	16.67%

Source: Calculated by author

All of the interviewees residing in the salt water area are older than 50 years. As a whole, 60% of the respondents are older than 50; 36.67% of them are from 36 to 50 years old and only 3.33% of them are younger than 35 years old. One Farmers Association officer in salt water area said that young people in the villages now tend to work in non-agricultural sectors such as industrial or service, which explains the high number of farmers belonging to middle and old group. Statistic number in secondary data showed that population in agricultural section has reduced from to 82% in year of 2000 to 69% in 2010 from total population of the province.

A typical farmer's household has around four to six members, and on average less than three members are in their working age. Besides income from farming, farmers in the research area have other activities to increase their income. Half of them have income from service or business activities like off-farm work, or a small grocery store. The interviews show that, 80% respondents in salt water area have income from other sources.

4.3 Impact and Perceptions of climate change

During the study the archives of the Department of Agriculture and Rural Development in Ben Tre Province and Ben Tre Province People's Committee were visited to collect information and the documents related to agricultural production activities; impact of climate change to agriculture; extension services; policies and plan for climate change adaptation.

Ten famers in fresh water area, ten famers in salinity water area, and ten famers in brackish water condition area participated in the field study. Every single interviewee in these three ecological areas in Ben Tre was asked about local weather patterns in the last five years

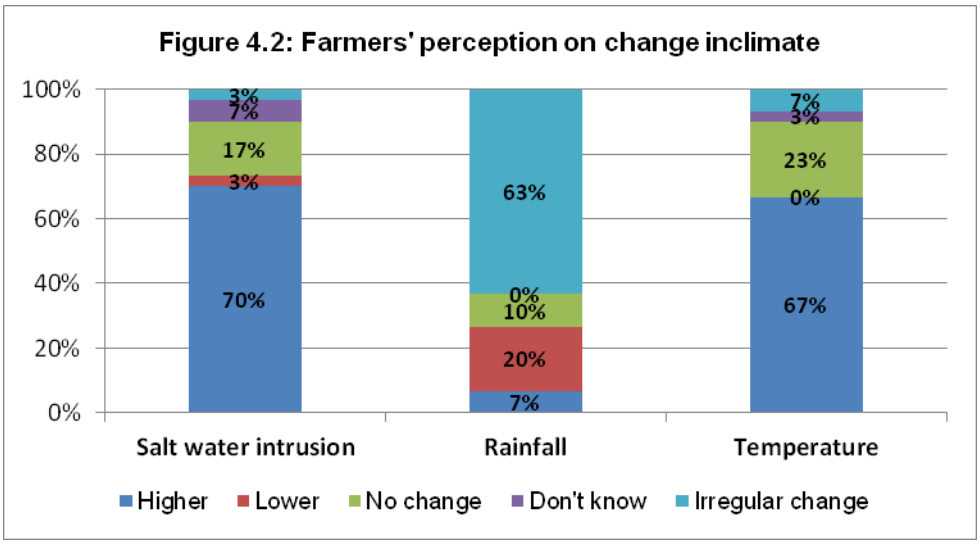
The Agriculture – Aquaculture Plan report of Ben Tre (2010) confirmed that Ben Tre province is one of the most affected areas by salinity intrusion. Besides, variability in weather patterns is also a problem of environment in the Southern region. In recent years, the weather pattern has occurred unpredictably. Variability in weather, to some extent, influences on the agricultural sector is reflected in changing rainfall patterns and changing temperatures.

To define how farmers perceive climate change the respondents were asked to describe level of salinity in their area on last five years. Twenty-one of the farmers indicated that salinity is increasing and more or less affects their agricultural production and livelihoods activities. One of them mentioned a decrease in salinity; five farmers thought that salinity had not changed and two of them did not know. Out of five respondents who said not to perceive a change in the salinity of water, four of them stay in fresh water area. Mrs. Bon who lives in brackish area said that "*two recent year, salinity water come earlier and last longer. Before I can start Summer-Autumn rice crop in March or April but last year I had to wait until June and this year was end of May*". Mr. Thien a farmer living in a fresh water area said "*every year I grow 3 crop of rice per year but last year I nearly totally lost in Summer-Autumn crop because of salt water intrusion, so this year I decide to grow only two crops per year. If not I would lose again"*. Mrs. Tien a farmer in salt water area said, she could no longer grow grass to feed the cows because of the salt content. "*I cannot grow grass for the cows now because of too much salt in the land here."*

Farmers in aquaculture are also affected by lack of brackish water for shrimp farming. Mr. Hay –extension worker in Ba Tri district mentioned that farmers in this area bred the seed prawn two month later in this year compare to the schedule of Official Agro-Forestry Extension Center as 16 February. The reason was salinity of water up to 40ppt- double of suitable condition for prawn. Several years before, normally it took four months for farmers to grow prawn reaching 30-40prawns/kg, but in two recent years it took about 6 months and prawns are very easy to die. It costs more money for caring time and food which caused trouble for farmers in this area.

Salt water intrusion has also affected the water resource in the province. One farmer in this area said the salt water now remained for as long as eight months of the year. "*Before, sail water remained in six months and it had six months of fresh water but now salt water last as long as eight months so we don't have enough fresh water to drink*". He added more "*even in four month of fresh water, the water also tastes saltier*".

In overall farmers participating in the study indicated that the climate is changing (figure 4.2). They describe and stress different aspects of the change and all coincided that it has negative effects to their daily activities and their livelihoods. In particular, farmers talk of the unpredictability of the weather and the intensity of weather events compared to previous years. When asked to describe their perception about salt water intrusion, rainfall pattern and temperature in local area, 70% of the thirty farmers answered that salinity of water are higher, 60% said rain fall pattern was irregular change and 67% asserted that temperature are increasing. One third of respondents answered that the reason for climate change is made in Heaven while the same proportion of respondents say that they do not know the reason that causes climate change. The rest of the respondents indicate that climate change is caused by human. 20% of the interviewees thought that weather events will more intensity in next twenty years; up to 77% of people do not know what will happen in future.



4.4 Adaptation activities

The experience of centuries has taught the traditional farmer how to deal with climate variability. In response to changing weather patterns, farmers in Ben Tre had a number of practices like the choice to grow different crops (intercropping, mixed cropping) or different varieties, adjust seasonal calendars, to improve the use of irrigation water or shift cultivation from one place to another and diversification in agriculture to deal with salt water intrusion and drought. Table 4.2 showed some methods in agricultural practice that farmers used in recent years to cope with climate change. It enables to identify the most common responses adaptive in farming practices is “Use different kind of varieties or crop”, “change in planting date suitable with climate condition”, “change in management practice” and “doing other job beside agricultural activities”. Measure is a set of activities such as varying planting by adjusting planting techniques; use new seed that are drought-tolerant or resistant to saline water; growing a number of different crops to reduce the risk of crop failure; changing in irrigation method, fertilizer using and labor.

Many interviewees said that they have changed from long–term rice crop to short-term crop. While others reduced three season rice crop to two season rice crop. In saltwater area many farmers switch from agriculture to aquaculture or even switch to work in non-agricultural activity. Leader of Farmers Association in Giong Trom district indicated that the areas used for coconut cultivation has expanded in recent year because coconuts could grow on all kinds of soil while fruits were less suitable. So most of Ben Tre's brackish zones were used

for coconuts and coconuts could also grow with other crops (intercropping), including cocoa, banana and pomelo.

Table 4.2: Farmers' Adaption activities in agriculture practices

No	Adaption in agricultural practices	Fresh water area	Brackish water area	salinity water area	Total
1	Moving to new cultivated area	10%	-	-	3%
2	Use different kind of varieties or crop	50%	50%	80%	60%
3	Grow different kind of /crops/plants	30%	30%	-	20%
4	Switch from cultivation to livestock	-	10%	-	3%
5	Switch from livestock to cultivation	-	-	10%	3%
6	Switch from agricultural to non- agricultural activities	-	10%	-	3%
7	Change in planting date suitable with climate condition	30%	60%	80%	57%
8	Change in management practice	40%	50%	90%	60%
9	Doing other job beside agricultural activities	20%	40%	70%	43%

Source: Calculated by author

For water issues, the climate change problems of the studied area relate mainly to the shortage of water in the dry season because of a prolonged drought period and intrusion of saline water. All villagers are using rainwater for drinking. The rainwater is generally stored in tanks but it provides water during a limited time of the year. Villagers respond to the pressure by investing more in water storage equipment or changing water use practices.

4.5 Sources and situations of information approach for farmers related to farmers' adaptation activities

4.5.1 Source of information

Government's extension Center

The main representative of Department of Agriculture and Rural Development (DARD) is The Official Agro-Forestry Extension Center which responds to select the technical information used for extension activities, and processing the extension materials. Main extension services transferred to farmers are: published books and newspapers; TV, radio program; training courses form extension staff; or organizing training courses from specialist of university or other organization; the results of field trials. At community level, each extension worker is assigned to one or two communes covering around seven thousand farmers. S/he is responsible for organizing training courses, monitoring of innovation adoption, and epidemic/pest control.

Other institutions

Other extension services apart from the official extension system are provided by some other local institutions and programs as they provide agricultural information for farmers. They include mass organizations, mass media, and national or foreign funded programs.

- Mass organizations: Mass organizations are initiated and directed by government and divide into different social groups such as the Farmers Union, Women Union, War Veteran Group, and the Youth Union. Main function of those organizations is to assist farmers in agricultural production through technology transfer, production diversification

and organize in coordination with the official extension system, disseminate and promote state policies.

- National or foreign funded programs: they include research and development projects, NGOs. They are important sources of technological information for local farmers and frequently organize training courses in coordination with the mass organizations and extension center
- Mass media: Mass media is applying for transfer information to farmers such as TV programs, radio programs, printed leaflets, newspapers (local and national), field guides and manuals. Leaflets and TV programs are the media preferred by farmers for agricultural information. Farmers can keep printed materials as a reference and use them for a long time. And the program in TV is interesting.

Informal net work

Kinship, friendship and neighbors are considered as the main channels of informal communication in the community. Those networks are an important source of information for large numbers of local people, given their limited access to mass media and lack of direct contact with the local government and other institutions. This network is the most cited relation in interpersonal communication networks.

4.5.2 Situations of information approach for farmers related to farmers' adaptation activities

At community level, the training courses held for farmers by Official Agro-Forestry Extension Center base on the topics which are selected according to its special objectives. Sometimes they are held for leading farmers, who are expected to spread the information to other farmers in their village. However, According to local famers, most of the training programs for farmers are according to the already made schedule, not base on demand of local farmers. Due to the financial constraints, the budget for extension materials, equipment is still limited. There is still lack of trained professionals to write and film TV programs for extension activities.

There was still not any special program training about climate change for both extension workers and farmers. Information about change weather pattern and crop season usually broadcast on commune's radio-casting of villages and announcement in province newspapers. Information about seeds, breed, fertilizer, pesticide and management practice usually introduce in training program. The numbers of farmers participating in training program were still limited. As interviewing 30 of farmers 20% of them said that did not participate in any training or activities of local area from the last 12 months, 36.67% of them seldom participated and 43% of them participated regularly. When asking about their lack of participation in the program of the government, a farmer, Mrs Thua said "*I spent all time in the field. it is not raining at all in this time while water in the canal is very salty. It cannot use for irrigation. If no raining, till my crop will lose all*". She added more: "*There is not much information that I can apply to my crop. By the way, my neighbor usually participate in many program so if there is something new he will inform to my family*"

Traditional dimensions such as oral transmission from friends, neighbors and relatives were most frequently answer by respondents when asked about source of agricultural information. Traditional Vietnamese society is organized around family relations and neighborhoods, and the family plays a central role in social life. 93% of the respondents were born in the district. Many of the respondents who had attended at least one training session stated that they had discussed it with their relatives or neighbors afterwards. Illustrated in table 4.3, ninety-seven percent (97%) out of 30 respondents indicated they

accessed agricultural practices information by oral transmission and 73% of them chose this source for climate-relate forecast information.

TV and radio are common sources for farmers searching information. 67.7%respondents indicated TV and 43.3% indicated radio are their sources to update weather information, while 40% of them indicated TV and 26.7% indicated radio are their sources to update agricultural practices information. On TV, there have been special channel of government for farmers which started from 22 April 2011 (VTC16). The air time for extension program is four times per week according to many topics. There are several extension programs in local TV program and in other the provinces' TV programs. Several respondents indicated that they cannot watch the extension program regularly since they have to work in the fields or some programs are not their interest. One third of respondents indicated that they usually got information form extension services and mass organizations and very few of farmers search information from books or newspapers.

Table 4.3: Main source of agricultural information approach

	Climate-relate forecast		Agricultural practices information	
Source of information	Frequency	Percentage	Frequency	Percentage
Book/Newspaper	3	10.00%	0	-
Internet	0	-	0	-
TV	20	66.67%	12	40.00%
Radio	13	43.33%	8	26.67%
Extension service and mass organisations	10	33.33%	10	33.33%
Oral transmission	22	73.33%	29	96.67%

Source: Calculated by author

4.6 Telecommunication infrastructures and using for livelihood activities of farmers

During the study, the archives of the Ben Tre Province People's Committee were visited to collect information and the documents related to telecommunication infrastructures of the province. Thirty famers in three ecological system areas participated in the field study. The majority of respondents in the study area have used mobile phone in the past three months regardless of whether or not they actually own one.

4.6.1 Telecommunication infrastructures

The study demonstrates the exponential growth of the mobile phone market in the province. There are 229,203 landlines and 718,426 mobile phones in the province in 2010. The average numbers of telephone subscribers are 75.5 per 100 inhabitants, which included 18.26 landlines and 57.24 mobile phone subscribers. Meanwhile, the number of Internet users is still modest and stands at 8.42 users per 100 inhabitants, which are concentrating mainly in urban areas. The province had 651 transmission stations for mobile phone, two telephone exchange centrals, and 68 satellites. The province now has 7 telecom service providers which are: Ben Tre Post Office, Ben Tre Telecom, and Viettel Telecom, the EVN Telecom, MobiFone, S-Fone and Ha Noi Telecom. Among them, the Ben Tre Post Office is currently commanding the largest post services market share with a network of branches and agencies casting all over the province. Most of the people in the study area are using service from Viettel Telecom. Seventy-six percent (76%) of interviewees said that they are using service of this supplier because mobile signal of Viettel' service has covered throughout the country and the remote areas. About 80% of the interviewees have been accounted to use mobile phone. Of the thirty respondents, sixteen of them indicated that they have mobile phones; eight indicated that they use both mobile phone and landline; four of farmers have landlines only and only two of them do not use telephone.

Viettel and Ministry of Agriculture and Rural Development have signed an agreement on 20 January 2010 cooperate to develop the agricultural information service supporting to rural areas. Experienced specialist in agriculture from Ministry of Agriculture and Rural Development supported the system "Call center of agricultural information 19008062" of Viettel to consult and provide agricultural information from farmers in over the country. Farmers can call to 19008062 or send a message to 8062 to look up the price of agricultural products, materials; technique of planting, breeding, taking care of, maintaining; weather information, diseases warnings; trading on agricultural products, breed and input (machines, fertilizers etc.). Viettel had the promotion program reducing the cost for farmers making a call or sending messages. The farmers' questions sent to the call center are answered daily, which meet timely their production problems. Besides, according to Hay, extension worker in brackish water area, there are several organizations also have the consultant service for farmers through telephone. They are commercial or production companies related to agricultural materials.

4.6.2 Using mobile phone of farmers

Perceived benefit of mobile use

The main perceived benefit of mobile use mentioned by respondents is to connect and improve communication with family and friends. Mobile phones are particularly useful in cases of emergency. Mobile phones are also popular as a status symbol.

When asked about the benefits of using mobile phone for livelihood of farmers, all of respondents indicated that using mobile phone can constitutes an important support for their livelihood in many ways due to the features of convenience, saving time, dynamic. Farmers can access to many sources of information at the same time. Most farmers indicated that they often call to their suppliers to ask about the price and new kind of seeds, fertilizers, pesticides and other chemicals that are suitable for their crop. Farmers also update and learn new agricultural technologies from their neighbor or friends, and relatives in other areas who have experience or success in agricultural production. Mr. Ni, a farmer in brackish water area, indicated that the suppliers usually have information to share with the farmers. They are often technicians from colleges or universities. Farmers prefer to buy materials from suppliers who can provide them technical information.

Using mobile phone for adaptation activities

To understand if farmers are using mobile phone for seeking or exchange information for adaptation activities, several questions were asked about outgoing calling that they made in the last three months as follows (table 4.4):

- Most of respondents called to buyers to ask for market information (67%). Participants indicated that they had been using mobile phones to directly discuss prices with buyers and crosscheck prices for their produce.
- Eighteen of farmers (account for 60%) called to supplier of agricultural input to ask information about fertilizer, pesticide, and seeds suitable for their farming practice. From this source they usually update the information about new seed or chemical to apply.
- Eighteen farmers call for friends, neighbors or relative in local area and six farmers called to people in other areas to exchange the information relate to weather forecast and agricultural practice in the last three months. Even though, few people did not call to friends in other area, they still have their phone number in case they need to call them.
- Only few calls were made to people in government like extension workers or Farmers Union officers but more than 50% of them have their phone number. Ni, a farmers, in brackish water area, indicated that he rarely call to extension workers or Farmers Association' offices because it is difficult to get quick answers since they are always busy. During a conversation in his house with Hay, an extension worker, to get his

opinion about Ni's testimony, the author observed that there was a small store selling agricultural inputs in his house, a board with his and his wife' phone number and another with his work schedule during the week. He indicated that each extension worker is assigned to one or two communes covering around seven thousand farmers, which make it impossible for him to visit them regularly. Many farmers contact him by mobile phone and sometimes it causes trouble for him. "*Farmers are now using mobile phone a lot. I have to work over time when I'm at home. Farmers call me all the time. Sometimes I have to switch off my phone when I am at home*" he said. To illustrate this further, our conversation was interrupted by several phone calls during the interview.

- Three out of thirty respondents made outgoing calls for organizations or agricultural service center for their consultant services. They are commercial or production companies related to agricultural materials. When discuss with farmers about using agricultural consultant service, Mr. Chien, a farmer in fresh water area, said that many farmers know about that service but they rarely call to them because the fee still high. He mentioned that if there were a service free of charge for farmers, many people would use that.

Table 4.4 Farmers' using mobile phone for *agricultural information*

No	Objective	Saving mobile number	Saving landline	Saving both mobile and landline	Saving mobile number and called	Saving landline and called	Saving both and called
1	FA Offices	10	-	-	6	1	-
2	Extension worker	8	-	-	3	-	1
3	Agricultural product buyers	3	-	-	12	-	8
4	Veterinary worker	4	-	-	5	1	4
5	Suppliers of agricultural input	1	2	-	-	11	7
6	Friends/relatives in local area	3	6	-	8	5	5
7	Friends/relatives in other area	7	5	4	1	1	4
8	Organisations/services related to agricultural	2	-	-	3	-	-

Source: Calculated by author

Barriers of using mobile phones of farmers

Seventy- seven percent (77%) of respondents indicated the monthly cost of mobile phones is high compare to their income. Rest of respondents indicated that it does not affect much their expense. Farmers have different strategies to reduce the cost of mobile usage such as using pre-paid service because of the ability to control the cost and spending behaviors; making very few outgoing calls. Over one third of the respondents had made one to three outgoing call in a week. Forty-six percent (46%) farmers had made more than three outgoing call in a week. 18% farmers had made outgoing call every day. All of respondents have not made any outgoing SMS message due to illiteracy and lack of knowledge factors. Mr Binh, 50 years old farmer said "*It is easier to make and receive the call. I don't know how to send message. Besides, the letter is too small. I cannot read it and I am not sure if I sent a message, the receiver could know how to read it*" he added more "*Only youths usually send message. Older like me nobody do that*". Most of respondents indicated that face to face interactions are still preferred in many contexts. However, respondents still spent significant amounts for monthly expenditure on mobile phones with average 2.45% compare to their income.

5. ANALYSIS AND DISCUSSION

This study described the vulnerability context of Ben Tre Province related to climate change impacts which are salinity intrusion and changing in weather pattern. It has far-reaching impacts on economy and farmers' livelihood because of the impacts to their agricultural production activities. The combination of more drought in the dry season and the sea water travelling higher up the rivers has combined both to increase the amount of salt in the water and to carry the salted water into areas not previously affected by salinization which makes growing of agricultural products virtually impossible and results to the shortage of fresh water for production and clean water for living activities.

This study investigated how farmers in Ben Tre perceive of climate change, how they have adapted to whatever climate change they believe has occurred and what the sources of information are for their adaptation activities. Thirty farmers were interviewed and asked to describe verbally any long-term changes in temperature and rainfall pattern and salt water intrusion in their local areas, as well as any measures they had taken to adapt. The study analyses data on farmers' perceptions of climate change, their adaptation activities as well as the barriers of sources of information linked to farmers' characteristics to reveal the potential of using mobile phones supporting to strengthen the sources of information.

5.1 Perception of climate change of farmers

The literature on adaptations also makes it clear that perception is a necessary prerequisite for adaptation. All farmers participating in the study indicated that the climate is changing. They described that the climate has become hotter, the rains less predictable and there is an increase in the amount of salt in the water. One third of respondents indicated that the reason for climate change is divine intervention or natural phenomenon while the same proportion of respondents said that they do not know the causes of climate change. Most of respondents do not know climate change would tend to complicated impact in future. It can be noticed that understanding of farmers' perceptions of causes of climate change is important as this understanding might be decisive in determining farmers' responses and their efforts to address human activities that may contribute climate change mitigation and adaptation. If farmers are not aware that human activities may alter climate related processes, the implication for adaptation and mitigation is not efficient. This conclusion is in line with Pettengell (2010) where he indicated that access to information is the key to help farmers become aware about the climate change and external inputs to be able to make decisions about their future activities.

5.2 Adaptation activities of farmers

All farmers participating in the study indicated that the climate is changing. There is evidence that farmers in Ben Tre are aware about the impacts of changing weather pattern to their livelihood. Farming households have used various adaptation measures such as adjusting the crop calendar or using alternative crops and seed varieties. Different types of crops, coconuts and fruit trees that are more resistant to saline intrusion are being developed. Pettengell (2010) argued that, responding to a disaster like climate change in rural areas, adaptation is often seen as choice between reducing general vulnerability such as by diversifying their livelihood strategies, and preparing to cope with specific hazards. In Ben Tre, faced with financial constraint, instead of investing in costly defensive efforts such as small-scale irrigation, farming households have used alternative adaptation strategies. There has been a significant change in structure of land used for cultivation in Ben Tre in

recent years. According to a DARD report, the land used for cultivation is now used for aquaculture, rice fields have been reduced, and crop cultivation has switched to coconut. These changes were made not necessary for climate change adaptation as there are other factors involved such as income, market demand etc. However, most of respondents indicated that salinity intrusion and changing in weather pattern is the main cause for their change in cultivation structure. Adoption of new technologies for alternative adaptation measures of farmers requires new managerial knowledge, as well as understanding of the interactions between crops and climate.

5.3 Sources and types of information

Ospina and Heeks, (2010) argued that, in adaptation processes within vulnerable livelihoods in developing countries, both institutions and structures play a key role in determining access to resources, mediating the effects of hazards, and enabling the decision-making frameworks. National governments have a specific role in establishing the policy and regulatory environment to encourage adaptation by individuals, households and private sector businesses. The choice of adaptation interventions depends on national circumstances. Besides, local actors are the key to achieving real impact on the communities. From dynamic local governance, the international donors, agencies and national governments can prove their role in establishing effective enabling environments and channeling resources and technical support, ultimately effective adaptation (IFRC, 2009).

The main government department supporting to farmers dealing with climate change issue in Ben Tre is The Official Agro-Forestry Extension Center which is administrated by the provincial Department of Agriculture and Rural Development. However, communication from the government to rural is still largely done by top-down approach. Most of the training programs for farmers are based on pre-determined schedule, and not based on demand by local farmers. Activity for dissemination information about climate change adaptation to community and awareness of farmers is still limited due to the financial constraints, shortage of labour both in quantity and skill. The budget for extension materials, equipment is still limited. Each extension worker is assigned to one or two communes covering around seven thousand farmers so in most cases, extension workers rarely have direct contact with local farmers. Most activities for transferring technical information are coordinated with a member of Farmers Union and other mass organization members include providing agricultural information to farmers.

The ineffectiveness of the top-down approach can be seen by the low rate of participation by farmers on extension activities in which only 43% of respondents participate regularly and all the r have rarely or never participated in over a year. Besides, farming practices of farmers in the province are mostly based on their own experiences. Agricultural information mainly comes from traditional sources like oral transmission from friends, neighbors and relatives. Although respondents indicated TV and radio as common sources of information to the farmers, but there is not much air time for extension programs. Some farmers cannot also watch TV regularly. In the first place, they never used mass media as the main source for adopting an innovation. Extension leaflets seldom reach the farmers. So farmers in the province are facing the challenge in terms of access to information and knowledge for climate change adaptation

5.4 Potentials of using mobile phones for information provision and knowledge exchange for farmers

While farmers in Ben Tre are facing the challenge in terms of access to information and knowledge for climate change adaptation, mobile phones are increasingly accessible to

farmers in Ben Tre Province. Farmers in the province have very limited access to other modes of communication such as internet, making mobile phones the only option available. Leeuwis, (2004) also indicated that the basic communication forms take place without technological devices as involves physical presence of people such as face to face communication can be enhanced by the rapid develop of ICTs such as computer and mobile devices. Telephone can potential reaches large audiences and creates a network for interactive communication between the senders and receivers.
Based on the general information of the province, only 2.5% of the labor force has college or university level education while more than 80% of respondents are in primary and secondary school level. However, since using mobile phones requires only basic literacy, it can be said that majority of those who had mobile phones had the basic level of education to make use of the technologies. Study in Ben Tre province reveals some potential of mobile phone in strengthening information provision and knowledge exchange to and between farmers to support to adaptation strategy in the context of climate change adaptation in many ways as follows:

5.4.1 Information for livelihood adaptation strategies:

Access to forecasts, access to appropriate technology and management practices: Mobile phones can sharing of learning and experiences among farmers in local and other regions about crop varieties, farming techniques and weather forecast information faster than before. Calls enable farmers to save time, diversify crops, and to get new information. There are increasingly accessible public data and information held by institutions and devices such as Viettel Telecom and other organizations. Farmers can be accessible from any location enabling collaboration across boundaries. With accurate and timely information farmers could decide on their livelihood strategies in future.

Reducing general vulnerability by improving people's incomes: Mobile phones can contribute to improve incomes of farmers to deduce general vulnerability of climate change by enhancing the ability to access agricultural market information. Sixty-seven percent (67%) respondents have used mobile phones to directly discuss prices with buyers and crosscheck prices for their produce, instead of relying on middlemen or a few buyers. It helps farmers make decisions on the best time to harvest and sell agricultural products.

5.4.2 Diversified sources of information and communication for climate change adaptation

External information and knowledge: Farmers can access to external information and knowledge by sharing information with friends or relatives in other areas or through call centers such as Viettel Telecom service or other organizations, farmers can connect with experienced specialists.

Two-way exchange information and knowledge: Mobile phones help to strengthen social ties among farmers which create opportunities diffusion of innovations through their mechanism of information sharing. When individuals interact frequently in social networks they are more likely to exchange information. In the study in Ben Tre, 60% of respondents use mobile phone to call friends, neighbors or relative in local area and 20% of respondents called to people in other areas to exchange the information relate to weather forecast and agricultural practice

Local information and knowledge generation: Adaptation largely occurs at community's level so there cannot be a denial of the role of local knowledge and local experiences for climate change adaptation processes. Farmers understand about the nature systems stress and know how to cope with it by their own knowledge that is acquired through accumulation

of experiences, and experiments over years. In Ben Tre the main sources of agricultural information to farmers are from relatives, friends, neighbors. Some techniques quickly found popularity in the area because they were seen as solutions for current problems from their relatives or neighbors. Therefore, the role of mobile phones in knowledge generation of local information cannot be overlooked.

Strengthen local empowerment: Literature study indicated that local coping strategies and traditional knowledge need to be used in synergy with government and local interventions (Ospina and Heeks, 2010). Call centers or consultant services become a link between the farmers and the leading scientists from Ministry of Agriculture and Rural Development, organizations or universities. This has created a greater participation of farmers between community members and broader networks. It can strengthen local empowerment and the ability to self-organize in response to external climatic disturbances. Farmers have more opportunities to raise their voice to decision makers. The farmers are advised for their issues and from those issues government also come up with long term or short term solution strategies. This interactive communication can help bridge the gap between researchers, advisers and farmers and in strengthening the links between scientific and traditional knowledge.

5.4.3 Challenges of using mobile phones for climate change adaptation

Although there is quite a lot of excitement for the potential of mobiles to have a positive effect to improve the sources of information to farmers in the province, number of challenges are raised such as gaining community involvement and identifying solutions that are specifically relevant to vulnerable communities. There are still only few public interventions that would help to strengthen the effect of this ICT system.

Besides, studies have emphasized that the high cost of mobile phones and the farmer's relatively low income serve as major barriers for adoption by farmers. Most of respondents indicated that face to face interactions are still preferred in many contexts. The main perceived benefit of mobile use by respondents is to connect and improve communication with family and friends. Mobile phones are particularly useful in cases of emergency. Mobile phones are also popular as a status symbol.

However, mobile phones have already become part of the farmer's culture. Ten years ago it would be difficult to predict the current uptake of mobile phones in rural areas. As information technology continue to evolve, it seems reasonable to suggest that within ten years the mobile phone will be able to access a range of data based services such as market and other agricultural information as mobile voice telephony will converge with other digital technology.

6. CONCLUSION AND RECOMMENDATION

This chapter provides a summary of the study. An overview of the study is presented first followed by a presentation of the key findings of the study which includes the answers to the research questions and some recommendation. A brief discussion on the study's limitation is likewise given. The chapter ends with an implication for further research.

Overview of the Study

The study explored the role of mobile phone in strengthening information provision and knowledge exchange to and between farmers to support to adaptation strategy in the context of climate change adaptation in Ben Tre province.

The study suggests that climate change and related stressors are posing a challenge to livelihoods of farming communities in Ben Tre Province which still increases. The impacts of salinity intrusion and changing in weather pattern have far-reaching impacts on economy and farmers' livelihood because of the impacts to their agricultural production activities. The combination of more drought in the dry season and the sea water travelling higher up the rivers has combined both to increase the amount of salt in the water and to carry the salted water into areas not previously affected by salinization which makes growing most agricultural products virtually impossible and leading to the shortage of fresh water for production and clean water for living activities.

Farmers are developing strategies to adapt to climate change impacts. Farming households have used various adaptation measures such as adjusting the crop calendar or using alternative crops and seed varieties. Different types of crops, coconuts and fruit trees that are more resistant to saline intrusion are being developed.

Access to information is the key to help farmers become aware about the climate change and its external input to be able to make decisions about their future activities. However, farmers in the province are still facing the challenges in terms of access to information and knowledge for climate change adaptation. Communication from the government to rural is still largely done by top-down approach. Activity for dissemination information about climate change adaptation to community and awareness of farmers is still limited due to the financial constraints and shortage of labour both in quantity and skill. Farmers participating in extension activities are limited. Besides, farming practices of farmers in the province are mostly base on their own experiences. Agricultural information mainly comes from traditional sources like oral transmission from friends, neighbors and relatives. Although respondents indicated TV and radio are common sources of information to the farmers, but there is not much air time for extension programs and farmers cannot watch regularly. Besides, they never used mass media as the main source for adopting an innovation. Extension leaflets seldom reach all of farmers.

Key Findings of the Study

One of the key findings this study is that mobile phones are increasingly becoming accessible to farming communities of Ben Tre while there is the continued absence of other ICTs infrastructure. Mobile phones offer a relatively affordable and accessible option to farmers, compared to other ICTs. Mobile phones can contribute to livelihood adaptation strategies for farmers by enhancing their ability to access information of forecasts, appropriate technology and management practices. Mobile phones can contribute to improve incomes of farmers to deduce general vulnerability. Moreover, mobile phones can

play the role in diversified sources of information and communication for climate change adaptation and strengthen local empowerment. Farmers can access to the sources of information not only in local areas but also in other places. With the information farmers could have planning, preparedness and decision for their livelihood strategies in future.

However, the adoption and use of mobile phones for access to information and knowledge sharing for climate change adaptation in the province is still a relatively new phenomenon. Although there is quite a lot of excitement for the potential of mobiles to have a positive effect to improve the sources of information to farmers in the province, there are still only few public interventions that would help to strengthen the effect of this ICT system. There is a need of public interventions in local, communities and national level. It is important that more funding is committed to making use of new and emergent ICTs for climate change adaptation and more attention is devoted to practical solutions, rather than broad brush statements concerning the utility of ICT. Mobile phones are likely to continue to play a large role in climate change adaptation. However, at present there is a clear disconnect between mobile phone uses and the data captured through monitoring networks using new ICTs. It is important that NGOs and governments begin to consider the range of climate change applications that can be made available with the projected increase of mobile broadband and devices.

As discussed above, the cost of a mobile phone is still very high compared to farmers' income which remains to be the major barrier for adoption. For this reason, face to face interactions are still preferred in many contexts. To address this constraint, the government may consider providing reduced cost of mobile phones at the early stage to make them accessible to farmers. Once they have appreciated the value of information through mobile phones, there is the probability of the farmers patronizing the service for a fee. However, this measure should still take into consideration learnings from previous experiences to avoid dependence by farmers on subsidized. After all, the intention is to make the intervention sustainable which can be made possible only with the full support by the communities. In the context of building an improved information provision and knowledge exchange to and between farmers, this study presents an urgent need to step up public awareness campaigns and capacity building at different levels, from district, commune and village level.

At the center of this campaign are the people whose livelihoods are the most affected by the impact of climate change. They have the local knowledge and experiences necessary in understanding climate change adaptation processes. Only by increasing their awareness about climate can they be involved in finding or creating solutions and informed decisions to deal with the impact of climate change on their lives and livelihoods. In order to reach an informed decision, access to information is crucial and mobile phones can provide the means to make this information readily accessible to the community.

Limitations of the Study

The study has some limitations. Given the short period allocated for field work, the study can only cover a small sample size. A bigger sample size may have provided a more reliable data that is representative of the community. The analysis was also confined to limited information derived from fieldwork. Other aspects of analysis that would have been useful to the study and provided sufficient understanding of the people's behavior and interests such as the age, gender and education factors were not covered.

Implications for Future Research

Aside from covering the aspects that were not included in this study, other implications for future research would include an in-depth analysis of the other elements of the Sustainable Livelihood Framework. Analysing the interrelations of the other assets with all the other elements of the framework would provide a more holistic picture of the situation in Ben Tre Province that may be valuable in understanding in detailed the role of mobile phones or other ICTs in relation to climate change adaptation.

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