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USAID Mekong Adaptation and Resilience to Climate Change (USAID Mekong ARCC)

Vulnerability Assessment Report

Thuan Hoa commune, An Minh District, Kien Giang
Province

AMDI Vietnam



June 2014

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Acronyms

AMDI – Asian Management and Development Institute

ARCC - Adaptation and Resilience to Climate Change project

CAM - Climate change vulnerability assessment and adaptation

CC - Climate change

CCA - Climate change adaptation

CWR - Crop wild relative

LMB - Lower Mekong Basin

NTFP - Non-timber forest product

SLR - Sea level rise

SRI - System of rice intensification

USAID - United States Agency for International Development

VCA - Vulnerability Capacity Assessment

VNRC – Vietnam Red Cross

1. Introduction

Climate change poses a threat to all humans and ecosystems worldwide. Climate change has diverse and complex impacts, many of which impact the Lower Mekong Basin (LMB). The LMB is a region of rich diversity of landscapes, biodiversity, and ethnic and cultural diversity. The LMB landscape has been largely transformed for agriculture, especially for rain-fed and irrigated rice. The LMB supports the largest freshwater fishery in the world both from capture fishery and aquaculture. In terms of hydro-climate, the diversity and productivity of the LMB is driven by a unique combination of hydro-climatic features. The combination of two monsoon regimes is the fundamental driver of the Mekong hydro-climate (USAID Mekong ARCC, 2013).

Projected changes in the region include increases in the intensity, frequency and duration of flooding, increases in annual temperature, decreased dry season precipitation, and increased river flow year round (USAID Mekong ARCC, 2013). The implications of such projections threaten the aquatic and terrestrial ecosystems and the communities in the LMB. Severe socio-economic consequences are expected in the region (Warner *et al.* 2009). Presently, in addition to climate change, the LMB is also experiencing high levels of population and economic growth and environmental degradation that will exacerbate the impacts of climate change. To reduce the worst impacts of climate change on the peoples of the LMB, urgent attention must be paid to reducing sources of vulnerability and improving their resilience to climate change (WWF, Cambodia, 2013).

Located in the LMB, the Mekong Delta has experienced changes in hydro-climate, development, and impacts of climate change like other countries. Although Vietnam has achieved lower Middle Income Country status, more than 33 million people still live on less than two dollars a day. Many of them live in rural and remote communities with few services and limited livelihood options. Vietnam is ranked as one of the most disaster-prone countries in the world with around 70 per cent of its population at risk of typhoons, torrential storms and flooding (World Bank, 2005). Furthermore, the communities settled along the Mekong Delta, a low-lying coastal region, are at greater risk of natural disasters. This is because the region is subject to unstable weather conditions resulting from climate change. The Mekong Delta has been identified as one of the global hot spots for climate change (USAID Mekong ARCC, 2013). The impacts of climate change on Kien Giang Province are already threatening livelihoods and exposing vulnerabilities. The region is already experiencing an increase in maximum temperature, an increased minimum temperature, increased rain fall resulting in flooding in the wet season, and a drier terrain in the dry season, and is expected to experience intensified storms in the future as well as more severe droughts and salinity.

With support from USAID Mekong ARCC, Asian Management and Development Institute (AMDI) in collaboration with Vietnam Red Cross (VNRC) is implementing a project in Thuan Hoa Commune, An Minh District, Kien Giang Province, Vietnam from January 2014 to December 2015. Communities and local authorities in Thuan Hoa commune will build their capacity to analyze, plan, and respond to climate related vulnerability through a participatory approach to support coordinated and ecologically sustainable climate change adaptation (CCA) planning. This approach promotes community awareness and coordination throughout the commune. The community will be supported to implement priority

improvements to their livelihoods to improve their adaptive capacity. The project will provide vulnerable households access to climate resilient agricultural techniques and opportunities to diversify their livelihoods. The sustainability of the proposal outcomes will be supported through learning and sharing among stakeholders. This will also contribute to further scale up of community-based, equitable and gender sensitive adaptation in the LMB, and provide an improved evidence base to inform and influence Government policies and processes.

2. Methods

The main methodology used to conduct the VA in Thuan Hoa Commune, Kien Giang Province, was expert consultation with a top-down analysis of future scenarios and analysis of exposure, sensitivity and adaptive capacity to existing climate change threats. Considering the projections of Mekong ARCC Reports (2013) and Vietnam MONRE Climate Change Scenarios and Sea Level Rise (2012), the AMDI team conducted the VA to assess the vulnerability of Thuan Hoa commune's livelihoods, ecosystems, disaster risks, and gender to climatic threats by:

- Scaling down the ARCC and MONRE results and projections;
- Consultation with local authorities in the commune and district;
- In-depth consultation with district agricultural experts; and
- Review and analysis of secondary data available from Mekong ARCC, AMDI's community profile and awareness surveys and district statistical yearbooks.

The AMDI team then discussed vulnerabilities and adaptation strategies to reduce impacts of climate change in the target site, focusing on 4 main themes: livelihoods, ecosystems, disaster risks, and gender as the best means to maintain resilience and maximize the social and environmental sustainability of the site. We provide details of these processes below.

3. Analysis of Current and Future Risks—Provincial Level Climate Science from Mekong ARCC Study

3.1. Overview of Kien Giang Province, Vietnam

Kien Giang is a south-western province of the Mekong Delta (Figure 1). The landscape predominantly consists of intensively farmed rice paddies and accompanying waterways and road networks. Rural households typically engage in a livelihood mix of rice farming and fishing (including aquaculture and sea capture fisheries). Although the poverty rate in the province is low relative to the rest of the LMB (6% by Vietnam standards¹), the high rural population (1.4 million) means that the incidence of poverty is high. Moreover, the intensive nature of farming and the high exposure to extreme events (e.g. flooding from the Mekong mainstream and coast storm surges) raises the vulnerability of households to fall below the poverty line (Mekong ARCC, 2013).

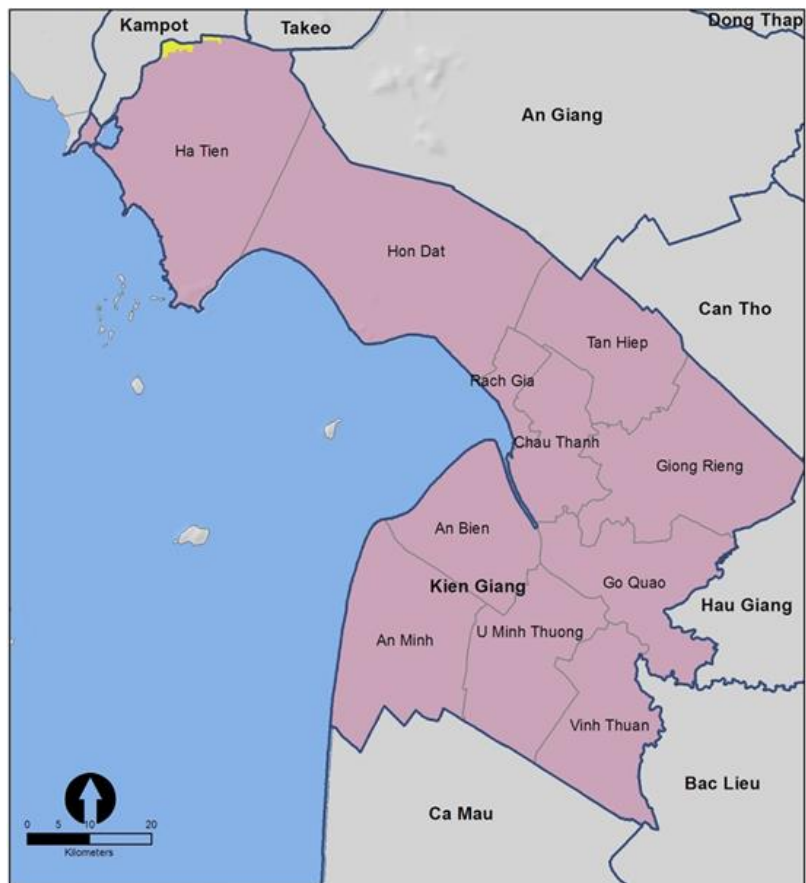
The proximity of the coast is a defining factor in the natural and built environment in rural areas. Farming relies on a dense network of canals and dykes controlling water management, including the

¹ Vietnam's national poverty rate was 11.1% in 2012 (General Statistics Office of Vietnam)

inflow of saline surface water. Soil fertility (due to high acidity) is generally poor, requiring intensive use of inputs in farming. These factors increase the exposure of rural households to extreme events, including flooding from the Mekong mainstream and coastal storm surges. Aquaculture is a common practice; conversion of land from rice to saline shrimp production involves a high level of risk (USAID Mekong ARCC, 2013).

The rural poor are typically landless or have very small land-holdings. Non-permanent housing comprises a majority of housing types in rural areas. Health access and food security for the entire population is relatively high, although significant discrepancies exist between different income groups. Provincial economic growth is high, facilitating the development of agro-food processing and other opportunities for rural incomes. However, the official annual rate of outward migration (0.7% of the total population), which is likely to be a significant under-estimate of actual migration, indicates that local opportunities are insufficient for a significant proportion of the population (Mekong ARCC Main Report, 2013).

Figure 1 Map of Kien Giang Province showing An Minh District. Pink shading indicates almost 100% of the province is made up of the delta eco-zone. (USAID Mekong ARCC Main Report, 2013)



LIVELIHOOD ZONES, KIEN GIANG PROVINCE

- Province Boundary
- District Boundary
- Lowland plains and plateaus
- Delta



icem
Data Source: ICEM 2013,
MRC GIS Database

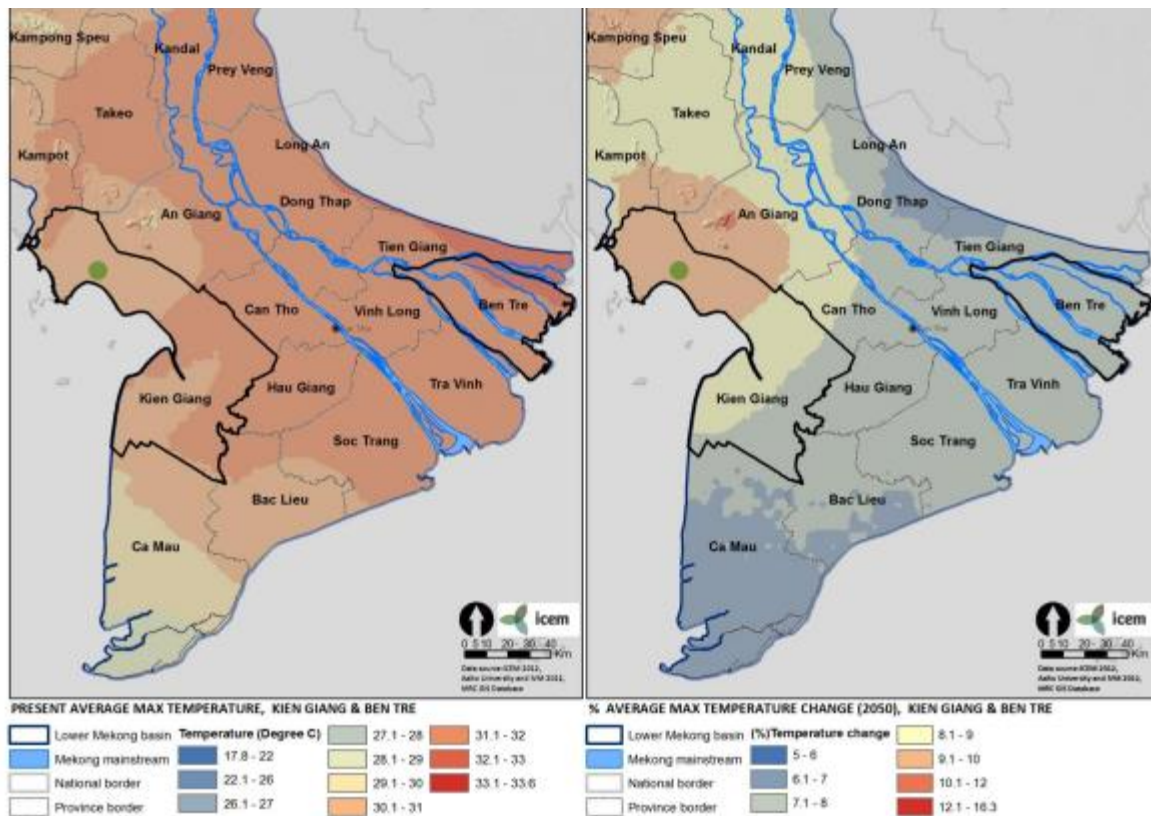
3.2. Scientific Projections for Kien Giang Province

Temperature

The daily maximum temperature will increase between 2 to 3°C throughout the year (Figure 2). Under baseline conditions maximum temperatures vary on average between 28.7 to 34.3°C during the year, with temperatures peaking in April, averaging 33.7°C and dropping to a minimum in December and January. With climate change, temperatures will continue to follow a similar pattern; however there will be positive shift in the mean temperature of 3°C. Under baseline conditions, average daily Kien Giang Province maximum temperatures do not exceed 38.5°C, in the future with climate change average daily maximum temperatures will reach 41.8°C.

Under baseline conditions, average daily minimum temperatures range between 22.2 - 26.2°C, peaking in May. With climate change, temperatures will continue to follow a similar pattern; however there will be a positive shift in the average of 1.6°C (24.7 to 26.3°C).

Figure 2 Map of Kien Giang showing change in average maximum temperature by 2050 (USAID Mekong ARCC Main Report, 2013)

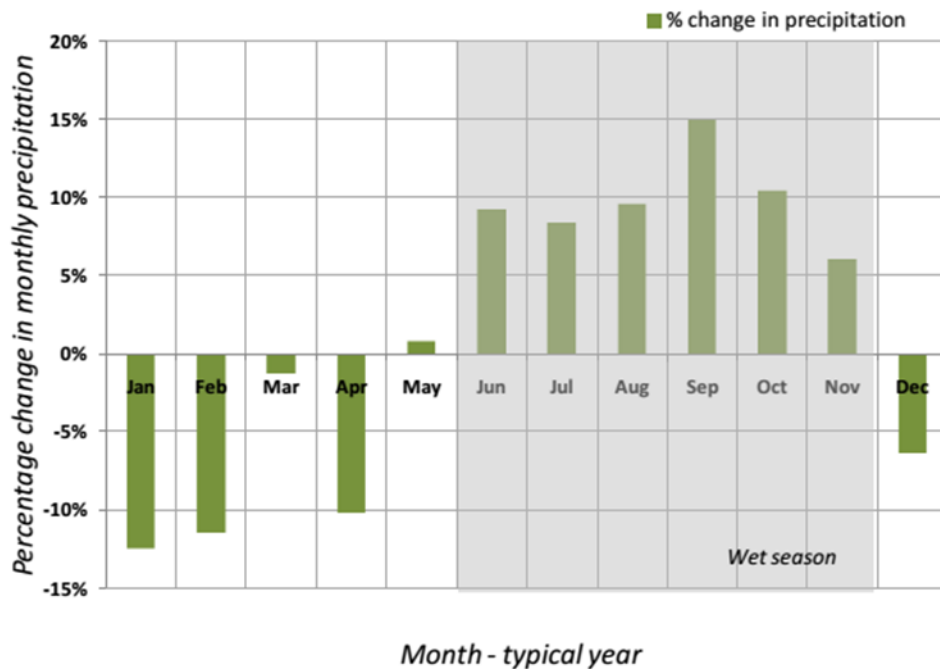


Precipitation

Annual precipitation will increase by 5 – 8%. Large daily rainfall events will increase in size up to 50 mm. Kien Giang province shows a strong seasonal pattern characterized by the monsoon rains from May to

November. Peak rainfall occurs in October accounting for about 20% of the total annual rainfall. With climate change annual rainfall will increase from 1,280 mm/yr to 1,370 mm/yr (+90 mm/yr). Peak monthly rainfall in October will increase from 260 to 285 mm/yr (Figure 3). The largest increases in rainfall will occur during September and October (more than 10% increase in monthly rainfall), while the largest reduction in rainfall will occur in January, February and April (more than 10% reduction in monthly rainfall). This means that the wet season will become wetter and the dry season will become drier

Figure 3 Percentage change in monthly precipitation for Kien Giang Province 2013-2050 (USAID Mekong ARCC Main Report, 2013)



Flooding and Inundation

Sea level rise and flooding may cause drastic changes in the depth and duration of flooding in Kien Giang. Under climate conditions during an average flood year over 400,000 ha that was previously rarely or never flooded to a depth of 1.0 m is projected to experience flooding of this depth for up to 121 days per year. Similarly an area of over 100,000 ha that was previously rarely or never flooded to a depth of 0.5 m will experience flooding of this depth. The maximum flood depths during an average year may also increase due to climate change. A total of 141,000 ha historically inundated up to depths of 1.0 m may be inundated by 1.0 to 3.0 m by 2050.

Drought

Comparison of monthly rainfall and Potential Evaporation (PET) conditions gives an agricultural definition of drought. Under historic conditions drought is a typical occurrence between December and April. This trend will continue with climate change, however, there will be a significant increase in the

occurrence of agricultural drought conditions in April-May. Historically, drought occurred in April 60% of the time, while with climate change this will increase to 80% of the time. Occurrence of drought in May will also double from 8% to 16%.

3.3. Threats and Vulnerabilities

Projections for the impacts of climate change induced conditions in 2050 for Kien Giang Province are summarized in this section. They are drawn from the USAID Mekong ARCC theme reports. This information informs the more comprehensive localized vulnerability analysis in Section 5.

Agriculture

Table 1 Agricultural vulnerabilities to climate change in Kien Giang in 2050

Agricultural enterprise	Threat	Exposure and impact
Irrigated rice	Increased temperature	About 50% of days in March-May in 2050 have a maximum temperature exceeding 35°C. About 50% of days of maximum temperature are expected to exceed the optimal zone in both wet and dry season. An increase in temperature in early rainy season may cause heat stress, reducing rice tillering and yields. The effect of increased temperature will be more severe with droughts in early rainy periods
Rain-fed rice, Irrigated rice	Sea Level Rise & saline water intrusion	Sea level will rise about 30 cm by 2050. Sea level rise causes saline water intrusion inland through canal systems in the dry season and increases flood severity in the rainy season. Rice suffers a significant yield loss with a salinity concentration above 4%. Yield losses depend on the location, time and duration of the stress

Fisheries

Table 2 Fisheries vulnerabilities to climate change in Kien Giang in 2050

Fisheries enterprise	Threat	Exposure and impact
Capture fisheries	Increased temperature	<p>About 50% of days of maximum temperature are expected to exceed the comfort zone in both the wet and dry season.</p> <p>Estuarine species appear most vulnerable to increased temperatures and flash flooding</p> <p>Invasive aquatic species such as the Golden Apple Snail will benefit from the changing conditions, possibly at the expense of some indigenous species</p>
Aquaculture	Increased temperature	<p>Last percentile (75-100%) of maximum temperature ranges from 37-41°C in the period of March and May (in the early wet season), compared to the baseline ranging from 35-38°C.</p> <p>Increased temperature between 9-12% from June to November.</p> <p>Semi-extensive inland field aquaculture of prawns is vulnerable to increased temperatures.</p>
Aquaculture	Sea level rise & saline water intrusion	Sea level will rise about 30 cm by 2050. Sea level rise causes saline intrusion inland through canal systems in dry season, which salinizes irrigation canal water and paddy soils and increases flood amplitude in the rainy season.
Aquaculture	Variability in precipitation	<p>Increased precipitation, decreased water availability, and drought</p> <p>Increased precipitation can be an issue in September - October, when the upper 3rd percentile is above 400 mm.</p>

Livestock

In Kien Giang, confined relatively stressed small commercial pig systems will be very highly vulnerable to climate change. Increasing heat stress will lead to reduced voluntary food intake and reduced growth rates, lower reproductive performance, reduced immunity (increasing disease problems) and behavioral problems. Climate change may make some small commercial pig systems economically unviable.

Temperature increases may have effects on rice cultivation and reduce availability of scavenging areas for ducks that scavenge fallow rice fields. Intake may be somewhat reduced but of little consequence to field-running layer duck systems, resulting in a predicted medium vulnerability to climate change.

Socio Economic Vulnerabilities

Beyond the direct, immediate impact of climate change on livelihoods, there are indirect factors to consider over the longer term. For example, lower rice yields due to climate change may (i) lower incomes, reduce food security, and, potentially lower household health, (ii) increase dependence on capture fisheries and NTFPs for food, and (iii) decrease the level of household and community income available to spend on asset improvements or repairs.

3.4. Non-climate Risks

In Kien Giang, flood protection dykes have been built on most of rice areas since the early 2000s. The flood control dykes protect the rice land from seasonal floods, enabling farmers to plant two to three rice crops per year. The flood control dykes on most of the rice areas also obstruct flow or stronger flow of water currents that cause erosion of river banks. These dykes may also prevent mangroves from expanding inland when sea level rises.

Rice yield in Kien Giang in the dry season will face the threat of more intense and longer lasting salinization along with increases in temperature. As a result, rice yield will also depend on the availability of fresh water from upstream sources, which remains uncertain depending on hydropower and other sector developments (industrial, irrigation, population growth) in upstream countries (USAID Mekong ARCC Climate Change Impact and Adaptation Study on Agriculture, 2013).

4. Introduction to Thuan Hoa

Thuan Hoa Commune is located in An Minh District, Kien Giang Province, with total land area of 8,300 hectares, about 50 kilometers south west of Rach Gia, the main city of Kien Giang Province. It is a coastal commune, bounded to the west by the sea, south by Tan Thanh commune (An Minh district), north by Nam Thai A commune (An Bien district), and east by Dong Hoa commune (An Minh district). The landscape predominantly consists of farmed rice paddies and accompanying waterways and road networks. Rural households typically engage in a livelihood mix of rice farming and fishing (including aquaculture and sea capture fisheries).

The commune is divided into 8 villages including: Muoi Bien, 9B, 9A, 8I, 8II, Ban A, Ban B, and Xeo Quao. Thuan Hoa Commune used to be a part of the National Wetland Park, the U Minh Thuong National Park, one of the most important wetland parks of Vietnam. It has been transferred to residential and farming land due to the development need of the country. The commune is about 20 kilometers from the current U Minh Thuong National Park.

The population of this commune is approximately 16,401 people with the main livelihood areas being rice production,

Figure 4 Map of Thuan Hoa Commune



aquaculture (shrimp and blood cockle), and NTFP harvesting. The poverty rate in the commune is relatively higher to the rest of Kien Giang (12.48% by Vietnam standards); the high rural population means that the incidence of poverty is high. Moreover, as noted above, the intensive nature of farming and the high exposure to extreme events (e.g. flooding from the Mekong mainstream and coast storm surges) increases the vulnerability of households to fall below the poverty line (USAID Mekong ARCC, 2013). Thuan Hoa Commune is located on the coastal plain of the Mekong Delta and is particularly susceptible to sea level rise (SLR), due to its very low elevation (0.2-0.4 meters above sea level)². As the main livelihood areas all have the potential to be severely adversely affected by SLR and associated saline intrusion as a result of climate change, this commune could particularly benefit from the Mekong ARCC-supported adaptation initiative. The MONRE Climate Change and Sea Level Rise Scenarios predict that the area will be below sea level by the year 2100, according to worst case climate change scenarios.

This is a unique site with a high level of biodiversity, and the site is considered regionally important for conservation and sustainable development. The area encompasses the coastline of the Mekong Delta, Mekong River estuary, mangrove forest, mudflats, and natural and manmade canals. The project area experiences a pronounced tropical cycle, with heavy rain from May-October, and a dry season from approximately November to May.

4.1. Community Awareness

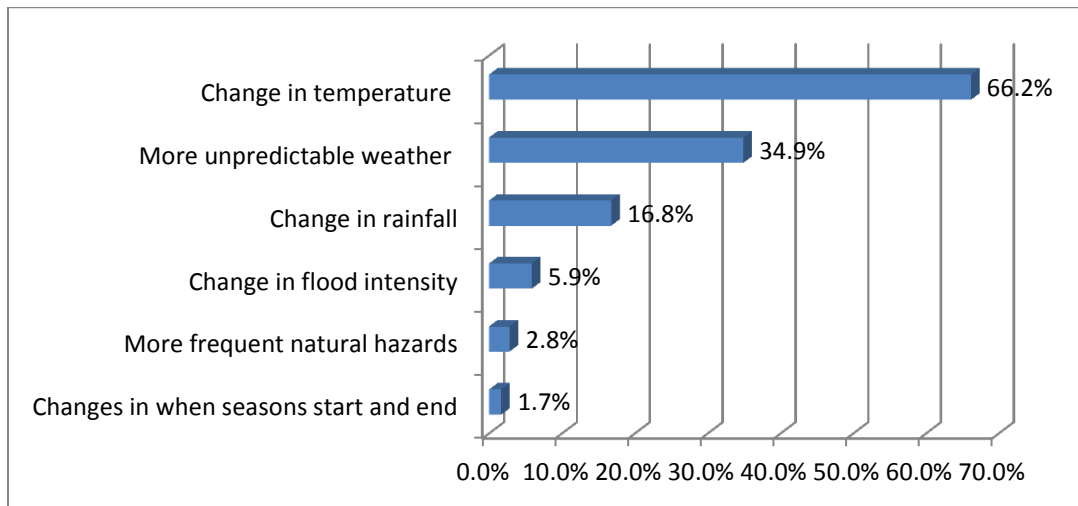
This section highlights villagers' understanding of climate change and their perceptions on threats from changes in weather patterns. The information is drawn from the Awareness Survey Report, conducted by AMDI in 2014.

Among 358 households that participated in the Awareness Survey in Thuan Hoa commune, three-fourths of the interviewees reported that they had noticed some changes in the weather recently but most of them (96.4%) had just started to notice these changes in the recent five years, only 2.8% of the total surveyed population started to notice these changes around ten years ago.

Regarding specific changes in weather, it is revealed through the survey that the most significant and apparent change was the increase in temperature (Figure 6). 66.2% of total respondents reported that they found the weather was becoming hotter every year and the summer lasted longer than before. Approximately 35% of households found the weather more unpredictable and unusual these days. Change in rain was also noticed by 16.8% of respondents who said they had experienced more rain in the rainy season and sometimes unexpected rain in the dry season.

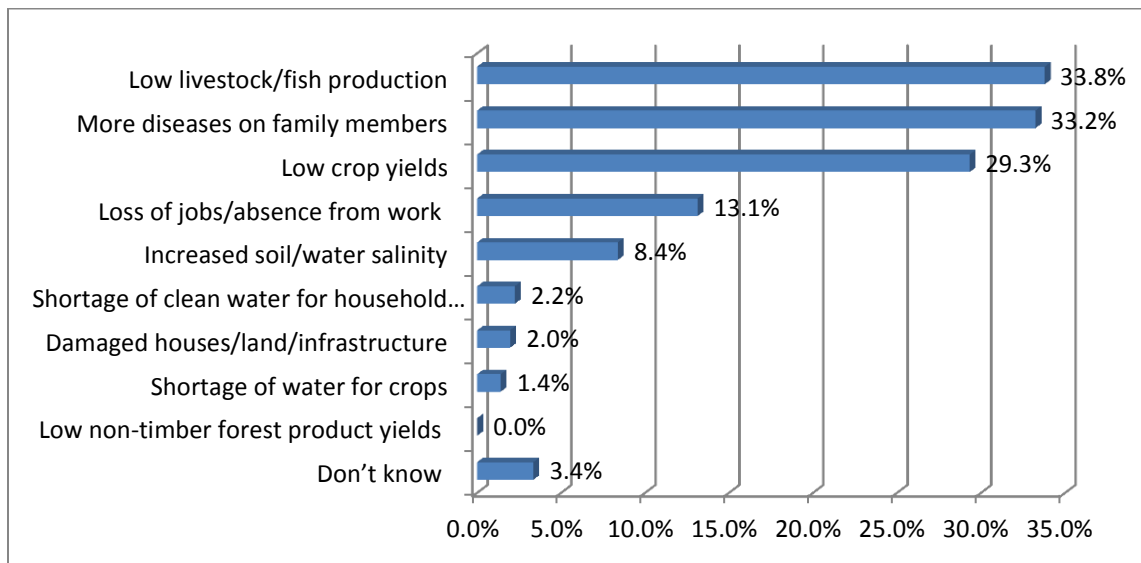
² Statistics are from phone consultations with local commune authorities

Figure 6 Weather changes noticed by people in Thuan Hoa Commune (AMDI Awareness Survey Report, 2014)



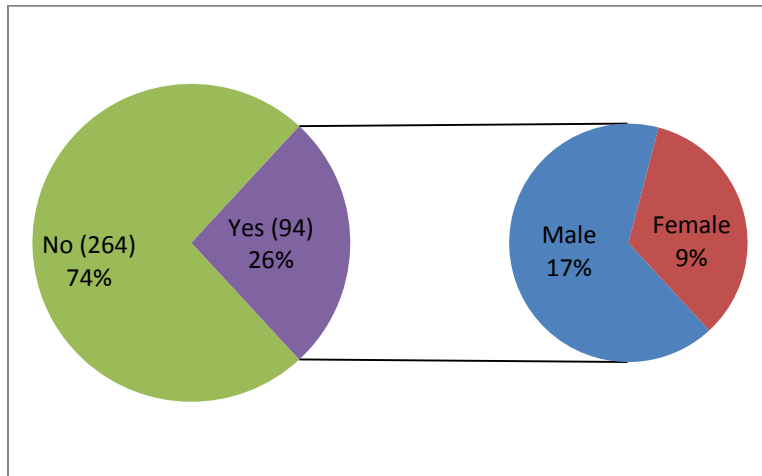
On being asked about the impacts of weather changes on the respondents' lives and their families, the three impacts of most concern were low livestock/fish production, family members getting more diseases and low crop yields (Figure 7). As mentioned above, the main source of income in this area was from aquaculture, thus when the weather changed unexpectedly, it directly affected their production. Through interviews with aquaculture households, most reported that they had experienced low production or even complete loss to their products, especially shrimp and blood cockle, due to increasing diseases and unusual weather. Failure in crop production was under similar concern as the consequences of more pests, unexpected rain and natural disasters such as floods and storms. Around one-third of the respondents mentioned increasing human diseases.

Figure 7: Impacts of weather changes in Thuan Hoa Commune (AMDI Awareness Survey Report, 2014)



Among those who know what climate change is, 81.9% confirmed that climate change had effects on their community, and the number of male respondents was 2.5 times higher than female (Figure 8).

Figure 8 Proportion of people in Thuan Hoa who know about climate change (AMD I Awareness Survey Report, 2014)



Similar to the noticed changes in weather, the most obvious effect of climate change that surveyed households noticed was temperature increase. It was identified by 42.6% of respondents who know about climate change as a climate change impact on their community. Increase in disasters and sea level rise were the other two impacts that local people were concerned about, as reported by 26.6% and 24.5% of interviewees who know about climate change. Other impacts of climate change on local community were mentioned by a number of respondents such as salt water intrusion (20.2%), and more insect/pest/disease threats to crop/animal/aquaculture (17%).

Regarding the effect of climate change that people most worried about, the most frequent answer was increase in temperature (5.3% of total sample size or 23.5% of those aware of climate change), followed by low livestock/fish production (13.6% of those aware of climate change). Some interviewees also mentioned other effects that climate change might have on their community such as soil and water salinity, more diseases on humans, more pests and diseases on crops, livestock and fisheries, and more frequent natural disasters. However, responding to the question about how prepared they were to deal with the effects of most concern, more than 70% reported that they either didn't know or were not prepared at all.

Among 94 cases who had known about climate change, 41.5% thought that they could do something to prepare for future climate change impacts on their community, in which measures to restore forest and protecting the environment was mentioned with the highest number (12 cases), following by rebuilding or reinforcing housing structures (10 cases), and changing the crop calendar to match with changed weather (10 cases). Out of 39 cases aware about preparing to deal with climate change, 23 respondents were able to give two or three measures and most of these respondents were already carrying out the mentioned methods.

4.2. Non-climate Risks at Community Level

Thuan Hoa commune was originally under mangrove forest and part of the U Minh Thuong National Park that encompasses the threatened melaleuca wetland ecosystem. Large areas of melaleuca and mangrove forest were converted to rice-shrimp farming in the early 1990s. A large area of coastal and inland wetland was also cleared for crop and aquaculture production. Destruction of mangrove and melaleuca forest increased the risk of sea erosion, storm surge, sea water intrusion, and reduction of biodiversity and habitats of coastal wetlands.

Thuan Hoa commune has a system of rivers and canals, which functions as an irrigation network for agriculture and aquaculture. The exception is a part of Xeo Quao village, where a saltwater control dyke and culvert is being built. Threat from low flow of fresh water from the Mekong has been reported recently, affecting the dry season rice crop. Higher floods during the rainy season flow over the embankment, destroying the main rice crop.

4.3. Community Context

This section provides an introduction to the community assets, income sources and ecosystems of Thuan Hoa Commune. This information is drawn from the Community Profile Report, conducted by AMDI in 2014. It focused on four out of eight villages within Thuan Hoa Commune: Muoi Bien, Xeo Quao, 8I, 9B.

Community Assets

Transport infrastructure of the commune is of varying quality. Roads are accessible by car and truck in all weather conditions to the commune center. From there to villages and households, motorcycle or boat travel is generally required. In many parts of villages the roads are still unpaved (soil) and narrow so can only handle motorbikes and bicycles. The main canal is an important transport route, as it is still usable during most floods and after heavy rain events. Over 90% of farmers in the commune have access to land with an average of 2 ha per household.

Housing in Thuan Hoa commune is a combination of 47 % permanent structures (brick, concrete, stone, hard wood) and 53 % semi-permanent structures (corrugated metal, sticks, straws, mud). The commune has one secondary school, one primary school with four campuses located in 4 villages, and one kindergarten.

The commune is served by a number of governance and institutional assets. The commune People's Committee leads and governs all state-management activities in the commune, elected by the commune People's Council for a 5-year term. The current term is 2011-2016. The People's Committee consists of one president and two vice presidents, heads of departments of agriculture and rural development, fisheries, culture, society, security, defense, health, education and statistics. The commune People's Committee is directly supervised by the district People's Committee and responsible for economic and social activities, defense and security of the whole commune. In the commune, there exist chapters of

mass organizations including the Fatherland Front, Red Cross, Women’s Union, Youth Union, Veteran Association and Farmers Association.

Income Sources

The most important source of income for the communities of Thuan Hoa Commune is from cultured fisheries (Table 3). Rice farming is not a significant income option for Thuan Hoa commune because of its low yield in comparison to other Mekong provinces. In addition, most areas in Thuan Hoa commune are affected by salinity so both land area for rice-farming and rice yield are decreasing. Moreover, the market price for rice is much lower in comparison to fishery products; and the inputs for rice farming are costly to the farmers. Therefore the rice produced in Thuan Hoa is for subsistence consumption, and is important for household food security. Casual labor is an important source of income, especially so because it is not directly dependent on ecosystems and the impacts of climate change.

Table 3 Major income sources for households in Thuan Hoa Commune (AMDJ Community Profile, 2014)

Income source	Level of importance for community income generation			
	Slightly important	Important	Very important	Critical
Shrimp				X
Crab		X		
Blood cockle		X		
Fish	X			
Rice	X			
Livestock	X			
NTFPs	X			
Casual labor		X		
Regular employment	X			
Business (shop, trader)	X			

Analysis of how these livelihood activities depend on the ecosystems around them is presented in Section 4.3.

5. Localized Vulnerability Analysis

This section outlines the results of the vulnerability assessment process, which combines the existing data on threats and their impacts from USAID Mekong ARCC reports with the results of village and expert-level consultations. This chapter briefly outlines the vulnerability methodology used, and presents a summary of key climate change induced challenges to livelihood activities (Table 5). Then, we outline the vulnerability of the commune through chapters on ecosystems, natural disaster risks, and gender. We also discuss actions to reduce vulnerability associated with threats to each assessment theme.

5.1. Understanding Vulnerability

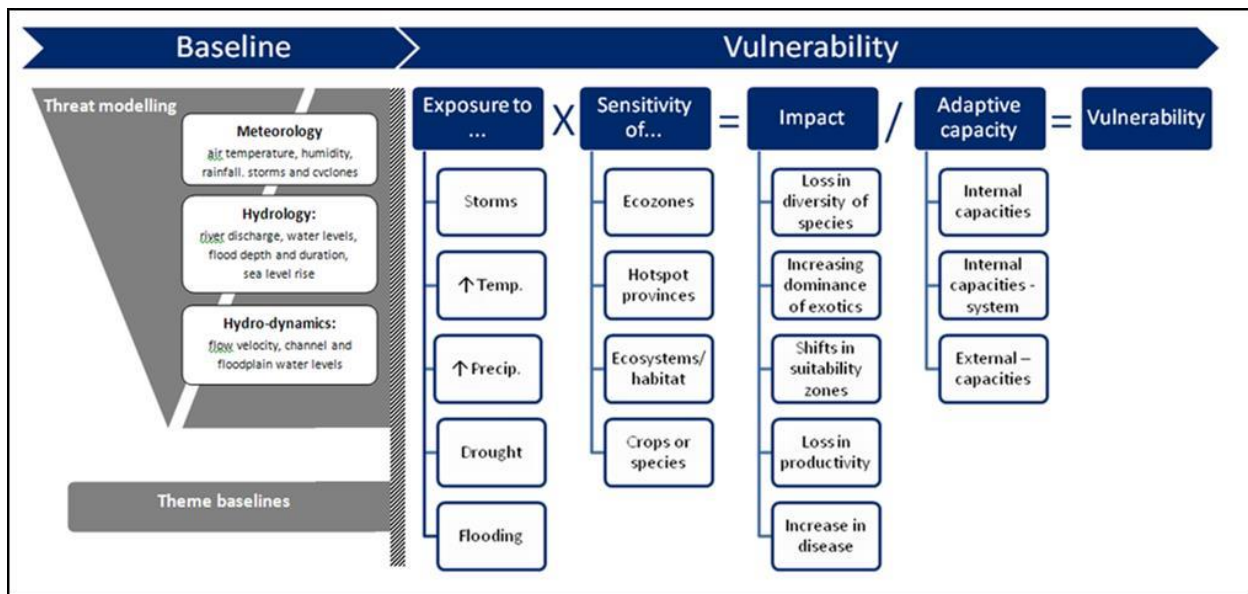
Research into vulnerability in this study is guided by the ICEM Climate Change Vulnerability Assessment and Adaptation (CAM) (ICEM 2011) methodology. This study uses part of this methodology to conduct an assessment on the exposure, sensitivity, and adaptive capacity of systems and assets to climate change (see Figure 9). The following terms are integral to the CAM methodology:

Exposure is defined as the degree of climate stress on a particular asset or system component; it is influenced by long-term changes in climate conditions, and by changes in climate variability, including the magnitude and frequency of extreme events.

Sensitivity is the degree to which a system will be affected by or is responsive to climate change exposure.

Adaptive capacity is understood in terms of the ability to prepare for a future threat and in the process increase resilience and the ability to recover from the impact.

Figure 9 Components of vulnerability that are used in this study (USAID Mekong ARCC Main Report, 2013)



5.2. Livelihoods Vulnerability Assessment

The following section presents a vulnerability analysis of livelihoods according to the CAM methodology, which is based on scientific sources of information (USAID Mekong ARCC and technical experts) and supported by AMDI's community consultations with people in Thuan Hoa Commune (Table 4). It expands on the information on vulnerable livelihood activities presented in Section 3.3. The following indicators were considered for the CAM methodology: Exposure: proximity to coastal area, size of coastal population, severity of threats. Sensitivity: Infrastructure, poverty, soil quality, ecosystem health, natural resource dependent livelihoods. Adaptive capacity: Education levels, training availability, technical advice availability, community assets, access to capital, government-lead programs.

Table 4 Vulnerability analysis of key livelihoods and adaptation options, Thuan Hoa Commune

Livelihood Area	Threats	Impact Summary		Adaptive Capacity	Vulnerability	Potential Adaptation Options	
		Exposure	Sensitivity				
Aquaculture	Increased temperature. Last percentile (75-100%) of maximum temperature ranges from 37-41°C in the period of March and May, compared to the baseline ranging from 35-38°C.	High	High	Semi-extensive inland field aquaculture of prawns is vulnerable to increased temperatures.	Medium	High – very high	Reduce stocking densities in ponds, supplementary aeration in ponds to boost DO levels and improve water circulation and mixing. Ponds excavated that have both shallow and deep areas, where fish can move to, as diurnal temperatures change
	Sea level rise and saline water intrusion. SLR of about 30 cm by 2050.	High	High-Very high	Saline intrusion inland through canal systems in dry season, which salinizes irrigation canal water and paddy soils and increases flood amplitude in the rainy season. Rice yield will depend more on availability of fresh water from uncertain upstream sources	Medium	High	Sluice gates or higher embankments
	Variability in precipitation	Medium	Medium	Increased precipitation, decreased water availability, and drought. Increased precipitation can be an issue in September - October, when the upper 3rd percentile is above 400 mm.	Medium	Medium	Higher embankments. Ponds excavated that have both shallow and deep areas to buffer against sudden change of water environment.
Capture fisheries	Increased temperature. About 50% of days of maximum temperature are expected to exceed the comfort zone in both the wet and dry season.	High	High	Estuarine species appear most vulnerable to increased temperatures and flash flooding. Invasive aquatic species (Golden Apple Snail) will benefit from the changing conditions, possibly at the expense of some indigenous species	Medium	High	Recovery of coastal ecology such as mangrove reforestation. Installation of culverts and bridges to ensure that tidal exchange is not constrained
Rainfed rice	Sea level rise and saline water intrusion.	High	Medium	Sea level rise causes saline water intrusion inland through canal systems in the dry season and increases flood severity in the	Medium	Medium	System of rice intensification (SRI) techniques can be applied to mitigate declining

				rainy season. Rice suffers a significant yield loss with a salinity concentration above 4%. Yield losses depend on the location, time and duration of the stress			yields, since farmers' water management capacities are high in the Mekong Delta.
Pig production	Temperature increases	Very high	High	Increasing heat stress will lead to reduced voluntary food intake and reduced growth rates, lower reproductive performance, reduced immunity (increasing disease problems) and behavioral problems. Climate change may make some small commercial pig systems economically unviable.	Low	Very High	Changing to controlled/more controlled rearing environment is expensive and generally beyond small commercial units. Local animal health and extension service capacity is suboptimal where accessible, more remote areas have limited access. Typically these farms will seek out and utilize these services more than less commercial livestock systems
Field-running layer duck production	Temperature increases	Medium	Low	May have effects on rice cultivation and reduce availability of scavenging areas for ducks that scavenge fallow rice fields. Intake may be reduced but of little consequence to field-running layer duck systems, resulting in a predicted medium vulnerability to climate change.	Very low	Medium	Birds and systems are relatively adaptable and resilient in terms of temperature, management systems do not stress birds. Animal health capacity is limited and underutilized.
NTFP - Mangroves	Sea level rise,	High	Very high	Strong wave action, Coastal erosion. Increased human collection if other plants are stressed by increased temperature Planned coastal dyke in Kien Giang will prevent mangroves from expanding inland when sea level rises	Medium	High	Strong financial incentive for sustainable management of this resource. Protected areas more heavily enforced by authorities

5.3. Agroecosystem Vulnerability Assessment

There are four main livelihood areas in the commune, all based on different ecosystems: the mudflat area, mangrove forest, aquaculture zone and the rice-shrimp zone. These are described in the context of direct human production and climate change stresses, and a summary of their vulnerability is presented (Table 5) based on both scientific information (USAID Mekong ARCC reports) and local information from community consultations.

The mudflat area along the coast line of Thuan Hoa commune covers about 1000 ha. All of the mudflat area is currently under the district natural resource management unit. The area is being contracted out to households (maximum of 5 ha per household) for practicing capture fisheries. Households pay a fee of 300,000 VND/ha (USD 15) per year for the right to harvest natural fisheries on the allocated area. Use of seine net is the most popular practice. The most common capture fish are blood cockle, clam, and fishes, namely Asian sea bass (*Lates calcarifer*). The mudflat area and associated livelihood dependence is highly vulnerable to SLR and storm surges.

The mangrove forest area is considered as protected forest and is currently under the management of the district Sub-Department of Natural Resource and Environment. All the 1,150 ha of the protected mangrove forest in the commune is being allocated to 300 households. Households living on the contracted forest area are allowed to collect NTFPs and to clear up to 30% of the allocated area for aquaculture purposes; the remaining 70% should be kept as forest. However in practice, households tend to clear more than 30% of the contracted area in order to expand aquaculture.

The aquaculture zone involves semi-extensive pond culture of blood cockles, crabs, tiger shrimp, and harvest of natural shrimp is being practiced. Risks of losses of culture shrimp in ponds due to embankment overflow are reported to be more frequent lately. The aquaculture practice faces high vulnerability to SLR and storm surge. Households responded with coping strategies of strengthening and building higher embankments. There are about 200 households involved in extensive aquaculture on 626 ha of aquaculture zone adjacent to the mangrove forest. The common species being raised are blood cockle, shrimp and mud crab. Farmers reported that yield of cockle and crab is declining in this zone because of continuous over-stocking, lower source of natural feed, and pollution.

The rice-shrimp zone is the most important livelihood area of Thuan Hoa commune. Over one half of the commune area, about 4,312 ha, is under shrimp-rice farming. Prior to 2003, all of this area was planted to two rice crops. Saline water shrimp culture was introduced into the system to replace the dry season rice by allowing the saline water in after the harvest of the rainy season rice in December. Because the income from shrimp is much higher than rice, farmers tend to prolong the shrimp crop by continuing stocking of shrimp seed late into the period of rice crop. This practice results in salinization of the land such that the subsequent rice crop cannot be established. About half of the shrimp-rice area is affected (2000 ha) by this practice. This practice results in a change from a rice-shrimp to a mono-shrimp system that is not sustainable in the long-term. In order to re-establish the rice-shrimp (or shrimp-vegetation) system on the mono-shrimp area, farmers are advised by commune authorities to experiment with

planting sedge grass, which can survive salinity up to 2% (unlike rice). This advice aims to improve the food security and long-term income security of Thuan Hoa households.

Under the rice-shrimp system, farmers can get a rice yield of 3.6 t/ha, and a shrimp yield of 350-400 kg/ha per year. Increased temperature at the end of dry season and sudden change of water salinity due to heavy rains are reported to decrease shrimp yield.

Table 5 Vulnerability rankings for each agroecosystem component

	River and Channels	Mangrove forest	Mudflat	Rice farming field	Aquaculture farming field
Threat	Pollution from motorboat traffic, chemical fertilizers and pesticides	Population pressure, clearance for aquaculture and crop cultivation	Sea level rise, over fishing	Saline water intrusion, shortened period favorable to rice cultivation	Drought, high temperature at the end of dry season
Threat trend	Increasing	Increasing	Increasing	Increasing (shortened period favorable to rice cultivation)	Increasing (lower yield, high mortality and increased risk of disease)
Vulnerability	Medium	Medium	Medium	High	High

The threat trend and vulnerability categories in Table 5 are based on scientific information from USAID Mekong ARCC reports and local information from AMDI community consultations and field observations. The main source of pollution to river and channels comes from motorboat traffic. The trend is increasing due to population pressure in the commune. Pollution from discharge of chemical fertilizers and pesticides from crop production is minimal in the commune since the main crop is rain-fed rice in the rice-shrimp system. Farmers keep the use of chemicals on rice to a minimum so not to affect the shrimp and crab production.

Sustainability of yields of rice and shrimp crops depends on ecological health, therefore it is important that farmers understand the impacts of agricultural and aquacultural techniques on the ecosystems they rely on. Both rice and shrimp on rice-shrimp fields are highly sensitive to the condition and balance of interchange of saline and fresh water in dry and wet seasons. The rice crop serves as a vegetation stand that provides biomass and habitat for organisms that are the natural feed for the following shrimp crop. Extending the shrimp growing period would require the retention of saline water in the field that will negatively affect the yield of the rice crop.

5.4. Non-timber Forest Products (NTFPs) and Crop Wild Relatives (CWRs)

This section outlines the importance of the important NTFPs and CWRs in Thuan Hoa Commune, and presents a summary (at provincial level) of key impacts of direct human behavior and climate change on their vulnerability (Table 6).

NTFPs and CWRs are essential for food security, medical remedies, fiber, building structures and furniture. Pressures on land and natural resources have meant that often the only remaining sources for these natural products are protected areas. Therefore there is a strong financial incentive for sustainable management of this resource. The remaining area of mangrove forest in Thuan Hoa commune is about 1150 ha. In order to encourage local people to participate in protection, forest is long term contracted to households. Households are allowed to clear 30% of the forest area for aquaculture production and to collect NTFPs on the contracted area. Timber products from thinning of mangrove forest are used as fuel or marketed and sold as fuel wood. Collection of natural fishery products (blood cockle, clams, crabs and shrimp) in protected mangrove forest is a source of income for poor households. However households in reality tend to clear more than the 30% that is contracted for. This degrades the mangrove ecosystem and decreases the effectiveness of the original policy which is designed to assist households, with the end result being the increase of the community’s vulnerability to SLR, saline intrusion and storm surges.

Table 6 Vulnerability of NTFPs and CWRs in Ken Giang Province (USAID Mekong ARCC Main Report, 2013)

NTFP / CWR	Exposure and impacts	CC Sensitivity	Non-CC Sensitivity
Mangrove (<i>Sonneratia spp.</i>)	Some harvesting for timber, increased human collection if other plants are stressed by increased temperature. Planned coastal dyke in Kien Giang will prevent mangroves from expanding inland when sea level rises. SLR, strong wave action, coastal erosion	Very high	Moderate
Wild rice (<i>O. rufipogon</i>)	Lack of recognition of conservation value Loss of habitat due to increasing conversion to agriculture Genetic erosion due to genetic flow between cultivated rice and wild rice in proximity	Low	Low - high
Aquatic plants (<i>Sesbaniasesban</i> , <i>Typhaorientalis</i> , <i>Lepironia articulate</i>)	Increased salinity near the coast Habitat change – land use conversion to aquaculture and agriculture Over-harvest	Very low – moderate	Very low - moderate
Honeybee (<i>Apis dorsata</i>)	Timing of flowering of preferred plants may be altered Overharvesting of honey driven by increase in market demand and price. Increasing human modifications of landscapes, infrastructure – roads and other development. Increasing use of pesticides and agrochemicals. No conservation status for this species	Moderate	Moderate

5.5. Disaster Risk Vulnerability Assessment

The location and topography of Vietnam makes it one of the most disaster-prone areas in the world. Over 70 per cent of the population is at risk from an average of six to eight tropical storms and typhoons per year and consequent sea surges, saltwater intrusion, flooding and landslides. Climate change will cause an increase in the intensity, frequency and scale of these weather-related disasters and there is mounting evidence that shows that it is also altering when and where disasters occur. In Vietnam, disasters already cause significant loss of life and extensive damage. Every year, an average of 530 people are killed from climate-related disasters, 2.3 million are affected and there are losses of approximately USD 212 million (equivalent to 1-1.5%GDP). Climate change will further increase the vulnerability of people to disasters, particularly the poorest, most marginalized and those heavily reliant on ecosystems.³

Vietnam's Government and NGO community have been active in reducing the vulnerability of its people to disasters for many years, with significant progress achieved over the past decades. The National Strategy for Natural Disaster Prevention, Response and Mitigation to 2020 outlines Vietnam's approach for disaster mitigation and management, particularly focusing on floods, storms and drought. The Strategy aims to reduce disasters and their impacts on people, property, agriculture, economic well-being, environment, and sustainable development. The main tasks include reducing the forecast period for storms, drought, salinization and other phenomena; strengthening dykes, dams and other disaster prevention infrastructure; improving organizational and human resource development; education and awareness-raising; development of disaster prevention, developing response and mitigation technology and science; improving capacity in research and rescue and growing international cooperation and integration. To address some of these issues, a Disaster Risk Management (DRM) Law was promulgated by the National Assembly in 2013. This Law allocates clearer responsibilities, improves the institutional arrangements of Ministries and ensures better enforcement of DRM measures. In addition, the Community-based Disaster Risk Management (CBDRM) Programme to 2020 was established in 2009.

The Government of Vietnam has made significant progress in the area of DRM in the past decade. Activities currently underway to improve national DRM, are hoped to improve the institutional frameworks, clarify roles and responsibilities and encourage better partnerships and coordination to maximize resources. Vietnam is also increasingly recognizing climate change's influence on disasters and working to integrate these considerations into policies and programs. The next step will be translating these into actions on-ground. This will require the building of capacity at national, provincial and local levels and distributing sufficient funds to support the activities.

Kien Giang province, located in the lower Mekong River Delta, faces river flooding, storm, whirlwind and salt intrusion. The impact of climate change is increasing river bank erosion, sea water rise and tidal surge. In addition, its economic growth and achievements made in human development are under serious threat due to climate change impacts; that is, wetter wet seasons, dryer dry seasons, higher

³ General Statistics Office of Vietnam (GSO), Central Committee for Flood and Storm Control

intensity rainfall, flash flooding, and increased frequency of tropical cyclones. According to scenarios which forecast a 100 cm rise in sea levels by the mid-21st century, the Mekong River Delta will become the worst affected area which would account for 90 percent of the national flooded zone. Research provided by Can Tho University that estimates climate change impacts from 1980 to 2030, shows that Kien Giang is among those which have experienced and will continue to be affected by climate change.

Vietnam’s national sea dyke program is a long term project and is important to DRM in all coastal provinces from Quang Ninh to Kien Giang. Dykes and large-scale sluice gates are planned for the Thuan Hoa coastline, however it is difficult to predict how this will affect the coastal zone and people’s livelihoods as well as when the infrastructure will be completed which depends on national funding availability.

At commune level, the approach to disasters is still mainly top-down. Annual planning for disasters is based on the commune annual flood and storm control plan. Disaster response is the current focus and capacity of the commune, rather than preparedness. This includes loudspeaker announcements on hazards, advice to citizens on evacuation points, and mobilization and actions of emergency authorities. Currently, the local authorities and people receive information about disasters and weather through national and provincial TV and radio. The VNRC is involved in capacity building and training for disaster situations, including first aid training. There is opportunity for improvement in commune level preparedness strategies, including early warning systems.

Every year, the People’s Committee of Thuan Hoa commune summarizes and evaluates the disasters that have occurred during the year to develop a disaster management plan for the next year. The disaster management plan includes disaster response measures and a clear division of responsibilities and tasks among departments, sectors and mass organizations in the commune. However the impact of climate change on livelihoods and daily activities of the community is not addressed in the plan.

Consultation with local authorities and communities in Thuan Hoa commune, Kien Giang province show that the commune is experiencing the changes in the pattern of natural hazards and associated climate change impacts: sea level rise, salinity, storms, and flooding. The people reported that they observed climate variability, including higher than average temperatures, more unexpected storms and cyclones, heavier rainfalls over shorter periods of time, more severe droughts, saline intrusion in dry seasons, shorter rainy seasons and longer dry seasons. Table 7 presents detailed analysis of threats, sensitivity, exposure, vulnerability and some potential adaptation options for the community’s major hazards.

Table 7 Disaster risk vulnerability assessment of Thuan Hoa commune, Kien Giang province, Vietnam

Threat	Exposure, sensitivity, impact	Vulnerability	Adaptation Options
Flooding/sea level rise	<ul style="list-style-type: none"> - Increased precipitation, wet season flows in the Mekong and sea level rise likely to increase severity and frequency of floods - Very High exposure due to climate and development and also lack of drainage in 	High	<ul style="list-style-type: none"> - Development of forecasting and early warning systems for flooding and vector-borne disease - Construction of raised community flood shelters

	<p>the intensive system of fields and waterways</p> <ul style="list-style-type: none"> - Medium sensitivity because poverty and other welfare indicators relatively strong and past experience of flood events - Major threats are water-borne and vector-borne disease, food insecurity from loss of crops or income-generating assets 		<ul style="list-style-type: none"> - Strengthening existing dyke and waterway network - Review and upgrade drainage capacity of fields and waterways - Building new dykes and roads - Install raised rainwater tanks to provide emergency water during flooding - Swimming lessons for children
Salinity	<ul style="list-style-type: none"> - Increased temperature, dry season river flows in the Mekong and sea level rise likely to increase severity and frequency of salinity - Very High exposure due to climate and sea level rise also lack of drainage in the intensive system of fields and waterways as well as adaptive farming mechanism to increasing level of salinity - High sensitivity because main income generating and food security are dependent on level of salinity - Major threats are water-borne and vector-borne disease due to lack of clean and fresh water especially during dry season, food insecurity from loss of crops or income-generating assets 	High	<ul style="list-style-type: none"> - Review and upgrade drainage capacity of fields and waterways - Build sluice gate and dyke to control sea water - Install raised rainwater tanks to provide emergency water during dry season - Shift seasonal calendars - Introduce new varieties more resistant to salinity - Shift to saline water farming and aquaculture - Plant trees that can de-salinize the water
Storms	<ul style="list-style-type: none"> - Increased intensity of storms predicted to hit the commune is stronger associated with high waves and high tide, sea level likely to increase severity of storms - Very high exposure due to climate and topography, temporary housing structure (accounting for 53% of houses) and poor road conditions (in many part of villages, no concrete road, and small road can serve only motorbike, no car) - High sensitivity because lack of coping experiences and capacity to storms, - Major threats are deaths and injuries caused by collapsed structures and sea water, associated with water-borne and vector-borne disease, food insecurity from loss of crops or income-generating assets, housing and basic infrastructures 	High	<ul style="list-style-type: none"> - Development of forecasting and early warning systems for storms and vector-borne disease - Construction of raised community storm shelters - Improve housing conditions of private households to be resistant to storms - Strengthen existing dyke and waterway network - Review and upgrade drainage capacity of fields and waterways - Build new dykes and roads to serve as evacuation route

5.6. Gender Vulnerability Assessment

Overview of gender and climate change in Vietnam

According to Wamukonya and Rukota (2001), the main rationale for differentiating between men and women as far as climate change is concerned, is the different roles that the two sexes play in different societies. Understanding how the different expectations, roles, status and economic power of men and women affect and are affected by climate change will improve interventions to reduce vulnerability in the developing world. Effective design and implementation of adaptation measures could be enhanced by acknowledging and taking into account different ways in which climate change impacts men and women (Wamukonya and Rukota, 2001).

The differences in gender roles indicate that climate change will impact women and men differently, based on their different roles and responsibilities in their community and their level of access to natural and other resources including knowledge. Literature review confirms that lack of empowerment and limited access to and control of assets, limited access to productive resources such as land, technology, credit, education and training, formal employment and training, as well as susceptibility to HIV and AIDS exacerbates gender inequalities. These factors not only intensify inequalities between men and women but also, make woman more vulnerable to poverty, disasters, risks and climate change.

Vietnam has a strong track record on promoting gender equality and women's empowerment, and legislative and policy frameworks are in place to address gender inequality and promote women's rights, including the Law on Gender Equality and the Law on Domestic Violence. However, traditional attitudes and practices which impede the realization of women's rights persist, and progress on some fronts, such as participation in decision-making, the position of ethnic minority women and girls, and women's access to economic resources, remains uneven. Although the National Target Program to Respond to Climate Change (NTP-RCC) emphasizes gender equality as a guiding principle, it is largely silent as to how this will be realized, with no specific targets or activities to address women's vulnerability or gender issues, in particular at the community level. At the same time natural disasters policies and others that relate to climate change, and the responsible agencies, are not addressed in legislative and policy frameworks for gender, including the Law on Gender Equality.

In Vietnam, while awareness of gender equality has increased, this does not always translate to increased gender equality in practice. Women's participation in household decision-making has increased slightly. Women's community participation has also increased, in particular in events which relate to women's traditional role such as festivals and social events; however, participation in local formal political and management structures remains low. This has implications for women's participation in planning and decision-making for climate change at the household and community level. Women's productive role and contribution to households is being affected as a result of natural disasters and climate stresses, which impacts on their ability to maintain household subsistence while their less access to livelihood assets would limit them to cope with major shocks and stresses. Men and women identify different measures in response to climate change, yet women's voices are not being heard in decision-making on natural resources, and disaster management, despite their central role and responsibilities.

Gender and climate change in Thuan Hoa Commune

Through the consultation with Women’s Union and Health Clinic in Thuan Hoa commune, it is confirmed that women in this community are facing the same risks and vulnerabilities as mentioned above. These vulnerabilities are described below and summarized in Table 8. In addition, from the baseline survey results, women in Thuan Hoa commune are at even greater risk due to their low education level (13.6% of women are illiterate compared to 5.3% of men). And while the majority of women had primary education accounted for (62.1%); only 20.9% had secondary education; and only 2.4% had high school education (AMDI Awareness Survey Report, 2014). In this commune, men are dominant in the community governance structure. There are no women as the heads of the People’s Committee, technical units or mass organizations, except the Women’s Union. Currently, women account for about 25% of the total staff of the commune government.

As a result of the awareness survey, on being asked whether the respondents knew about “climate change”, significantly only 94 out of 258 respondents confirmed that they had heard about this term before, accounting for approximately one fourth of the total population survey. Among those who had heard about climate change, the number of males was twice more than females (62 males and 32 females). This also meant that up to 84.5% of the women participating in interviews were totally unaware of climate change even though they noticed the weather pattern had been changed recently.

Fisheries are the mainstay of livelihood of coastal peoples. However, the marine fisheries are threatened by possible changes to the SLR and storms and salinity. Any change in the frequency, timing or distribution of the upwelling would influence production, with significant economic impacts due to the prominence of marine resource industries in Thuan Hoa. The predicted rise of 0.3m or more in sea level would certainly inundate significant parts of Mekong Delta, especially Kien Giang and Thuan Hoa commune. As a result, it is women who will most likely suffer the consequences of reduced household incomes and nutrition as this industry is impacted further. Water resources are highly vulnerable to climate change. In Thuan Hoa, when the water becomes more saline, it threatens the livelihoods and health of the people, especially women, who consume more water than men for their hygiene, cooking and drinking.

Table 8 Gender implications of climate change and other impacts in Thuan Hoa Commune and Kien Giang Province (USAID Mekong ARCC Main Report, 2013; AMDI Awareness Survey Report, 2014)

Threat	Potential gender implications	Adaptive capacity
Saline intrusion due to sea level rise and storm surges leading to lower rice production	Saline intrusion significantly reduces the productivity and/or viability of rice farming. In Kien Giang women are employed as laborers in rice fields. Lower productivity may increase their workload. Shrimp farming may be a viable alternative on saline affected land. Male labor is dominant in shrimp farming as it is a more physically and mentally demanding activity and it is culturally perceived to be more appropriate for men. Shifting land use from rice to shrimp would reduce women’s income opportunities (Nguyen et al. 2010)	Construction of dykes may reduce negative impacts of SLR
Sea level rise reducing the availability of NTFPs	In Kien Giang women take the main role in gathering NTFPs for food and medicinal purposes (Nguyen et al. 2010). SLR reduces habitat of mangrove ecosystems. Reduced access to NTFPs reduces women’s access to NTFPs for subsistence purposes and income opportunities.	Improved regulation and enforcement of mangrove protection forests

Increasing storms, salinity, SLR leading to declining fisheries	Significant economic impacts due to the prominence of marine resource industries in Thuan Hoa. Women will suffer most consequences of reduced household incomes and nutrition as this industry is impacted further.	Construction of dykes may reduce negative impacts of SLR. Mangrove restoration.
Higher health risks	Women are typically the primary caregivers for the sick. Greater incidence of illness in other household members due to, for example, higher temperatures places greater burden on women that limits their capacity to fill other household tasks and income-generating activities. Water scarcity is related to higher rates of gynecological disease. Water scarcity places a high physical burden on women as they travel further to obtain water for cooking and cleaning.	Good level of access to health clinic and health professionals in Thuan Hoa Commune
Low female education levels	Women lack knowledge on CC and its impacts, and therefore are limited in their ability to respond (AMD1's Awareness Survey found 84.5% of women in Thuan Hoa Commune are totally unaware of climate change).	Proposed women-targeted projects to increase awareness and understanding of CC and its impacts. This has flow-on benefits for children's education on this topic
Low female involvement in governance	Development of policies that are 'gender blind', and do not recognize the unique often vulnerable position of women in society. (AMD1's Awareness Survey revealed women account for 25% of the total staff of the commune government), and that there are no female heads of the People's Committee, technical units or mass organizations, except the Women's Union.	Women do have a platform for voicing concerns through the Women's Union. Proposed projects to improve women's involvement in local government and civil society organizations.

6. Discussion and Next Steps

This section summarizes the key findings of the vulnerability assessment, and proposes future directions for participatory research and adaptation options for Thuan Hoa Commune. Overall, the most vulnerable livelihood practices were found to be those within the rice-shrimp farming system. This is based on its significance as the primary income source of most of the Thuan Hoa population. 80% of the population is engaged in this system, and over one half of the commune area, 4,312 ha, is under rice-shrimp farming, making it the largest agro-ecosystem area. Components of this system were expanded upon in Section 4.2 in this report. Key vulnerable components as described in Table 9 takes into account the importance of the selected livelihood area/practice to the population of Thuan Hoa Commune.

Table 9 Key vulnerabilities and adaptation options in Thuan Hoa Commune, Kien Giang Province

Key vulnerable environmental/social component and threats	Impact summary	Adaptation options
Aquaculture Increased temperatures, SLR, saltwater intrusion	Increased temperatures result in higher mortality rate of prawns and yield losses. Saline intrusion inland through canal systems in dry season, which salinizes irrigation canal water and paddy soils and increases flood amplitude in the rainy season. Rice yield will	Reduce stocking densities in ponds, supplementary aeration in ponds to boost DO levels and improve water circulation and mixing. Ponds excavated that have both shallow and deep areas, where fish can move to, as diurnal

	depend more on availability of fresh water from uncertain upstream sources	temperatures change. Sluice gates or higher embankments
Capture fisheries Increased temperature	Estuarine species are most vulnerable to increased temperatures and flash flooding Invasive aquatic species (Golden Apple Snail) will benefit from the changing conditions, at the expense of some indigenous species	Recovery of coastal ecology such as mangrove reforestation. Installation of culverts and bridges to ensure that tidal exchange is not constrained
Mangroves SLR	Important for NTFPs, aquaculture, capture fisheries and reducing negative impacts of SLR and storm surges. Degraded mangrove forest results in stronger wave action and coastal erosion. Increased human collection if other plants are stressed by increased temperature. The planned coastal dyke in Kien Giang province will prevent mangroves from growing further inland when sea level rises	Strong financial incentive for sustainable management of this resource. Protected areas to be more heavily regulated and enforced by authorities
Gender inequality Climate change and non-climate impacts e.g. low education levels	Greater physical burdens on women due to water shortages and decrease in availability of NTFPs. Greater incidence of illness in other household members as the primary caregiver's – the mother – workload increases. Women lack knowledge on CC and its impacts, are under-represented in governance structures, therefore are restricted in their ability to respond	Proposed women-targeted projects to increase awareness and understanding of CC and its impacts. This has flow-on benefits for children's education on this topic. Proposed projects to improve women's involvement in local government and civil society organizations. Use existing platform – Women's Union - for voicing concerns.

The next step is to increase the participatory element of the vulnerability analysis, with the aim that community involvement will challenge, validate and enrich different aspects of the results presented in this report. This will be achieved through a vulnerability and capacity assessment (VCA). The VCA will be conducted in the Thuan Hoa community by local field experts from VNRC under the guidance and leadership of technical livelihoods experts and participatory research experts from AMDI. Participatory methods such as focus groups, interviews with key informants, village mapping, vulnerability matrixes and historical timelines will be employed to ensure the community's priorities in climate change vulnerabilities and adaptation are recorded. Where possible, the data on vulnerability assessment will be segregated by gender to ensure issues specific to different genders are considered in adaptation planning. This ongoing process will inform the development of future adaptation options for Thuan Hoa Commune.

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