A Publication of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

Vulnerability Assessment of Climate Risks
in Stung Treng Province, Cambodia

A JOINT UNDP - IUCN - MRC GEF-FUNDED PROGRAMME

MWBP.C.P.2.03.06

January 2005

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1 INTRODUCTION

As a part of the GEF funded, Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP)*, a joint programme of the four governments of Cambodia, Lao PDR, Thailand and Viet Nam, managed by the United Nations Development Programme (UNDP), the World Conservation Union (IUCN) and the Mekong River Commission (MRC), IUCN has participate in a dialogue focusing on water and climate change in the Lower Mekong Basin. The ongoing dialogue aims to infuse climate change concerns into the decisions made by water managers and policy makers, and to help local communities cope with and adapt to increasing climatic variability. Assessing vulnerability is a key component of this initiative.

The Cambodian assessment is one of three case studies that aims to assess the potential consequences of climate change on wetlands communities and livelihoods. As in the other studies conducted in Thailand and Laos, initial attention is given to understanding vulnerability and adaptations to current climate variability.

2 BACKGROUND

2.1 Climate and Society in Cambodia

The Kingdom of Cambodia has endured some of the most terrible tragedies of the last century. What then would compel its people to consider the risks of a changing climate? Simply this – Cambodia remains among the poorest nations in the world. Moreover, the population is overwhelmingly rural with only 14.4 per cent living in urban areas (Skeldon 1999).

Agricultural yield per hectare is among the lowest in Southeast Asia at less than one ton per hectare and rural farmers hold, on average only one hectare per household (Boreak 2001). These marginal yields are highly vulnerable to climate variability. Untimely breaks in the monsoon rains can devastate rice, potatoes and other crops. Flood and drought regularly reduce the efforts of rural farmers to naught.

Much of Cambodia's economy is linked to the vitality of the great Mekong River and its tributaries. Not only do the rivers serve as the primary transportation arteries, they also yield abundant aquatic resources.

Fisheries are critical to rural livelihoods and the national economy. Annual flooding regularly transforms riparian areas into flooded forests. The waters of the Mekong flow into the Great Lake Tonle Sap during the rainy season resulting in huge fluctuations in flooded surface area - from about 2,600 sq km during the dry season to between 9,000 and 14,00 sq km during the rainy season (ADB 2000). An estimated one million people, or 15 per cent of Cambodia's total population, depend on the flooded lake's fisheries for their livelihoods (Savath and Chanrithy 1999).

Variable climate including monsoonal activity and extreme climate events, such as flood and drought, affect the resources of the forests, rivers and wetlands, both wild and cultivated species have adapted to climate conditions – the temperature and the timing, intensity and duration of rainfall influence the primary productivity. Some species, however, may be ill equipped to weather future climate conditions.

Human populations have developed some resilience to uncertain climate conditions but climate surprises and extreme events continue to inflict considerable losses.

Moreover, current local coping strategies are barely sufficient to maintain current livelihoods, their coping strategies as the climate changes. Improved understanding of climate conditions can become a powerful tool that helps local communities and government agencies to plan for and secure improved quality of life, particularly in those areas where livelihoods are linked to climate sensitive resources.

2.2 Overview of Cambodian Climate

Climate in Cambodia, and throughout the Mekong River Basin (MRB), is governed by monsoon winds that alternately blow from the Northeast and Southwest. The rainy season begins with the arrival of the Southwest monsoon in May and continues until late September. The Northeast monsoon is characteristically colder and drier and lasts from November to March. April and October are transitional periods with unstable conditions.

Figure 1: Cambodian Climate

The high coastal mountains of Vietnam shield the basin during the Northeast monsoon, the cold and dry season. Temperatures in the MRB are high except during the early part of the Northeast monsoon (November-December) when the winds from Central Asia bring somewhat cooler air. The temperature gradually rises till February when under the influence of light southerly winds, the weather becomes very hot. This lasts until the Southwest monsoon commences in May.

Geographically and for purposes of developing regional climate change scenarios, Cambodia is classified as the lowland portion of the Mekong river basin and constitutes one of seven basic landform sections in the basin (Hirsch and Cheong 1996, MRC and UNEP 1997, MRC 2003a).

The Mekong lowlands cover the majority of Cambodia and small areas in Lao PDR and eastern Thailand. The Tonlesap, the largest inland body of water is in Cambodia and is of immense ecological and economic importance. The highland boundary is marked by the Khone falls in the south of Lao PDR, which is both a substantial navigational obstacle and the site of extensive wetlands with significant aquatic biodiversity.

In Cambodia, the average harvested area increased from 1.5 million hectares in 1986 to 1.9 million hectares in 1992-1993 and 2.1 million in 1999. The most recent figures from 2000 are that 2.32 million hectares are under cultivation. Major problems are associated with flooding, acidic sulfate soils, salinity intrusion and drought (MRC 2003b).

The hydrological regime of the Mekong River is primarily dependent on alternating wet and dry season climates. High water period lasts from August to October in the upper basin and September to November in the lower part. The flood season begins in June to July and runs through November- December with a peak in September. The flooding season accounts for 85-90 per cent of annual runoff. The dry season by contrast accounts for only one to two per cent annual flow (Hoanh et al 2003).

Rainfall varies considerably throughout the Kingdom. In the lowlands, annual rainfall ranges from 1,000-1,700 mm while in the highland it ranges from 1,000 to 2,700 mm and from 1,000 to 3,000 mm in the coastal areas. These figures are based on the limited number of rainfall stations in Cambodia. As a result of the civil war, the number of operational stations was reduced from 61 to just 12. Similarly, before 1979, air temperature was measured at twelve stations nationwide, now only six stations are used. There is only one station that measures other climate variables such as evaporation and winds (Ministry of Environment 2001).

In rural Cambodia, groundwater resources are used for domestic consumption and small scale irrigation of vegetables and fruit trees. Although groundwater resources are considered insufficient for large scale irrigation, it is reported that more than 6,000 wells have been drilled since 1980 and in the delta, the extraction rate has increased dramatically from 120,000 m^3/day in 1997 to 290,000 m^3/day in 2000 (Hoanh et al 2003).

3 METHODOLOGY

A planning meeting with local and provincial representatives was held in September 2003. At that meeting the assessment activity was re-designed to reflect local interests and conditions. As a result, the focus was expanded to include droughts.

A field survey was conducted in October 2003. Team members included representatives from two national ministries, four provincial departments and two NGO's including:

- Climate Change Office, Ministry of Environment
- National Disaster Management Committee
- Disaster Management Committee, Stung treng Province
- Department of Water Resources, Stung treng Province
- Department of Agriculture, Forestry and Fisheries, Stung treng Province
- Department of Environment, Stung treng Province
- CEPA
- Oxfam CA

The assessment activity was organised around a series of exercises that included focus groups, household surveys and a mapping exercise. The exercises aimed to document local experiences with:

- Rainfall and drought
- Flood extent and duration
- Seasonal activities
- Elements at risk (flood and drought)
- Houses, roads or other physical structures (such as bridges)
    - Crops
    - Livestock
    - Household assets (equipment)
    - Natural resources
    - Health
    - Water resources
    - Wage labor
- Coping strategies

The case studies included 25 household surveys in each of the two selected communities. Of the 50 total surveys, half addressed flood impacts and half addressed drought. In addition to describing local climate hazards, questions aimed to identify perceptions of the causes of vulnerability. Finally the exercises sought to document coping strategies during the preparedness, emergency response and recovery periods.

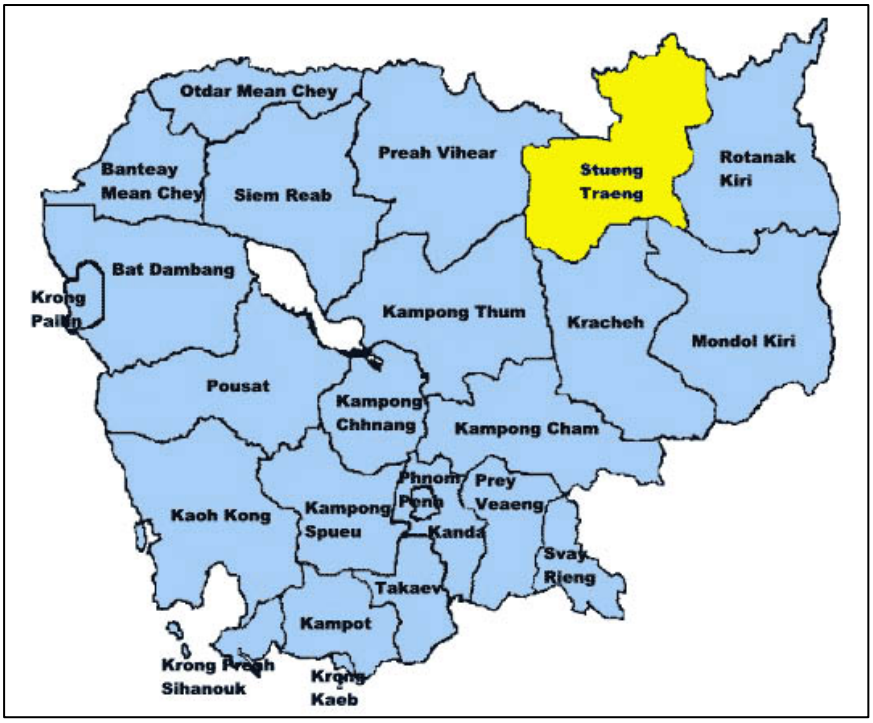
4 STUDY AREA

4.1 Stung treng Province

Stung treng Province, located in the northeast of Cambodia, borders Ratanakiri province to the east, Mondulkiri province to the south. Kratie, Preah Vihear and Kampong Thom provinces form the western border and Lao PDR forms the northern border. The province encompasses 12, 016 sq. km and is divided administratively into five districts, 34 communes and 128 villages. Stung treng Town, the provincial capital, is situated 481km from Phnom Penh. At present it is only accessible by river although a road connecting Stung treng to Phnom Penh via Kratie is under construction.

The population of Stung treng is 89,264 people, representing only 0.7 of the national population (Stung Treng PPA Team 2003). The 17,008 families living in Stung treng are sparsely distributed with only 13 people/km^2. Khmers make up the majority of the population followed by significant populations of Lao, Chinese, Vietnamese, Kuoy, Khek, Kavet, Phnong, Tumpuon, Lun, Stieng and Prov (Stung Treng PPA Team 2003). Despite considerable ethnic diversity, livelihood strategies are fairly similar.

Figure 2: Provincial Borders in Cambodia



The majority practice swidden horticulture (slash and burn) and raise paddy rice. Fishing, animal husbandry, hunting and collecting non-timber forest products (NTFPs) are critical components of the local economy.

Land use has changed dramatically since the land reforms following the establishment of the transitional administration. At this time, many lands were committed to private concessions. Today well over of two-thirds of the forest are under concession and unavailable to local communities.

Table 1: Land Use in Stung treng Province

Total forestland	**928,000**
National Vireak Chey Park	99,791
Forest Concessions	701,906
Forest lands not under concession	126,303
Ramsar site	14,600
Rice fields	19000
Fruit tree farm lands	2,193
Town and residential lands	5,265
Agricultural Concessions	108,252
Roads	2,496
Rivers	30,794
Fallow lands	13,200

Source: PDAFF 28 December 2001

The Mekong River flows north to south through Stung treng province and meets the Sekong River in Stung treng Town. Two other rivers, the Sesan and Srepork also flow into the Mekong mainstream. The rivers, characterised by rocky beds, deep pools and sandy islands create a rich aquatic habitat that serves as spawning and breeding grounds for a diversity of fish species including, the endangered *Pa Se Y.*

The flooded forests that are common in Stung treng occur in very few other places in Asia. This rare habitat provides an important refuge for young fishes during periods of high water. The abundant fruits, leaves and detritus in the flooded attract many species to the area (Stung Treng PPA Team 2003).

Recently, a new species of giant gourami has been found in the area and it is probable that many other species occurring here have yet to be described. Approximately 100 species of fish are found in the area, at least 50 of which are of importance to the fishing industry.

Although fishing in Stung treng accounts for only 0.2 per cent of the national fresh water fish production, the wetlands are an integral part of local livelihoods. About 90 per cent of the provinces population live along the rivers and streams and rely on fish for food and income. Fish is the major source of protein for people in Stung treng. Some fish species are spawned in Stung treng and then migrate to the Great Lake Tonle Sap before returning to Stung treng to spawn. Reduced fish stock in Stung treng therefore also affects the fish stock of the Great Lake Tonle Sap (Stung Treng PPA Team 2003).

The 37km stretch of the Mekong River from the north of Stung treng to the Lao border is categorised as a Ramsar site. This is one of three Ramsar sites designated by the Royal Cambodian Government. It is located in two districts, Talaboriwat and Stung treng district, and extends 500m along both sides of the bank of the Mekong River until the Cambodian-Laos border. It is characterized by a strong flow with numerous channels between rocky and sandy islands that are completely inundated during high water, and also higher islands that do not become inundated.

4.2 Study Villages

Selection of study sites was based on consultation with local partners. Both of the villages selected for this study were chosen because of their reliance on wetland resources and because they had already participated in an IUCN sponsored Participatory Poverty Appraisal (PPA) (Stung Treng PPA Team 2003).

Koh Chrim village is situated in O' Mareah commune, Siem Bouk district of Stung treng province along the Mekong River, and is about 35km from the town of Stung treng. Although it is an island, the size of the village has not yet been defined officially and residents have established farms across the river. Kreala Peas, located 48km north of the provincial town of Stung treng, is one of eight villages in Preah Romkel commune, Thalaborivath district. The entire village speaks Khmer. Market places for exchanging products include Stung treng and Voen Kham and border areas of Laos. Table 2 provides further background information on the villages.

Table 2: Study Village and Household Information

	Koh Chrim[1]	**Kreala Peas**
Population		
Population	567	574
Number of females	297	307
Families	120	112
Houses	86	104
Land Use		
Paddy land (ha)	55	170
Farmland (ha)	25	22
Swamp area with flooded forest (ha)		425
Material Resources		
Buffaloes	24	232
Cows and oxen	39	111
Pigs		156
Rice mills	4	4
Row boats	38	48
Motorboats	41	23

In Koh Chrim, according to IUCN's 2003 Participatory Poverty Assessment, at that time there was one school with two classrooms, one rice storehouse (for rice bank), two hostels, 39 latrines (20 supported by CAA and 19 by CRC), 86 hygiene water jars, five bridges (only one of them in good condition, other four in bad condition), limited electricity provided by generators, and five video sets. Other material resources owned by families in Kreala Peas that are not shown in Table 2 include two water pumps and 15 bicycles.

[1] Information for Koh Chrim on houses, rice mills, row boats, and motorboats is from IUCN's 2003 Participatory Poverty Assessment.

4.3 Economic Activities

Figures 3 and 4, produced as part of the current study, indicate the distribution of key livelihood activities throughout the year in the two study villages. The colored areas correspond to climate norms reported by villages. When the two villages are compared, some variation in the timing is observed. These differences reflect, at least in part, local variations in climate and environmental conditions.

Subsistence and other economic activities are fairly similar in both villages despite the variations in the timing of specific activities. Livelihood strategies include the following:

- Rice farming (paddy and upland rice)
- Fishing for both home consumption and market
- Animal husbandry (pig, chicken, cow, buffalo) for sale, consumption, draft (rental) and bank account.
- Hunting for market, home consumption and traditional medicine
- Vegetable cultivation and collection of wild vegetables for daily consumption and market
- Gathering non-timber forest products (NTFP's) such as rattan, resin, bamboo for sale and household consumption

Villagers in Kreala Peas also earn money by transporting passengers and goods by motorboat between the commune, Voeun Kham village (Laos border) and Stung treng town. A few households also generate income by milling rice in the community.

Figure 3: Seasonal Economic Activities in Koh Chrim

Koh Chrim	Jan				Feb				March				April				May				June				July				Aug				Sept				Oct				Nov				Dec			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Paddy Rice																																															
Plowing																							x	x	x	x																						
Sowing																							x	x	x	x																						
Transplanting																										x	x	x	x																			
Harvest	x	x																											x	x	x												x	x	x	x	x	x
Chomka																																															
Clearing								x	x	x	x	x																																				
Burning														x	x	x																																
Dibbling																						x	x	x	x	x																						
Weeding																						x	x	x	x	x	x	x	x	x																	
Harvest																																		x	x	x	x	x	x								
Fishing	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	X	X	X	X	X	X	X	X	X	X	X	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Plant																							x	x	x	x																						
Harvest																																					x	x	x	x	x	x	x	x	x	x	x	x
Vegetables	x	x	x	x																																		x	x	x	x	x	x	x	x	x	x	x	x
Wage Labor																													x	x	x	x																
Husbandry	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
NTFP																																															
Bamboo																							x	x	x	x	x	x	x	x	x																
Mushroom	x	x	x																				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
													Wet																More Wet				Dry				More Wet								Dry				

Figure 4: Seasonal Economic Activities in Kreala Peas

Kreala Peas	Jan				Feb				March				April				May				June				July				Aug				Sept				Oct				Nov				Dec			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Paddy Rice																																															
Plowing																	x	x	x	x	x	x	x	x																								
Sowing																					x	x	x	x																								
Transplanting																									x	x	x	x	x	x	x																
Harvest	x	x	x	x																																				x	x	x	x	x	x	x	
Upland Rice																																															
Prepare Land					x	X																																								
Burning											x	x	x	x	x	x																														
Planting																	x																														
Harvesting																																	x	x	x	x	x	x	x	x						
Chomka																																															
Prepare																																				x	x	x	x								
Harvest					x	X	x	x																																						
Fishing	x	x	x	x	x	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
NTFP																																															
Resin								x	x	x	x	x	x	x	x	x	x	x	x	x																											
Bamboo																					x	x	x	x	x	x	x	x	x	x	x	x														
Mushroom																	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x														
Rattan																													x	x	x	x														
																	Wet				More Wet												Wet															

It might also be noted that the community of Koh Chrim appears to place slightly greater emphasis on fishing while the people of Kreala Peas appear to emphasise cultivation of supplemental crops such as beans and potatoes.

Regarding natural resources, the bundles of non-timber forest products reported as valuable were similar in both communities and include the following:

- Firewood
- Frog
- Climbing Tree
- Thatch
- Timber
- Snake
- Wild Duck
- Prawns/Shellfish
- Bamboo
- Wood
- Wild Vegetable
- Crab
- Monitor Lizard
- Turtle
- Lotus
- Rash Skin Frog
- Fish
- Rattan
- Morning Glory
- Resin
- Rubber
- Water Duck
- Mushroom
- Snail

5 CLIMATE HAZARDS

Hazards are those physical elements of the environment that pose risk to human communities and endeavors - in this case, extreme or unexpected climate events. Typically a hazard assessment would look at the nature and behavior of the phenomenon considering, in the case of floods for instance, such features as the timing and speed of onset, extent and duration. An assessment might also consider the physical parameters that affect the probability of a hazard's occurrence at varying magnitudes. Calculating hazard occurrence probabilities (HOP) however requires detailed site-specific data. At present Stung treng has only one synoptic weather station. Given the considerable variations within the province, further study is required to determine the whether this site is representative. The section that follows records

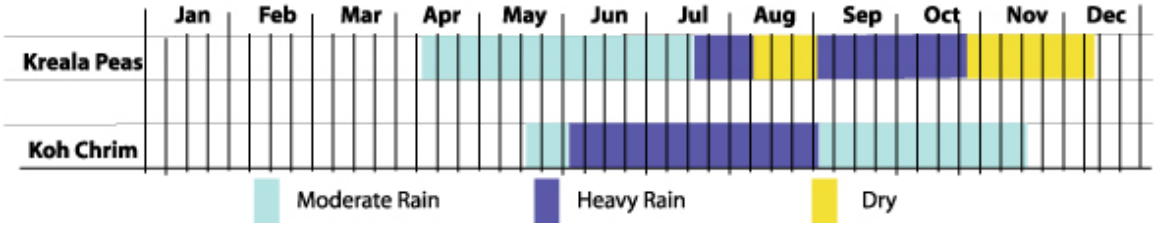
local perceptions of climate related hazards including breaks in the monsoon rains, droughts and floods.

5.1 Rainfall

As part of the vulnerability assessment, local villagers recorded the timing of seasonal changes as well as breaks and active periods in monsoon rains. Local perceptions of climate are especially important since Steng Treng Province has only one synoptic weather station. Although the two villages were only 83 kilometers apart, notable differences were recorded.

The most apparent difference is that the villagers in Koh Chrim reported a rainy season that was about two months shorter than in Kreala Peas wherein the rains begin five weeks later and end three weeks earlier. It was also noted that in Koh Chrim, the period of heaviest rainfall lasts twelve weeks and begins in mid May. In Kreala Peas, the heavy rains begin in mid July and last until the third week in October, with a notable break in the monsoon occurring for three weeks in August. The villagers in Kreala Peas also recognized a gradual tapering off of the monsoon rains lasting until the first week in December.

Figure 5: Intra-seasonal Variability



INSIGHT: The limited capacity to recall specific climate conditions reinforces the importance of community based monitoring. With an understanding of normal or expected rainfall patterns, communities are better prepared to make crucial decisions about livelihood activities. Moreover, local understanding of baseline conditions facilitates the development and application of climate information (such as seasonal forecasts and longer term projections).

5.2 Drought

The two communities also recorded the history of drought in their area. Unfortunately, the droughts mentioned in both communities only encompass the past few years.

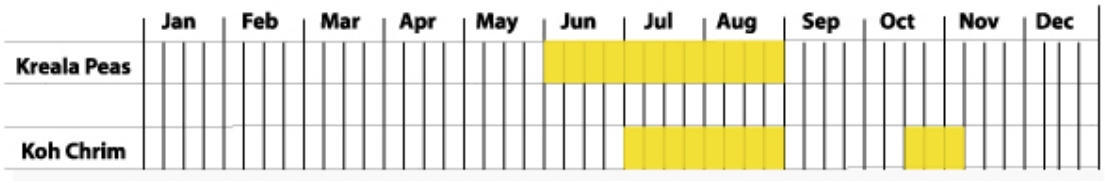
In Kreala Peas, 1999 was remembered as one of the worst drought years, while in Koh Chrim the years 2000 and 2003 were identified as especially difficult. It should be noted here that drought is not just a function of lower rainfall but is also related to baseline hydrological conditions in the community (i.e. availability of water), which may differ between the two villages.

INSIGHT: Baseline analysis of water resources in the villages is not currently available, this is an important contribution to both village planning and promoting village participation in the protection of wetlands ecosystems. Such analysis might include local geography and hydrological features as well assessing the demand for water and the extent of irrigation infrastructure.

As a result of the study it became clear that villagers recognise different drought patterns. For instance, the droughts of 2000 and 2003 are notable for a near complete absence of rainfall during the Southwest monsoon. By contrast, in 2002, both villages reported a brief period of drought that interrupted what is normally expected to be the period of heaviest rainfall. In 2001 and 1999, drought conditions were associated with two breaks in seasonal rainfall, meaning that the dry periods were separated by a period of some rain. It should also be noted that the two villages remembered the 1999 droughts differently, as shown in Figure 6.

Villagers noted that a brief break in rainfall in September-October is especially dangerous and droughts of this nature have led to severe crop losses and food shortages.

Figure 6: Local Variations in the 1999 Drought



INSIGHT: Any ability to anticipate seasonal conditions would be enhanced by the incorporation of forecasts of breaks and active periods in the monsoon cycle. Awareness of the various drought types facilitates planning for farm and water management.

5.3 Floods

Regarding floods, it was clear that recent floods have not had the devastating impact on these communities that are common elsewhere in Cambodia. Nevertheless, floods are a common feature of the seasonal landscape and, as indicated, can inundate parts of the village for up to 20 days. Kreala Peas flooded twice in 1999 and twice again in 2000. In both Kreala Peas and Koh Chrim flooding is most common in cultivated areas near streams. On a few occasions the waters reached settlement areas but villagers reported that the flooding was of short duration and generally not very deep.

The floods of 1978 were a noted exception. Due to the civil war, the village was abandoned during this period; however, when villagers retuned they noticed high water marks (about three metres) on the trees and houses.

Table 3: Recent Flood events Koh Chrim and Kreala Peas

Flood Years	Month	Village	Duration
2001	August	Kreala Peas	5 days
	Mid Aug	Koh Chrim	7 days
2000	Sept-Oct	Kreala Peas	15 days
	Oct	Kreala Peas	
	Mid July	Koh Chrim	7-10 days
1999	Sept	Kreala Peas	15-20 days
	Oct	Kreala Peas	15 days

1998	Sept	Kreala Peas	10 days
	Mid Aug	Koh Chrim	5 days
1996	Mid Aug	Koh Chrim	3 days
1994	Mid Aug	Koh Chrim	2-10 days
1987	Mid Aug	Koh Chrim	7 days
1978	??	Kreala Peas	

5.4 Summary

Both flood and drought are chronic events in Stung treng. Between 1998 and 2001 floods struck at least once per year. Between 1999 and 2003 some form of drought was reported each year in one of the villages. Both communities also noted that the combination of flood and drought, sometimes back-to-back kept villages in a near constant pattern of emergency response.

6 VULNERABILITY TO CLIMATE HAZARDS

A vulnerability assessment identifies the elements at risk in a community and asks why they are at risk. Unsafe conditions may result from inherent structural properties of the element, such as poor construction material, for instance, or from socio-economic conditions. Vulnerability assessments indicate the degree of damage that buildings, people or other elements would suffer in the event a hazard at a specific magnitude. The data gathered for this study documents historic vulnerabilities based on reported impacts.

6.1 Household Impacts of Floods

Rice Yield - Damage to rice crops is significant; an average of 30 per cent of the crop is lost in any flooding event. Since the average production is 1 ton per hectare or 60 *harb* (local measurement) and a family of five typically requires a minimum of 60 *harb* for annual consumption, this repeated loss is significant. In Koh Chrim 10 out of 13 respondents reported substantial losses of rice crop. One household reported total damage. Only one respondent reported damaged *chomka*. In Kreala Peas, ten respondents reported crop loss. Four reported 40-60 per cent damages. Three reported 80-90 per cent damage and three others reported total destruction of paddy production. Unfortunately the losses could not be correlated to landholdings.

Fruit and Other Crops - Mango and jackfruit were damaged in both villages. Koh Chrim suffered loss of orange and papaya, while Kreala Peas lost valuable banana and sugar cane crops. Loss of chili, eggplant, pumpkin and other garden vegetables were noted as well. Shortages of fruits and vegetables have a severe impact on nutrition.

INSIGHT: At present fruit production remains limited in Cambodia. The majority of fruits sold here are imported. It has been suggested that investments in fruit crops which take longer to mature has been constrained by the war. With sustained fruit production and the development of transportation infrastructure, locally produced fruit may present viable economic prospects for some communities.

Food Shortages - In both villages, many respondents indicated a general lack of food in the aftermath of flood events. However, a slightly different picture emerged when the details on consumption patterns were provided. In Koh Chrim 10/13 respondents

reported food shortages as a major impact of the drought. But only two out of 13 reported actual reduction in household consumption. One household reported a reduction from 0.75 kg/day to 0.60 kg/day. Another respondent in Koh Chrim reported reduction from 2.5 kg/day to 1.8 kg/day. Only one household reported a substantial change in fish consumption (from 2 kg/day to 0.5 kg/day). Several respondents however reported a reduction in vegetable consumption though no exact figures were available. In Kreala Peas 5/13 reported general food shortages while 6/13 reported actual reduction in household consumption. On average, the rice consumption was reduced to 60 per cent of normal and in one case it was as low as 50 per cent.

Loss of Livestock - In Koh Chrim 4/13 reported loss of ducks; 9/13 reported loss of chickens; and, 5/13 reported loss of pigs. The specific number and the relative significance of these losses for each of the households remain unclear. One household reported difficulty in finding feed for livestock. In Kreala Peas, no households reported loss of livestock, though as indicated in the map, floodwaters seldom reach the village area. One farmer noted that a buffalo was stolen, though it is unclear who the thief was or whether the flooding created an opportunity (or "need") for the theft.

Health - In the village of Koh Chrim 10/13 respondents reported one or more family members suffering malaria in the post-flood period. One respondent suffered dengue during the flood season. Stomach pains and diarrhea were also common. Respondents frequently made general reference to "fever", suggesting that self-diagnosis and reporting of disease needs to be verified more carefully. More detailed investigations are needed to ascertain the baseline incidence of malaria, dengue and other health conditions so that these may be distinguished from "flood related" cases.

After the flood, people in Kreala Peas noted that the water wasn't clear. Although a few filtration systems have been donated to the community, most people –even those who own the filters continue to rely on river water and rainwater for drinking. This likely has an effect on the incidence of diarrhea.

Debt - In both villages, floods were associated with debt. Further details are provided in the section on coping strategies.

Transportation - Two respondents in Koh Chrim reported transportation difficulties, presumably in moving carts to fields and traveling through the village on bicycles or the occasional motorbike.

Lost Assets - One respondent, in the village of Kreala Peas, reported loss of a boat and paddle. This is the only case of lost equipment or property. Also, in Kreala Peas, three homes collapsed, however, this did not occur during the flooding event, but rather was a slow process related to riverbank erosion, which is exacerbated by floods. In all three cases, the families had sufficient warning to move their belongings and to set up homes elsewhere in the village. In one case, new land was purchased, in another; the village council granted land and in the third case the family was forced to move to a home in the forest. It is important to note that issues of land tenure and access to new land remain loosely defined. It is unclear who decides whether or not to grant to new land or what criteria is used in the decision making process. Indeed, there is still no clear delineation of village land available in either Koh Chrim or Kreala Peas.

6.2 Household Impacts of Drought

Villagers in Kreala Peas provided more insights into the impacts of drought and identified 1994 and 1998 as two of the worst drought years. In Koh Chrim, people described the effects of the 2000 drought.

Rice Yield - All farmers in both villages reported damage to rice crops, noting the failures in sowing and transplanting. One villager in Kreala Peas noted that invasive grasses were unusually tenacious during the drought period. Farmers in Kreala Peas also noted reduced production in the *chomka* (swidden or slash and burn garden) where upland varieties of rice generally fair better. The village chief in Kreala Peas noted that farm yield is generally reduced to about 30 per cent of normal in 60 per cent of the village paddy fields. In Kreala Peas, in 1998 50 per cent of the rice crop was damaged and two per cent of the *chomka*. In 1994, between 70 and 80 per cent of the rice crop was lost.

Fruit and Other Crops - The village of Koh Chrim reported damage to both orange and apple trees while Kreala Peas was concerned with the impacts on mango and coconut harvest. Fifty percent of the banana plantations were damaged. Kreala Peas residents also reported significant damage to lemon grass, chili and eggplant. It is unclear whether these particular species are more susceptible to reduced rainfall than other garden species or if these are simply the most valued crops, or the only crops that respondents reported.

Food Shortage - Although most villagers in both communities indicated a general shortage of food as one of the impacts of the drought, the majority of respondents reported no actual change in the consumption patterns. This is particularly the case in Koh Chrim where only one person reported reduction in daily rice consumption and only two respondents indicated reduction in fish. Of these two, one reported an increase in vegetable consumption. In Kreala Peas, three out of 11 respondents recalled reducing rice and or fish consumption as a result of the drought. One household was forced to reduce their diet from three to two meals per day. Two families noted an increase in vegetable consumption during the same period.

Loss of Livestock - Loss of livestock is considered one of the most significant impacts of the drought. Pigs and poultry were suffered in both villages. Nearly all the ducks and chickens died. Many animals suffered heat illness. Villagers in Koh Chrim offered more detailed accounts and estimated that at least 60 chickens, 10 ducks, three pigs and three buffalo died as a result of disease or malnutrition. Almost every household interviewed lost some chickens.

Health - Every household surveyed in both villages associated the drought with increased disease. Fever, diarrhea, typhoid and malaria were all noted. Reliable baseline data, which is currently unavailable, is a needed to better understand the effect of drought on health.

Debt - Villagers in both communities reported higher debt as a result of the drought. Further details are provided in the section on coping strategies.

Changed Activities - Villagers in both communities indicated that their lives had been changed somewhat because they spent more time in their *chomka*. Also both invested more time in planting gardens, mostly beans along the riverside. Also, both communities reported more time devoted to fishing and hunting monitor lizards. As an indirect effect, because people needed to stay near the village to “try to survive”, very

few reengaged in wage labor. It should be noted that there were few details of the types of wage labour available to villagers in general, or during drought periods.

6.3 Community Perceptions of Climate Trends

When asked whether they noticed any changes in climate, such as changes in the timing, duration or intensity of the rainy season, the villagers in Kreala Peas responded that they noticed no changes while the villagers in Koh Chrim noted that rainfall seems more irregular and that the timing of the rains is less predictable.

6.4 Summary

Based on the assessment activities, it is clear that three most significant impacts from both flood and drought are:

- Rice and crop damage
- Loss of livestock
- Health

Initiatives that target improvements in these areas are likely to enhance general resilience to extreme climate events. However, further investigations with the community are necessary to establish baseline understanding of farm management practices and health conditions. Moreover, the discrepancies between public perceptions of food shortages and reported descriptions of actual consumption patterns warrant further inquiry. The fact that major casualties and property loss are not associated with extreme events (at least not in recent memory) should not lead observers to underestimate the severe affect that chronic flood and drought have on the development and livelihoods of these two villages. In addition, further investigations are needed to ascertain the vulnerability of specific forest and aquatic species to climate extremes.

7 COPING STRATEGIES FOR CLIMATE HAZARDS

7.1 Overview

Coping strategies reflect a community's (or household's) capacity to adjust to or recover from adverse impacts. This capacity also includes the resources available for preparedness, mitigation and emergency response. Questions of who has access to and control over these resources can be an important factor affecting local capacity.

A number of NGOs have been building capacity in areas that broadly support community resilience. In Koh Chrim, CAA has been supporting communities to conserve fisheries and improving health, hygiene and sanitation. Integrated Pest Management and Farmer Field School have been introduced as well. PASEC has been supporting communities in the education sector. The Cambodian Red Cross supports disaster relief and the health sector improvements.

In Kreala Peas, PFD has supported the community by improving water sanitation, drilling wells, introducing "backyard gardening" and constructing a primary school construction. YWAM has been supporting communities in the health sector including hygiene and sanitation (education as well as construction of latrines), family planning and mother and child health. CEPA has promoted community based fisheries and

forest management and training villagers to resolve conflict issues related to environment and tradition/culture with local authorities and relevant agencies. The Cambodian Red Cross provides relief during annual flooding.

In general both communities felt that they were able to recover from the flooding event of 1999 – that is 10 out of 13 respondents in Koh Chrim and 12 out of 15 respondents in Kreala Peas. Although the exact time that it took to recover was not recalled with certainty, most were able to describe their coping strategies and to identify the economic activities that helped them to recover. One villager characterised the state of recovery in these terms: “I’ve already saved enough rice for next year’s flooding season”.

Recovery from drought is considerably more problematic for both communities, noting however that both communities are presently in the throes of a drought. In Koh Chrim, four out of eight villagers reported they were fully recovered from the 2002 drought. Two households reported they have half recovered and one household reported that they were still not recovered. In Kreala Peas, 7 out of 11 have not recovered. In Koh Chrim, fishing was a common explanation of how they were able to recovery. In Kreala Peas, fishing, although mentioned, featured less prominently. Rather, animal husbandry, intensified *chomka* and other activities were considered key to the recovery process. One household noted that rainfall was the only sure aid to recovery.

7.2 Supplemental Activities

Floods - It is clear that in the aftermath of floods, villagers diversify their economic activities, or intensify activities that ordinarily are only marginal to their overall livelihood strategies. In Koh Chrim several respondents indicated that logging the nearby forests provided valuable income after the floods. No one in Kreala Peas listed logging among their coping strategies. However, because logging is illegal, villagers may have been cautious in their responses. Villagers in Koh Chrim also pointed to other valuable forest resources as key components of their coping strategy. Glues and resins are highly prized, though it is unclear how much these are collected during normal times. In Kreala Peas, honey gathering was also listed among the coping strategies although the respondent complained of poor yield for the labor invested. Hunting was also important in both communities. Monitor lizards and turtle were identified as possible sources of income in the village of Kreala Peas. Notably, nearly half the respondents in Kreala Peas indicated that cultivating beans by the riverside and sometimes even new crops such as tobacco provides an important source of income. Only one respondent in Koh Chrim indicated additional farming activities (in the *chomka*). Conversely, Koh Chrim residents saw fishing as an important component of the recovery process whereas as no one in Kreala Peas reported intensified fishing efforts. It is also worth noting that three respondents in Koh Chrim commented that they sought wage labour to supplement their income during the recovery process. One respondent in Kreala Peas reported that he hired out his ox cart for supplemental income.

Community members in Kreala Peas reported that after flooding events more time is committed to foraging in the forest. Wild potatoes, for instance, are viewed as an important supplement to post-hazard diets. Some reported more intense focus on bean gardens while other begin sowing short-term rice immediately after the waters recede.

Drought - In Koh Chrim, five out of eight respondents intensified their fishing activities (including fishing in both day and night time). In contrast, in Kreala peas, only three out of 11 suggested that they supplemented their income or food base with additional

fishing activities. Two out of eight in Koh Chrim intensified hunting activities while only one respondent in Kreala Peas did so.

As with flood recovery, in Koh Chrim, at least one person indicated that selling labour was one way to make additional income during difficult drought times whereas no one in Kreala Peas mentioned sale of labour as a possibility. Two respondents in Kreala Pease however, did augment their income by selling thatch. In general, the villagers in Kreala Peas recognised intensified bean gardening as a common drought period strategy.

7.3 Farming

Floods - A number of respondents indicated the adoption of new strategies. Some, for instance planted short-term rice after the waters receded, others utilized pumps to empty their paddy field. In Kreala Peas, two respondents reported that they rented more land to try to recoup their losses, two respondents hired additional labour; three respondents opened new land (*chomka*) in the forest. Some borrowed seed; others tried to plant short-term rice. Three planted new bean gardens and one established a tobacco crop.

Drought - Both villages reported that they switched to short-term rice. This effort was supported in Kreala Peas by CEPA who provided IR66, a short-term variety believed to fare well in drought conditions. Both villages also reported that opening more land was part of their modified farming strategy. In addition to opening more *chomka*, some villagers in Kreala Peas reported that they rented land.

Several villagers in Kreala Peas sought to hold water in the paddy by raising the borders. Villagers in Koh Chrim went one-step further and three households tried to pump groundwater into their fields. The cost of renting a water pump is quite high, estimated at 10,000 riel per day. Four respondents in Koh Chrim reported that lack of money was the main impediment to investing in alternate farm management systems. One exasperated farmer in Kreala Peas simply gave up any hope of transplanting until fall.

7.4 Fishing

Floods - Most respondents in Koh Chrim reported no change in their fishing strategy with the exception of two who reported that they began using rod and hook more frequently. In Kreala Peas several reported that they changed to rod and hook (which is more labour intensive) and increased the amount of time spent fishing. One respondent in Kreala Peas reported borrowing a boat in order to do so.

Droughts - Given the general reliance on fishing Koh Chrim, it is perhaps not surprising that villagers noted no change in their fishing strategies. Two respondents however, remarked that they intensified their use of rod and hooks. In Kreala Peas, several respondents did intensify their fishing efforts but some noted that they met with limited success. One respondent for instance noted that after two days there were still no fish in the net whereas a two-day's catch is usually about two to three fish. Some noted that that they began to fish daily rather than irregularly. They also said they intensified use of rod and hook and began exploiting the small canals near their fields. One respondent commented that he would like to change his fishing strategy but did not know how.

7.5 Household Assets

Floods - All respondents in both villages (except for two in Koh Chrim) reported the sale of livestock (poultry and pigs) in the aftermath of the flood. Very few were forced to sell valuable cattle (cows or buffalo) except in cases where medical treatment was necessary. It should be noted that the two respondents who did not sell livestock both opted to borrow substantially. One farmer in Kreala Peas reported selling one hectare of land. Interestingly, at least one respondent in each village reported buying a new boat after the flood.

Droughts - Relatively few people sold cattle during the drought period as compared with the post flood period. Only one person in Koh Chrim reported any sale and seven out of 13 in Kreala Peas reported sales. No one was forced to sell land or equipment.

7.6 Aid

Floods - The distribution of aid was highly variable in both villages. Of the 13 respondents in Koh Chrim, four received no aid at all, five received rice (about four to five days supply), three received buckets and three others received *krama* (versatile fabric worn locally). In Kreala Peas where 15 people were interviewed, five received rice, five received *krama*, three received various household goods (pots and spoons). Only one reported receiving cash and though his losses were not any heavier than other villagers. Two people in Kreala Peas participated in a food for work programme, building a new school in exchange for rice.

In both villagers, respondents were ambiguous about the sources of aid, sometimes mentioning Royal Government of Cambodia other times mentioning NGOs. In the village of Kreala Peas, the headman is said to have been involved in the distribution of aid, in Koh Chrim, there was no mention of the mechanisms for evaluating need or delivering aid.

Droughts - Aid was variable within and between the two villages. In Koh Chrim, three households (of 11) received rice – one received 40kg, the second received 20kg and the third was unspecified. No one in Kreala Peas received rice. (Note that 20kg is sufficient for four to five days.) Two respondents in Koh Chrim received *krama* and *sarongs*, no one reported this in Kreala Peas. One villager in each of the communities reported aid in cash – one man in Koh Chrim said he received 2,000 riel[2] from the Royal Cambodian Government. A man in Kreala Peas reported receiving 20,000 riel from an unspecified donor. In addition, two villagers in Kreala Peas received IR66 rice seed, presumably from CEPA. One other villager in Kreala Peas received food in exchange for work on the school building.

7.7 Loans

Floods - In Koh Chrim five out of 13 respondent reported borrowing money to help recover; three of these have already repaid the loan, one has paid partially. Loans of rice generally come with an interest rate of 50 per cent to be repaid at the time of next harvest. In Kreala Peas, seven out of 15 borrowed, although three of the loans were for medical expenses not related to the floods. Of the seven loans, six have been repaid and one has been partially repaid.

Droughts - Relatively few respondents from Koh Chrim reported borrowing money or rice during the drought. One person did borrow for medical expenses. One other reportedly sold labour for rice and a third bought such things as gasoline and household goods on credit but paid for the goods by the end of the week. In Kreala

[2] In October 2003, the exchange rate was 4,000 Riel = 1 US Dollar

Peas however, eight out 11 persons reported borrowing. Of these six, four have repaid their loans already.

7.8 Prevention

Floods - In both villages, the majority of respondents reported having prepared rice, firewood and utensils for cooking. In Koh Chrim, two respondents moved their livestock to higher ground and four more noted that raising the height of pens would be a good idea for future floods. Several reported having saved short-term rice seed as a general precaution and one insisted that vegetable seed should always be saved for emergency situations. One respondent in Koh Chrim also reminded of the importance of preparing seed for planting immediately after the water recedes.

Preparing seed for replanting was also noted in Kreala Peas. Buffalo were moved to higher ground (in one case). One farmer noted that rice seed and cooking seed should be kept in the same amount for emergency situations. One recommended saving at least 300kg of rice seed. One complained that there was no high ground for relocating cattle and another pointed out that he immediately moved his tools and equipment from the paddy fields to the village where the water levels generally are lower.

Droughts - When asked what they did or could have done to prevent drought related losses, the two villages showed an interesting difference. Both recommended the use of water pumps (although in Kreala Peas farmers were more explicit about the complementary strategy of raising the borders of the paddy field). Villagers in Kreala Peas relied on selling thatch or finding alternate income generating activities as a preventative measure suggesting that with more money they could be more resilient. Similarly, in Koh Chrim, villagers noted that more diversified activities (fishing, alternative crops, hunting and home gardens) could have prevented some of the hardships. The noted difference however was that many villagers in Koh Chrim suggested that vaccines or other interventions from a veterinarian could have prevented the massive loss of livestock that accompanied the drought (six out of eight respondents).

7.9 Early Warning

Floods - Early warning is limited in both villages. Reports do come in over the radio but these are not trusted since they often warn of floods that never occur. One person in Kreala Peas noted that he relies on the clergy who, in a rice eating ceremony augurs the size of floods for the upcoming season. One villager in Koh Chrim said that he only received word from the chief when the waters had reached the edge of the village. He said that instructions were given but did not recount what those instructions were.

Droughts - While no formal drought early warning system is in place, traditional knowledge plays an important role in anticipating the drought. In Koh Chrim villagers noted that the tail of the monitor lizard gives an early indication of drought, when the tail has more white stripes people believe there will be no rain in the coming season. Villagers in Koh Chrim also noted the sound of a particular morning bird's song as an indicator of drought. In Kreala Peas, when rice turns red, farmers know that they are definitely in a drought phases (although this doesn't give warning so much as confirmation). Similarly, other indicators of particularly dry seasons include exceptionally dry weather in early August and October during the transplant. Damage to sown rice and dead vegetables were also noted as indicators.

7.10 Summary

Coping with floods and drought is similar to the norms of subsistence in these villages, which is based on pursuing a set range economic strategies known to be available. Coping strategies are strongest in the recovery phase. When a family is in need of additional cash, for medical treatment for example, they sell cattle or borrow. When the rice harvest fails, they borrow rice from family or neighbors. Disaster preparedness is minimal. Even traditional early warning does not provide sufficient certainty or lead time for appropriate response. In general, there is little familiarity with response options; there is no evacuation plan and limited understanding of how to care for livestock or even human health during adverse conditions. The emergency response strategies appear haphazard with no coordination of relief activities, poor understanding of what relief may be available or how to access it and unpredictable patterns of distributing the little relief that is available. Given the current situation, future climate conditions are likely to exacerbate already vulnerable conditions. People will no doubt continue to cope in the manner with which they are most accustomed – with formidable endurance.

8 RECOMMENDATIONS

Adaptation to climate change and to climate extremes must extend beyond the notion of specific adaptations and should include the broader commitment to building adaptive capacity. In an important new volume, “Climate Change, Adaptive Capacity and Development”, editors Joel Smith, Richard Klein and Saleemul Huq draw attention to this important development in the ongoing dialogue about climate change adaptation. The distinction between “specific adaptations” and “adaptive capacity”, although subtle, has significant implications for recommended responses to changing climate.

“Specific Adaptations” such as investment in “planning for sea level rise, enhancing evacuation procedures, developing heat or drought resistant crop varieties and enhancing the robustness of water supply systems so that the capability to cope with specific impacts on climate sensitive sectors is enhanced” are important. However, such specific adaptations are less likely to succeed when, as in the case of most developing countries, adaptive capacity is limited.

“Adaptive capacity”, on the other hand, has to do with the adaptability of an affected system, region or community to cope with the impacts and risks of climate change (Smith et al 2003). The International Panel on Climate Change (Mc Carthy et al 2001) suggests that adaptive capacity is a function of

- Wealth
- Access to technology
- Stable and effective institutions
- Systems in place for dissemination of information
- Equitable distribution of power
- Well functioning social systems

Another way to think about adaptive capacity is to consider the availability of the five capitals: social capital, human capital, natural capital, technological capital and information capital. All of these are in short supply in Stoeng Troeng.

Given the general difficulty in securing a livelihood in Stung treng and the persistent alteration between flood and drought that, although are seldom devastating, do sufficiently compromise local capacity to meet basic needs, the relative importance of building adaptive capacity assumes greater significance especially at the local level.

8.1 Food Security and Income

Villagers in both Kreala Peas and Koh Chrim live at or near the poverty level and there is a minimal margin for error in meeting basic needs.

Improve Agricultural Production – At present the estimated one ton per hectare yield is relatively high by Cambodian standards, it is low by regional standards. If the average yield is higher, in the event of flood, drought or other climatic perturbation, losses will be higher, but so too will the remaining crop which may help to ensure basic food security. Improved production may be achieved through a combination of efforts. Irrigation will be addressed in a subsequent recommendation. Improved farm management techniques may be developed. At present the capacity in the Agricultural extension office is limited with only three field officers for the whole province. Capacity development within this office to assess current farm management practices and to engage in joint problem solving exercises with local farmers would be of value. Improved farm management might involve new varieties, improved information systems to promote “adaptive farming” (including the use of seasonal and intra seasonal forecasts) and consideration of irrigation options. Improved farm management might also include more diversity of crops especially more drought tolerant species. Improved farm management might also support agricultural research into suitable varieties including attention to optimal climate conditions.

Income Generation – When crop production fails, villagers are hard pressed to find alternative means of income to buy food. Often they are forced to borrow, sell of livestock or to reduce their food consumption. At present opportunities for generating supplemental income are limited as poor markets and market infrastructure do not favor the development of local legal produce (either agricultural, legal NTFP or cottage industries). The markets that are available for black market NTFP are unsustainable. More attention by government and non-government agencies to work with villagers to develop these industries could lead to more resilient communities. Weaving and other handicrafts could be marketed if villagers were more familiar with demands. Cooperative systems could be devised to hire a boat to bring goods to market in Phnom Penh. Such opportunities should be developed with local villagers and might involve field visits to Phnom Penh markets.

8.2 Resource Management

Given that many people intensify resource extraction in the aftermath of floods and droughts, concerted attention needs to be given to resource management systems.

Fisheries Management – Both villages rely heavily on fishing for both consumption and sale, although more so in Koh Chrim. Villagers have also noted declining fish stock this is in part due to increased pressure on fishery resources from local and non-local fisherman. More research is needed to determine whether climate or environmental change has been affecting fish stocks as well. A fisheries management program would need to focus on monitoring fish stock but would also need to address the question of establishing and/or enforcing fishing rights. Work with WFC and provincial fisheries management agencies should be continued and attention should be paid to the results of the recent World Fish Center survey on fishing and fisheries in Stung treng.

Timber, NTFP and NFAP – From the interviews it was clear that some villagers turned to illegal logging to supplement their income. This issue needs to be approached carefully as use rights in these areas are ambiguous and contentious. With NTFPs such as rubber, resins and rattan further research is needed to ascertain the impact of climate change on these products. Drought is known to have significant impact on rubber production. Reports from other parts of Cambodia indicate a near universal perception that rattan is harder to find. This is likely do to with over exploitation. Baseline survey of these products with villagers may be useful but management issues, particularly the question of right of access needs to be handled carefully. Both villages also rely on NFAPs (non-fishery aquatic products), in particular frogs and lizards. Frogs, in particular, are known to be highly sensitive to climate changes. More research in this area may generate some interest with villagers considering the widespread reliance of frogs in local diet.

8.3 Improved Information Systems and Preparedness Planning

Climate information can play an important role both in farm management systems and general disaster preparedness.

Early Warning Systems – Early warning systems generally alert the public to impending flood or cyclone risk. Recent advances in flood forecasting have been achieved in other flood prone river basins such as the Ganges-Bhramaputra in Bangladesh. Similar developments in the Mekong may be possible as well. As no early warning is currently available in Stung treng, any system would be an improvement. The early warning system should aim to translate flood warnings into local terms (for instance referring to familiar markers such as “flood waters will reach the top stair of the headman’s house by Tuesday morning”.) Warnings also need to be accompanied by clear instructions and a communications system tailored to locally available resources.

Preparedness Planning – Villagers should initiate a dialogue on appropriate response options in the event of a flood or drought. Preparedness planning should include identification of safe areas for people and livestock. Although no casualties have been reported in either village, evacuation /search and rescue strategies might be discussed as well. In addition, consideration should be given to appropriate emergency provisions such as quantities of rice and fuel to be put aside at the beginning of the season.

Coordinated Relief – At present the distribution of relief aid appears to be *ad hoc*. More attention needs to be given to assessing impacts in the immediate aftermath of extreme events and an appropriate system of identifying specific needs and affected households should be devised. Government representatives from national, provincial and community level as well as NGOs will need to coordinate their approach to the assessment and delivery of emergency relief. In addition, the development of rice banks for emergency food supply should be carefully considered and designed based on lessons learned from similar ongoing projects undertaken by Oxfam CA.

Advanced Climate Information – In addition to flood warning, advanced warning of general climate conditions could be useful to local farmers. This might include seasonal forecasts, intra-seasonal forecasts (breaks and active periods in the monsoon cycle) or even climate change projections. The development of climate information products should be tailored to local needs and emerge from a dialogue between the users and producers of climate information.

8.4 Health

In some cases labor is a constraining factor in agricultural production. Loss of available labor as a result of poor health needs to be addressed systematically.

Vector Borne Diseases – Malaria and dengue are commonly reported in the aftermath of both flood and drought episodes. However, more research is needed to determine whether the incidence is correlated to the extreme events. In general, diseases are rampant in both communities. Investments in community health care, education and awareness regarding vector-borne diseases and mosquito eradication programmes would enhance the overall resilience and well being of the communities.

Nutrition – Many families reported changing consumption patterns following extreme events. In addition to those households reporting reduced rice consumption, attention needs to be given to fruits, vegetables and other food to ensure that community members achieve the balanced diet to which they are entitled. Nutritional studies are currently underway in the province. The results of these studies should be carefully considered and integrated into the capacity building endeavors.

Water and Sanitation – Access to potable water remains problematic in both villages. Although a series of water filtration systems has been introduced, villagers are reluctant to use them (some say because they believe the concrete material is dirty) and continue to rely on river water. Very few ground water pumps are available. Of the two in Kreala Peas, only one is in working order. Access to clean water could substantially reduce the incidence of water-borne diseases and help to reduce the high incidence of diarrhea and abdominal complaints that villagers report (and seek treatment for). Water management systems should explore the possibility of tapping ground water but only after completing surveys of existing water resources, which are, at present, poorly documented in Cambodia.

8.5 Livestock Management

Villagers in both communities reported substantial loss of livestock. While some chickens may have been lost in floodwaters, the greater losses appear to be associated with disease and malnutrition following severe weather events. Villagers in Koh Chrim believe that veterinary services including vaccinations would be helpful. In addition, agricultural extension agents could reduce livestock loss through community awareness programs. One veterinarian from a neighboring province pointed out that even during normal periods many animals die of dehydration because they are not given sufficient water.

8.6 Irrigation

Although no villagers in either community explicitly indicated a need or desire for irrigation, it is potentially a viable strategy for reducing vulnerability to recurrent drought and could boost production significantly. The recommended approach is to conduct a feasibility study playing close attention to the environmental and socio-economic impacts of the develop net. Given the scale of investment, the community should be consulted at the outset as they might prioritise some other development opportunities. In addition, the analysis of costs and benefits should include risk scenarios of changing climate conditions. Numerous agricultural models that incorporate climate change information are currently available.

8.7 Dams and Environmental Flows

In the short term, the water regime is more at risk from the development of upstream hydropower dams in the Mekong and its tributaries. The potential impacts of changing environmental flows for fisheries and other wetland resources should be assessed more carefully. In addition, the assessment should incorporate climate change scenarios for use in decision-making by dam managers.

8.8 Climate Information Systems

Climate information can play an important role in decision making under both present and future climate conditions. At the local level, flood and drought forecasts, seasonal forecasts and intra-seasonal forecasts might be applied by local farmers and community members for adjusting their farming activities and preparing for extreme events. Longer-term climate projections are also valuable particularly for national planners. The capacity of the meteorological department needs to be improved. This includes capacity building and training for staff, installation of river gauges and synoptic weather stations representative of the province. In addition, investment in the research needed to model flooding events should be valued and sought after. Finally, climate information should be applications oriented and appropriate venues for maintaining dialogue between users and producers should be established and maintained. This could include environmental managers, water resource managers and agricultural extension agencies among others.

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Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), the World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. With funding from the Global Environment Facility (GEF), UNDP, the Royal Netherlands Government, MRCS, the Water and Nature Initiative (WANI) and other donors, the programme addresses the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands. MWBP aims to strengthen the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely. It is a five-year (2004-2009) intervention at three levels – regional, national and local – with demonstration wetland areas in each of the four countries: in the Songkhram river basin, Thailand; in Attapeu province in southern Lao PDR; in Stung Treng, Cambodia; and in the Plain of Reeds in the Mekong Delta, Viet Nam. The programme aims to:

- Improve coordination for wetland planning from regional to local levels
- Strengthen policy and economic environments for wetland conservation
- Generate and share information
- Train and build capacity for the wise use of wetlands
- Create alternative options for sustainable natural resource use and improve livelihoods

MWBP is a partnership between governments, aid agencies and NGOs, and provides a framework for complementary work for wetland conservation and sustainable livelihoods in the Lower Mekong Basin.

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A JOINT UNDP - IUCN - MRC GEF-FUNDED PROGRAMME

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