VULNERABILITY AND ADAPTATION TO CLIMATE HAZARDS AND TO CLIMATE CHANGE

A SURVEY OF RURAL CAMBODIAN HOUSEHOLDS

Final Draft

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I. PROJECT BACKGROUND AND OBJECTIVES

1.1. Project Background

In its 2001 report on impacts, adaptation and vulnerability to climate change, the Intergovernmental Panel on Climate Change (IPCC) concluded that there was high confidence that recent regional changes in temperature had discernible impacts on physical and biological ecosystems (IPCC, 2001). In particular, there is emerging evidence human systems have been affected by increases in floods and droughts. Projected changes in climate could have major consequences on hydrology and water resources, agriculture and food security, terrestrial and freshwater ecosystems, coastal zones and marine ecosystems, and human health. Adverse impacts include increased flood and drought magnitude and damages in temperate and tropical Asia, reductions in crop yields, decrease water availability, increase in the number of people exposed to vector and water-borne diseases.

As an essentially agrarian country, the Kingdom of Cambodia is highly vulnerable to the impacts of climate change. Agricultural production is dependent on the annual flooding and recession of the Tonle Sap Lake and the Mekong River. Sea level rise may affect the 435-km long coastline. Vector-borne diseases, in particular malaria, may become more widespread under changing climatic conditions.

Because it is not currently possible to predict the adverse impacts of climate change at the regional and local levels, the IPCC has argued for the strengthening of adaptive capacity to climate variability and extremes (IPCC, 2001). Least developed countries have the least resources and capacity to adapt, and are therefore the most vulnerable. The project entitled Formulation of the National Adaptation Program of Action to Climate Change (NAPA) aims to develop a realistically achievable country-driven program of action and priority activities addressing the needs of Cambodia for adapting to the adverse effects of climate change (UNDP, 2003). Specifically, the project's goals include: the synthesis of available information on the adverse impacts of climate change, climate variability and adaptation to climate hazards in Cambodia; the identification and prioritisation of potential activities to adapt to current climate variability, climate extremes and climate change. The NAPA project is funded by the international community through its contributions to the Global Environment Facility (GEF).

1.2. Objectives

The *Annotated Guidelines for the Preparation of National Adaptation Programmes of Action*, Decision 28 of the 7th Conference of Parties (CoP) of the United Nations Framework Convention on Climate Change (UNFCCC), provides the methodological basis for the development of NAPAs in least developed countries (UNFCCC, 2002). The identification of priority adaptation activities is the main goal of the NAPA. The formulation of the NAPA follows a participatory process that involves those who are most affected by climatic impacts, that is rural people and the poor. The NAPA builds upon existing coping strategies implemented by local communities in order to enhance their adaptation capacity. More specifically, the objectives of the NAPA project are: (1) to understand the main characteristics of climate hazards in Cambodia (flood, drought, windstorm, high tide, salt water intrusion and malaria); (2) to understand coping mechanisms at the grassroots level; (3) to understand existing programmes and institutional arrangements for addressing climate hazards and climate change; and (4) to identify and prioritise adaptation activities to climate hazards and climate change.

II. SURVEY METHODOLOGY

2.1. Site Selection for Climate Hazards Vulnerability and Adaptation

The selection of survey sites for the identification and prioritisation of adaptation activities to climate hazards and climate change is carried out in two steps. The first step consists of selecting provinces and the second step consists of selecting districts and communes. This process follows the existing Cambodian administrative hierarchy: province, district, commune and village. The village is the lowest administrative unit. In the first step, selection is based on geographical location of the provinces and paddy area affected by drought and flood between 1982 and 2002 (CRC, 2003a 2003b). In the second step, selection of the districts and communes is based on impacts on people, properties, and wells of the severe floods of the year 2000. The use of different approaches for site selection stems from the lack of data and time series.

First Step. The Level of Vulnerability (LV) of the paddy growing area of a province to drought and flood is based on the average annual area affected. The LV values are then converted into scores between 0 and 10, where the highest LV has a score of 10. LV values are divided into four categories as shown in Table 1.

Table 1. Level of Vulnerability (LV) Based on Score Values

No	Vulnerability Score	Level of Vulnerability
1	LV>7	Very vulnerable
2	3<LV≤7	Vulnerable
3	0.5<LV≤3	Quite vulnerable
4	LV≤0.5	Not vulnerable

Second Step. In Cambodia, floods are the main climate hazard. Availability of data on the impacts of floods is uneven, with more complete data for the severe floods of the year 2000. Information gathered by the Cambodian Red Cross (CRC, 2003a 2003b) include:

1. Number of people affected, injured/sick and losses of life;
2. Extent of agricultural areas affected (for rice and *chamkar*[1]);
3. Number of livestock heads affected (cows, buffalos and pigs);
4. Number of houses damaged; and
5. Number of wells contaminated.

In the analysis, data is combined into three categories: (i) level of fatality, (ii) property losses and (iii) number of wells contaminated. The Level of Fatality (LF) reflects the number of people affected or injured, and fatalities. The LF formula is as follows:

$$LF = \sum_{i=1}^{n} w_i P_i$$

[1] *Chamkar* are agricultural plots where vegetables and fruits are grown.

Where *i* is an indicator for people affected, injured and fatalities, *w* and *P* are weight values and number of people for the corresponding indicator. In this analysis the weight values for affected people, injured people and fatalities are 0.2, 0.3, and 0.5 respectively.

Property Loss (PL) is defined as the sum of property losses (agriculture, livestock and house) and the economic value of the property. The formula is as follows:

$$LF = \sum_{i=1}^{n} c_i Pl_i$$

Where *i* is an indicator for property, *c* and *Pl* are respectively economic values and type of property. For rice and *chamkar*, the data available consists of total area affected and destroyed, number of animals lost, and houses partly and totally damaged. This analysis assumes that affected crops could produce only 50% of the normal yield. The normal yield for rice is assumed to be the national average of 1.7 t/ha, and for *chamkar* (maize only) the national average of 2.08 t/ha (NIS, 2003). The market prices of rice and maize are assumed to be respectively US $100 and US $120. For livestock, the markets price per pig and cow is assumed to be respectively US $300 and US $1,000. The replacement value of a house was assumed to be on average US $500. If the house is partly damaged, the loss was assumed to be 50% of the replacement value. For wells, the LF is defined as the number of wells contaminated. The LF values are then converted into score values ranging between 0 and 10.

The Level of Vulnerability (LV) of the area to flood is defined as the weighted sum of the LF score values. The formula is as follows:

$$LV = \sum_{i=1}^{n} w_i LF_i$$

In this analysis, the weight values for fatalities, property losses and contaminated wells are respectively 0.3, 0.5, and 0.2. The Level of Vulnerability is divided into four categories as previously shown in Table 1.

Based on geographical locations, the provinces selected for field survey are further divided into four clusters:

1. Cluster 1 consists of provinces located north of Phnom Penh, upstream along the Mekong and Tonle Sap Rivers: Stung Treng, Kratie, Kampong Cham and Kandal;

2. Cluster 2 consists of provinces located south of Phnom Penh, downstream along the Mekong and Tonle Bassac Rivers: Pray Veng, Svay Rieng and Takeo;

3. Cluster 3 consists of provinces located around Tonle Sap Lake: Siem Reap, Kampong Thom, Kampong Chhnang, Pursat, Battambang and Banteay Meanchey; and

4. Cluster 4 consists of the coastal provinces of Cambodia: Kampot, Koh Kong and Sihanoukville.

Flood characteristics in each of the four clusters are quite different. In cluster 1, the duration of floods is relatively short (1-2 weeks), but flooding may occur more than once a year. In cluster 2, the duration is substantially longer (at least a month) but flooding usually occurs only once or twice a year. In cluster 3, the characteristics of floods are a combination of those of clusters 1 and 2, and

are dependent upon the proximity of the province to Tonle Sap Lake. In cluster 4, coastal provinces are exposed to high tide, seawater intrusion, and windstorm.

Records of droughts and floods from 1982 to 2002 clearly indicate that provinces that are vulnerable to floods are equally vulnerable to droughts (Figure 1). Prey Veng is one of the provinces most vulnerable to floods, while Battambang is most vulnerable to droughts. Figure 1 also shows that there are more provinces vulnerable to floods than to droughts.

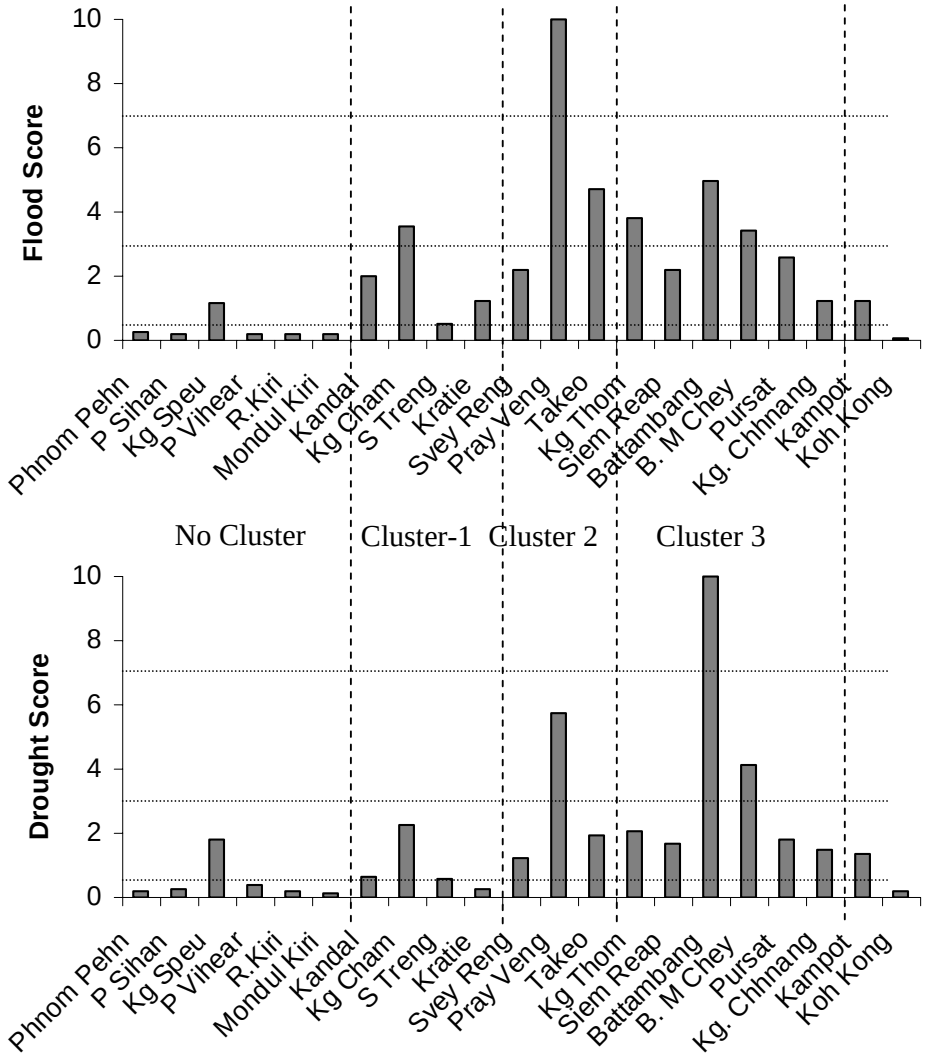

Figure 1. Level of Vulnerability to Droughts and Floods by Provinces

The 2000 flood impact data show similar patterns of vulnerability (Figure 2 cf. Figure 1). Based on the three criteria used (fatalities, property losses and number of wells contaminated), Prey Veng appears to be very vulnerable, four provinces to be vulnerable and eight provinces quite vulnerable. However, in terms of fatalities, Kandal, Prey Veng and Kampot are very vulnerable.

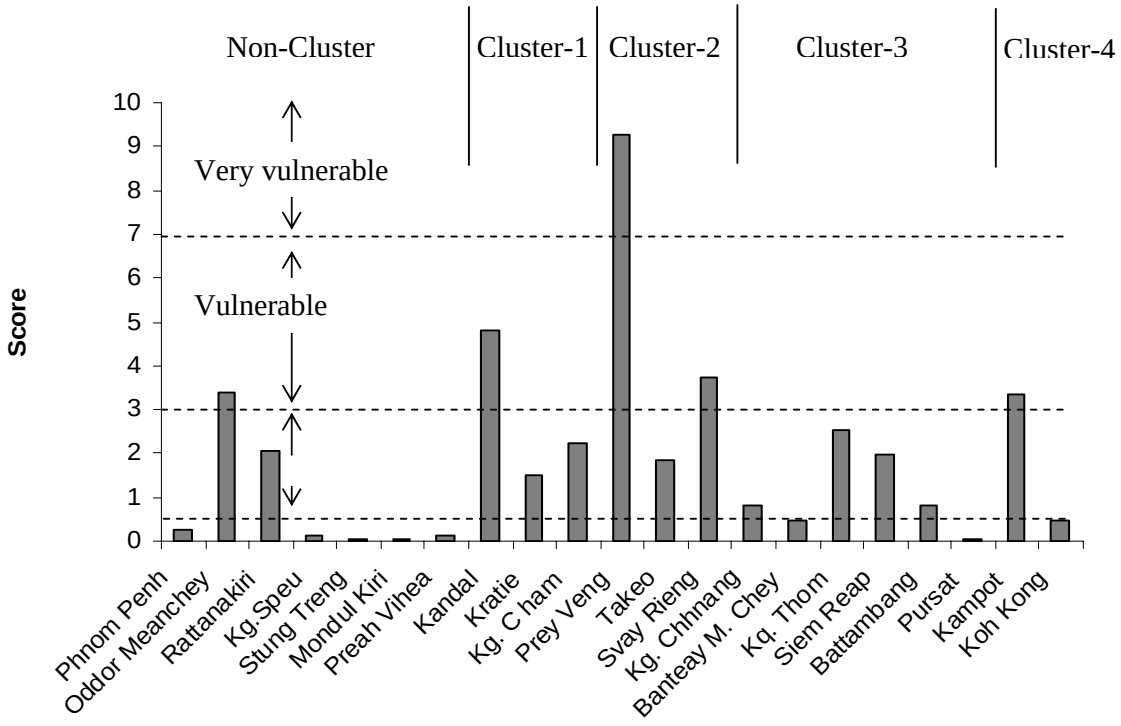

Figure 2. Level of Vulnerability to Floods by Province

2.2. Site Selection for Malaria Vulnerability and Adaptation

The Centre for Parasitology, Entomology and Malaria Control (CNM) has divided Cambodia into three regions according to malaria risk (CNM, 2003). The high risk region covers the north-eastern and north-western provinces and rubber plantation areas, which represents about 4.5% of the Cambodian population. The medium risk region consists of the central part of the country. The remainder forms the low risk region.

The number of malaria cases and malaria fatalities may be used to select provinces for field surveys. The Ministry of Health has recorded provincial statistics from 1997 to 2002. Average number of cases and fatalities for the period are provided in Table 2.

Siem Reap is the most vulnerable province followed by Battambang, Kompong Cham and Pursat as indicated by average number of cases and malaria fatalities. However, provinces that may present examples of successful coping mechanisms should also be investigated, since they may provide invaluable lessons for adaptation. Thus, a combination of high number of malaria cases and low number of fatalities would correspond to a low fatality rate, and thus suggest successful coping strategies for a given province.

Table 2. Average Number of Malaria Cases and Fatalities for 1997-2002

Provinces	Malaria Cases	Malaria Fatalities
Siem Reap	2,200	57
Battambang	1,724	91
Kampong Cham	1,767	57
Pursat	1,222	82
Pailin	977	16
Kampong Speu	830	35
Kampong Thom	867	24
Preah Vihear	867	24
Banteay Meanchey	768	26
Odar Meanchey	146	3

As one of the aims of the NAPA project is to explore adaptation measures, it is necessary to conduct surveys in different geographical regions of Cambodia in order to yield clues to successful social, behavioural, institutional or technological factors that may be conducive for malaria prevention and control (Table 3). The assumption is that people living in different regions will adapt differently to malaria incidence, and that adaptation mechanisms would depend on a variety of social, cultural, environmental and institutional conditions.

Table 3. Provinces Selected for Malaria Survey

Region	Most Vulnerable Provinces	Higher Adaptability Provinces
Costal regions	1. Kampot 2. Koh Kong	1. Kampot
Highland regions	1. Kratie 2. Rattanakiri	1. Stung Treng
Lowland regions	1. Siem Reap 2. Pursat	1. Siem Reap

This preliminary analysis for selecting survey sites is based on available information on droughts and floods provided by the Cambodian Red Cross and the National Centre for Disaster Management, and may only provide broad guidance. While provinces may be targeted for surveying based on secondary data, the more accurate determination of districts, communes and villages in each province can only be carried out with the participation of local authorities. Thus, the consultation of provincial and local authorities further helped the NAPA survey teams to select the sites most vulnerable to flood, drought, windstorm, high tide, seawater intrusion and malaria.

2.3. Survey Methodology

The questionnaires used for data collection by the NAPA project are broadly divided into non-health hazard and health hazard. The health questionnaires examine vulnerability and adaptation to malaria, while the non-health questionnaires cover flood, drought, windstorm, high tide and seawater intrusion. Questionnaires are further divided by types of stakeholders: households,

NGOs, and local authorities and informal leaders. Thus a total of six different questionnaires were used for data collection. The questionnaires were tested in Kandal Province and subsequently revised for simplification and clarification purposes.

All questionnaires are provided in the appendices to this report. The non-health household questionnaire is divided into four sections. Section 1 gathers general information about the demographic characteristics of the household, and examines water uses for household consumption and for agriculture. Section 2 records the characteristics of climate events occurring in the survey area (nature, intensity, frequency etc.) and assesses the household's vulnerability to these events. Section 3 investigates existing coping and adaptation mechanisms for each type of hazard in the survey area. Section 4 records the household's suggestions with regards to improving adaptation to climate events. The malaria household questionnaire is divided into three sections. Section 1 records the social and economic characteristics of the household. Section 2 examines malaria cases in the household, their treatment, and existing malaria prevention measures. Section 3 gathers suggestions from the household with regards to malaria prevention.

As discussed in the previous section, a total of 17 hazard prone provinces were selected for questionnaire administration. During the fieldwork period, the NAPA team further consulted with local authorities in each province to determine the most vulnerable areas at the commune and village level for field surveys. The NAPA project staff were divided into four groups of 4 to 6 surveyors. The itinerary of the staff began with the southern provinces, followed by an administration leg starting in the central provinces, going northward and circling around Tonle Sap Lake, then along the Mekong River to the more isolated north-eastern provinces. The surveys were administered from 12 May to 10 June 2004.

Surveyors were required to follow fieldwork guidelines, which comprised nine different steps: (1) Meeting with authorities at provincial and district levels, (2) Meeting with NGOs at provincial and district levels, (3) Site selection in consultation with authorities and NGOs at the provincial and district levels, (4) Meeting with authorities at the commune level, (5) Meeting with NGOs at the commune level, (6) Meeting with authorities and informal leaders at the village level (village council, elders, monks etc.), (7) Meeting with NGOs at the village level, (8) Meeting with households, and (9) Filling in the stakeholder meeting table. The objectives of the meetings included: explaining the objectives of the survey to stakeholders, determining the most vulnerable districts, communes and villages, and collecting supporting documents and information. The detailed fieldwork guidelines are provided in the appendices to this report.

Each household or organisation interviewed has been allocated a unique identification number for referencing prior to data input. A total of five different electronic files have been created with the Statistical Package for the Social Sciences (SPSS) software, corresponding to the main survey questionnaires. A distinction was made between the malaria subset and the subset for all other climatic hazards. The non-malaria household SPSS file includes more than 300 variables, while each of the other files from 60 to 100 variables covering the quantitative information collected. Questionnaires were keyed in by provinces in different electronic files which were merged at the final stage. Data was checked for consistency, reliability and input errors. Approximately 10% of all questionnaires collected were not usable because of incompleteness or inconsistencies. Usable questionnaires are divided as follows: 1154 households, 82 local authorities and 10 NGOs.

III. STATISTICAL ANALYSIS OF SURVEY QUESTIONNAIRES

3.1. Climate Hazards

A total of 684 households were surveyed using the non-health questionnaire, which covers the following climatic hazards: flood, drought, windstorm, seawater intrusion and high tide. The NAPA teams surveyed 17 provinces and 42 communes (Figure 3).

Without exception, all seventeen provinces surveyed have suffered from both floods and droughts. A more surprising finding is that a high number (15) of provinces have also experienced windstorms. To date, there has only been anecdotal evidence of windstorm events in Cambodia, which largely go unreported. Seawater intrusion was reported in three coastal provinces: Koh Kong, Sihanoukville, and Kampot. Kep Province also experiences seawater intrusion but was not surveyed because of budgetary constraints. High tide was recorded only in Sihanoukville and Kampot.

When asked what the most severe climate hazards are, villagers cite flood and drought in 17 provinces. Windstorm is considered to be the most severe climatic hazard in 8 provinces, while high tide and seawater intrusion in two provinces.

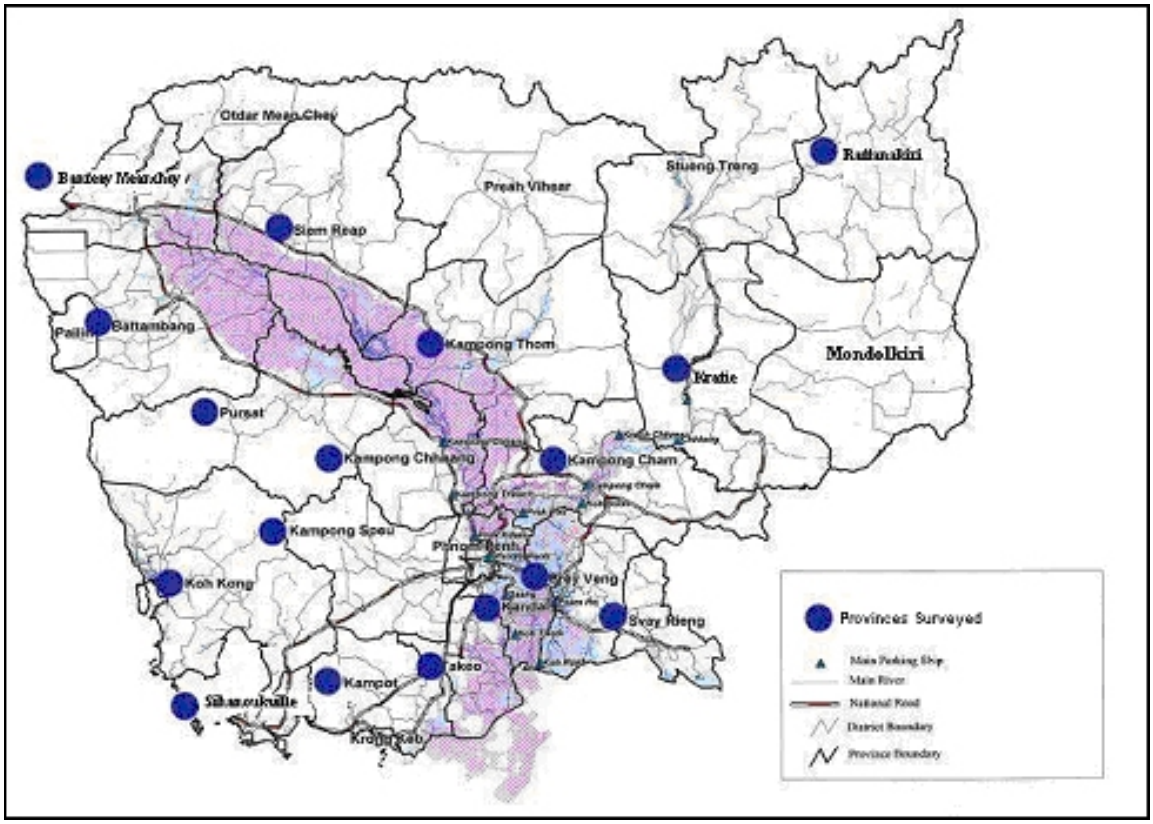

Figure 3. Map of Provinces Surveyed for Climate Hazards Vulnerability and Adaptation

3.3.1. Characteristics of Households

Almost all households (95%) stated farming as their main source of income (Figure 4), in particular rice farming (92%). This implies a high relevance of the research topic, that is, climate hazards, as

agricultural activities are naturally dependent upon climatic conditions. Some 58% of respondents are male, while 42% are female, which suggests only a slight bias towards male respondents for the whole sample.

Some 80% of houses are made of wood, while 14% are thatched. This is an indicator of income and poverty, as poorer households live in dwellings with thatched walls and roofs. An insignificant number of interviews were conducted in houses made of stone or cement.

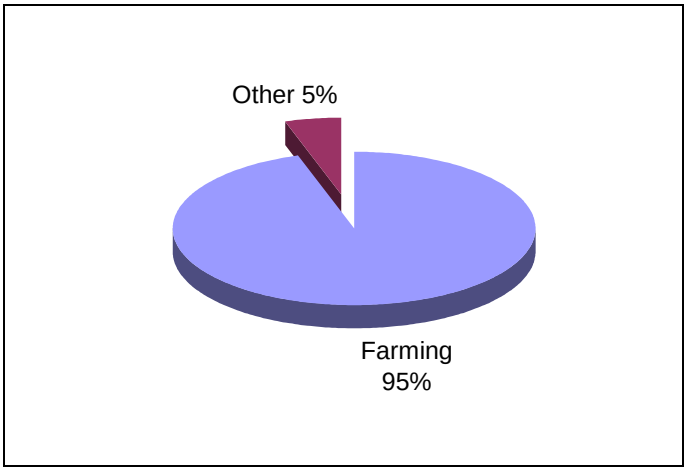

Figure 4. Main Source of Household Income for Non-health Questionnaire

3.1.2. Floods

In the areas surveyed, flood durations vary from a mere two days to some 180 days (Figure 5). The longest average flood durations are recorded in Banteay Meanchey (68 days), Kompong Thom (67 days), Siem Reap and Kratie (64 days), Kompong Cham (63 days), Svay Rieng (61 days). Kompong Speu (16 days), Sihanoukville and Koh Kong (15 days) experience the shortest average flood durations.

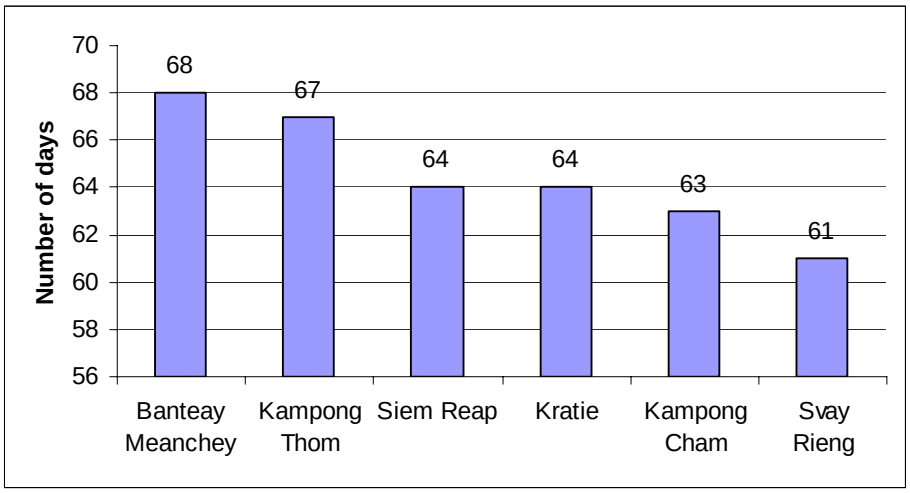

Figure 5. Longest Flood Durations

All 17 provinces suffer from at least two floods a year, while seven provinces experience at least four floods a year. Kompong Cham (83%) and Kratie (100%) record the highest number of respondents who have experienced two to four floods a year.

Countrywide, villagers cite the Year 2000 as the year of most severe flooding (51% of respondents), followed by 2002 (14% of respondents), and 2001 (12% of respondents) (Figure 6).

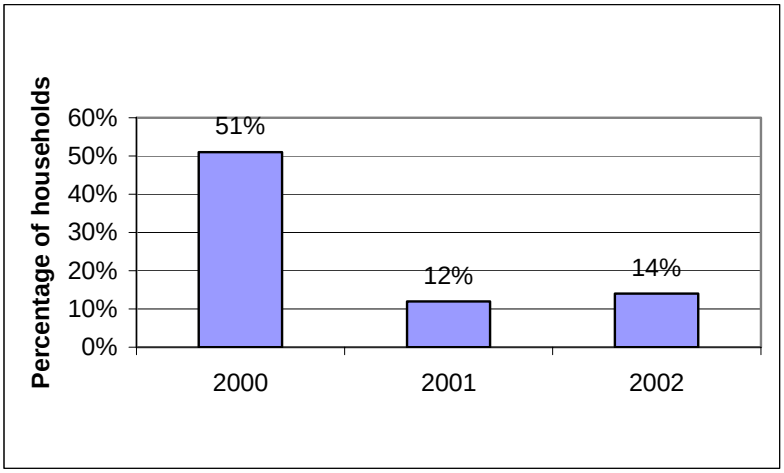

Figure 6. Years of Most Severe Floods as Quoted by Respondents

Villagers were asked to estimate flood depths around their dwellings and in agricultural fields, as well as average and maximum water level increase per night. These measures are necessary imprecise and are solely based on people's personal perceptions and recollection of flooding events. However, they provide some indications as to the nature of floods in different areas of Cambodia.

The highest depths of floods around houses are recorded for Koh Kong (2.1 m) and Kratie (2.5 m). The highest depths of floods in agricultural fields are recorded for Kratie (5.1 m), Koh Kong (3.2 m), Kandal (3.1 m), Prey Veng, Battambang, Kampot, Svay Rieng, Kompong Thom, Banteay Meanchey, Kompong Speu, Pursat and Koh Kong (more than 2 m). The lowest floods around houses are experienced in Prey Veng, Kompong Chhnang, Kompong Speu, Kompong Thom, Takeo, Sihanoukville and Siem Reap, with about 60 cm and less. The same provinces also record lower average depths of floods in agricultural fields, with less than 2 m. Rattanakiri records floods in agricultural fields of 2.7 m on average, however, villagers attribute the high amplitude to water fluctuations caused by upstream hydroelectricity dams in Vietnam. Average flood increases per night are highest for Kratie (5.1 m), Pursat (2.6 m), Kompong Thom, Pursat, Siem Reap and Kampot (more than 1 m per night).

Villagers were asked to share their experiences of dealing with floods and to describe existing ways to adapt to floods. Almost 20% of villagers interviewed did not make any preparations for flood at all; an additional 17% just planted their crops as usual. Traditional adaptation measures include building elevated enclosures for livestock, increasing the household's foodstock, increasing feedstock for animals, and preparing boats. An insignificant number of households interviewed moved to a safer place in anticipation of floods.

3.1.3. Droughts

As cited by villagers in the 17 provinces surveyed, drought is, alongside flood, the most severe climatic hazard that people have experienced. Villagers cite the year 2003 as the year of most severe drought (50% of respondents), followed by 2004 (32% of respondents). Taken together with flood information, every single year since 2000 has experienced either severe droughts or floods.

Countrywide, the main sources of drinking water for villagers during the dry season are wells (58%), ponds (14%), streams (12%) and rivers (9%) (Figure 7). The main sources of irrigation water for agriculture are lakes (19%), rain (18%), rivers (13%), streams (12%), and reservoirs (11%). Piped water is an insignificant source of water for the villagers interviewed(Figure 8).

Water shortages are a common occurrence all year-round: 81% of households interviewed suffered from water shortages for agricultural uses, while 54% suffered from water shortages for personal uses.

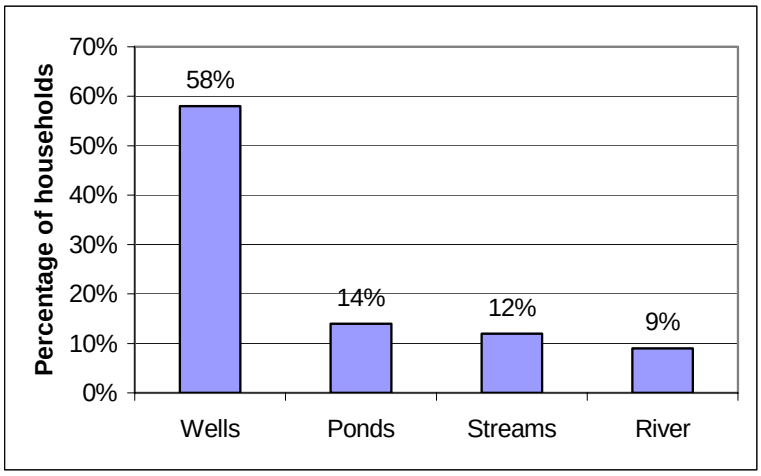

Figure 7. Main Source of Water for Household Consumption During the Dry Season

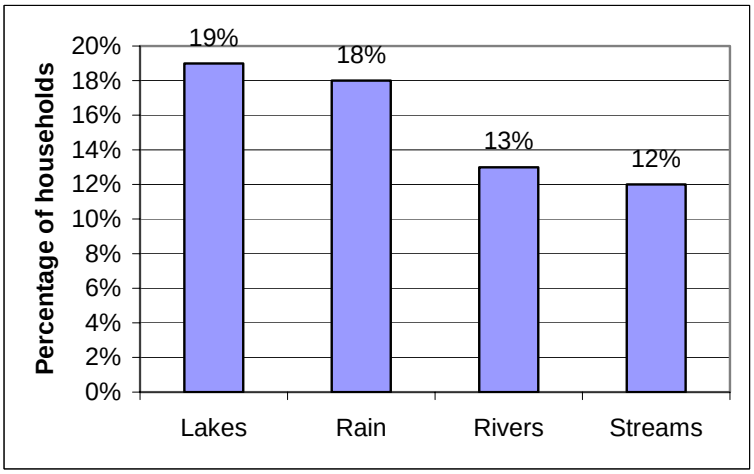

Figure 8. Main Source of Water for Agriculture During the Dry Season

Villagers were also asked whether they had noticed any changes in drought and flood frequencies in recent years. For 58% of villagers interviewed, the frequency of floods has increased in recent years. The figure is more significant for droughts, as 71% of villagers interviewed have witnessed an increase in the frequency of droughts. Although these figures cannot be considered to be representative of Cambodia as a whole, they are noteworthy in as much as the areas surveyed were specifically chosen for their vulnerability to climate hazards. Thus, areas that are already disaster prone may have experienced increased frequency of climate hazards in recent years.

Although villagers have traditionally coped with drought in a variety of ways, there appear to be serious limits to the extent to which people may adapt. Thus, 24% of villagers interviewed simply organise religious ceremonies in the hope that these will bring rain. An additional 16% plant crops as usual, again hoping that there will be enough rain for agriculture. Some 17% of households reduce water consumption: for instance, bathing may be limited to a few times a week; this could also consist of wiping oneself with a wet cloth instead of a full bath. About 12% of people were able to construct wells to adapt to drought, while 11% pumped water (Figure 9).

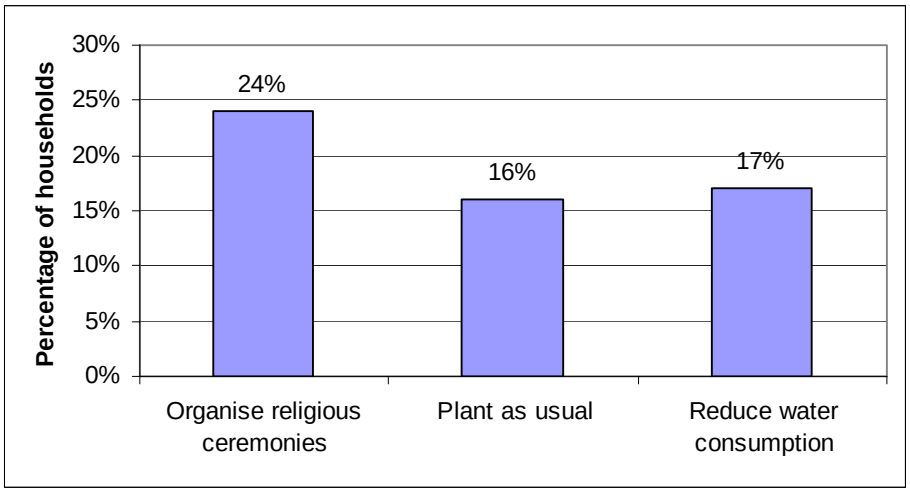

Figure 9. Household Adaptation to Drought

Surveyors discussed with villagers potential adaptation measures to cope with drought, and what the main obstacles were if these measures were implemented. For household uses, 28% of villagers suggest digging wells as a possible solution. Pond and reservoirs for dry season storage are alternative options. For agricultural uses, opinions are divided between the construction of canals (22%), reservoirs (6%) and pumping stations (8%). For measures for household water uses, as well as agricultural uses, the most often quoted obstacle to implementation is the lack of financial resources, with 33% and 41% of respondents respectively.

3.1.4. Warning and Post-disaster Assistance

Some 45% of villagers acknowledge that they have received some advance "warning about floods". This figure is misleading as in fact, what villagers consider to be early warning or advance warning remains very general and imprecise. For instance, villagers further downstream may have simply heard through word of mouth that upstream areas have been flooded, and that their area will thus be affected in the following days. In some areas, water levels are posted in public places, such as pagoda grounds or commune offices. However, surveyors have found out that interpreting the data is still a problem for villagers, as clear information about when flooding will occur is not provided. As for drought, 88% of villagers state that they have never received any form of early warning.

A large proportion of villagers (45%) interviewed have not benefited from any assistance after climatic hazards have occurred (Figure 10). About 30% of villagers benefited from assistance by the Cambodian Red Cross. This is by far the largest provider of post-disaster assistance in the sample surveyed. In comparison, the National Committee for Disaster Management (NCDM) and district and provincial authorities provided assistance to respectively 6% and 7% of villagers interviewed. Other sources of assistance are much less significant and include: neighbours and friends, commune councils, pagodas and NGOs.

In terms of assistance provided, 40% of households received food and medicine, 17% received a shelter, 16 % seeds, 11 % cash, 9% various utensils. Some 3% of people were assisted in their evacuation to safer grounds.

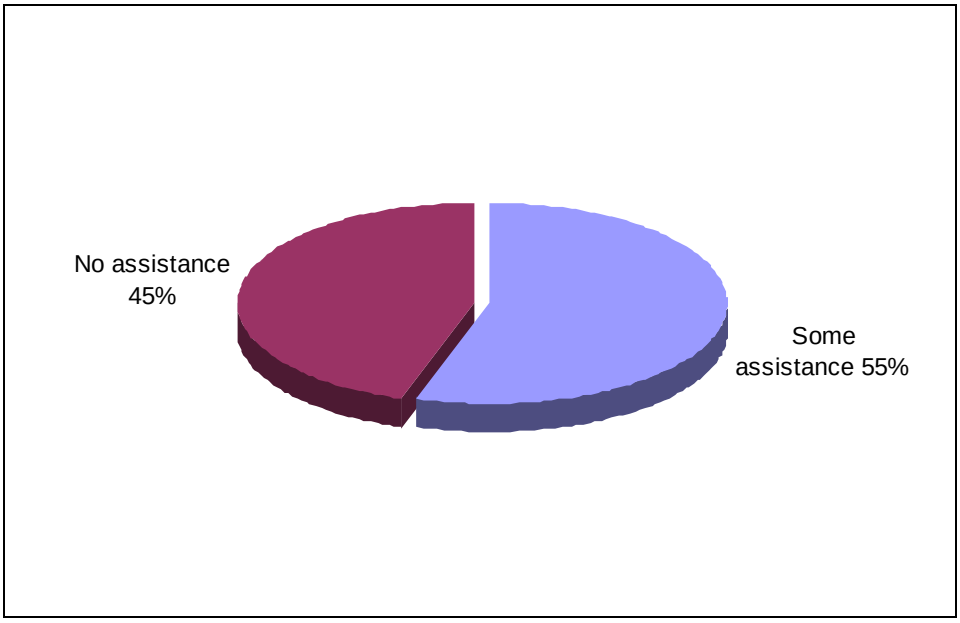

Figure 10. Percentage of Households Who Have Benefited from Post-disaster Assistance

3.1.5. Windstorm

Out of the 17 provinces surveyed, 8 provinces have experienced windstorms. Among households who have suffered from windstorms, 60% report a single occurrence a year, 19% two windstorms a year, and 17% three windstorms a year. In 70% of cases, the wind was strong enough to blow the rooftop away, and in 17% of cases the wind uprooted trees. None of the households interviewed reported any form of early warning before windstorms.

There are few existing traditional ways for rural people to adapt to windstorms. Many households interviewed (34%) simply stay inside their dwellings and use a combination of the following: strengthening of the house (17%) and flattening of the roof (5%).

3.2. Malaria

The malaria questionnaire was conducted in seven provinces: Battambang, Kampot, Koh Kong, Kratie, Ratanakkiri, Siem Reap, Pursat. A total of 172 households were interviewed in 12 districts, 19 communes and 40 villages (Figure 11).

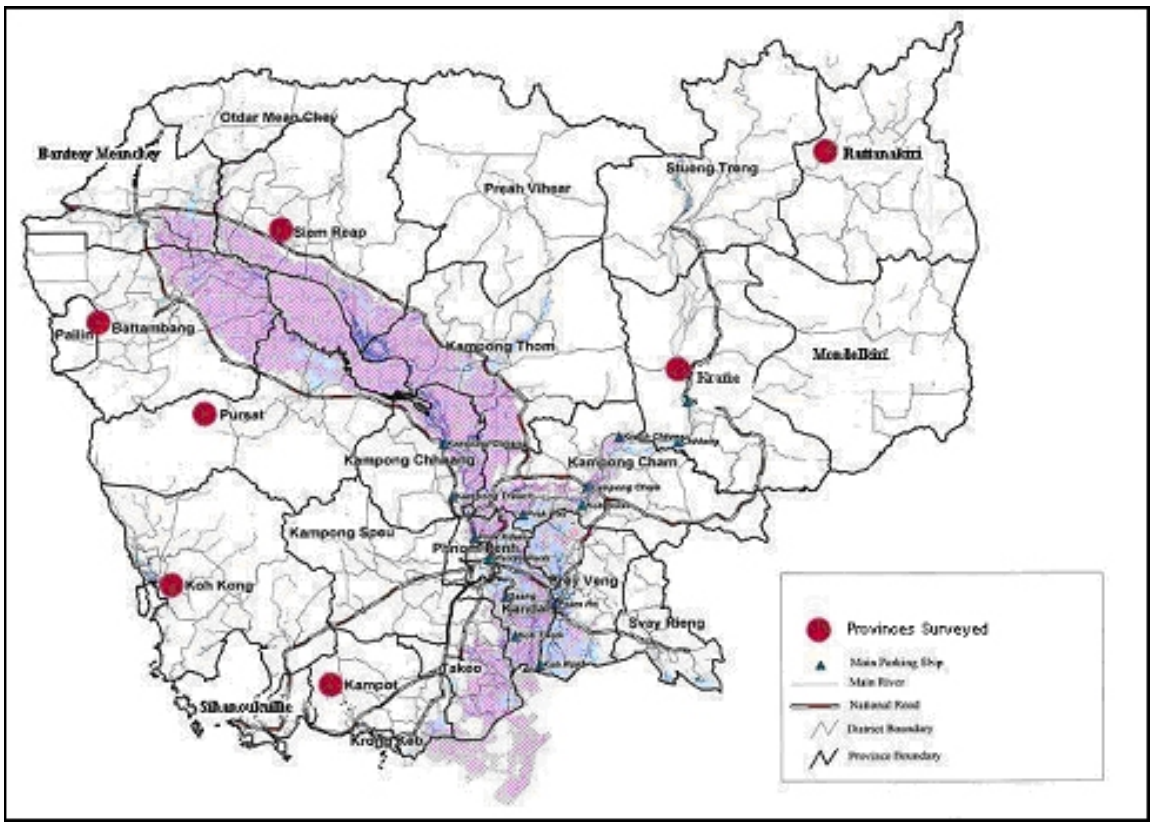

Figure 11. Maps of Provinces Surveyed for Malaria Vulnerability and Adaptation

Almost all households state farming as their main source of income (92%). Some 59% of respondents are male, while 41% are female. Some 82% of houses are made of wood, while 15% are thatched. These results are comparable to those for the non-health sample.

About 87% of households interviewed have experienced malaria, 82% diarrhoea, 18% dengue fever and 11% typhoid. Some 85% of households consider malaria to be the most severe disease they have suffered from (Figure 12).

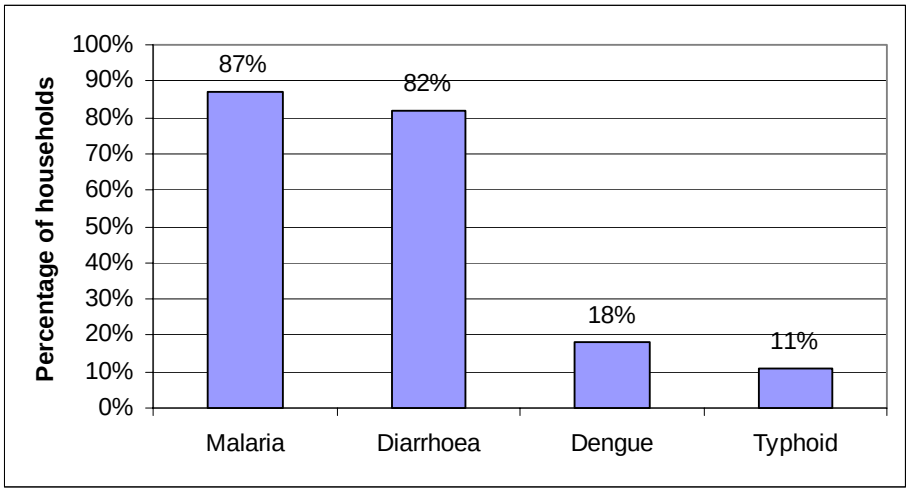

Figure 12. Illnesses Occurring in the Household

Surveyors attempted to determine the locations and the type of activities that presented more risks for villagers of contracting malaria. In about 26% of cases, malaria was contracted while cultivating *chamkar*. This compares to 28% of cases while logging in the forest, and 18% while staying at home (Figure 13). In some areas, according to an erroneous popular belief, malaria is contracted through drinking dirty water. Almost 63% of households contracted malaria during the wet season, 12% during the dry season, and 8% in both seasons.

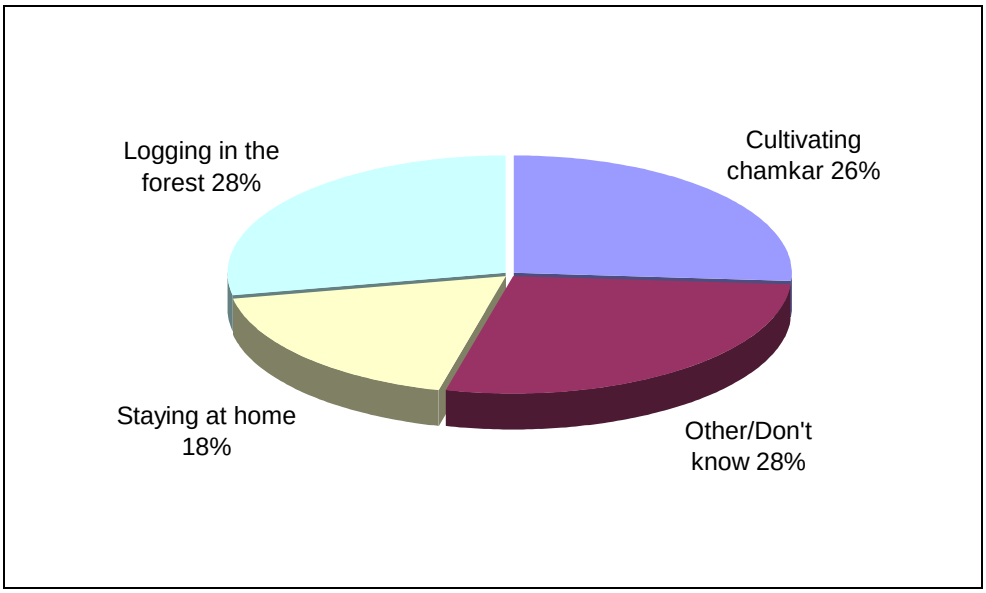

Figure 13. Locations Where Malaria Was Contracted

About 67% of households report that malaria occurrence is a continuous phenomenon, while only 20% report contracting malaria rarely. This would suggest that in the areas where the survey was conducted, malaria has become an endemic and common disease with regular occurrences.

The survey further investigates malaria treatment available to local people. Some 36% of households received treatment in private clinics, 25% in district health centres, 15% in commune health centres, 6% in provincial hospitals, and 7% of households used traditional medicine (Figure 14). The main reasons cited by households for choosing specific treatment options were: proximity to home (26%), perceived quality of service (29%) and above all, cost of treatment (89%).

Among households who received treatment in health centres, about 43% travelled more than 5 km; 31% travelled 1 to 5 km; and 25% travelled less than 1 km.

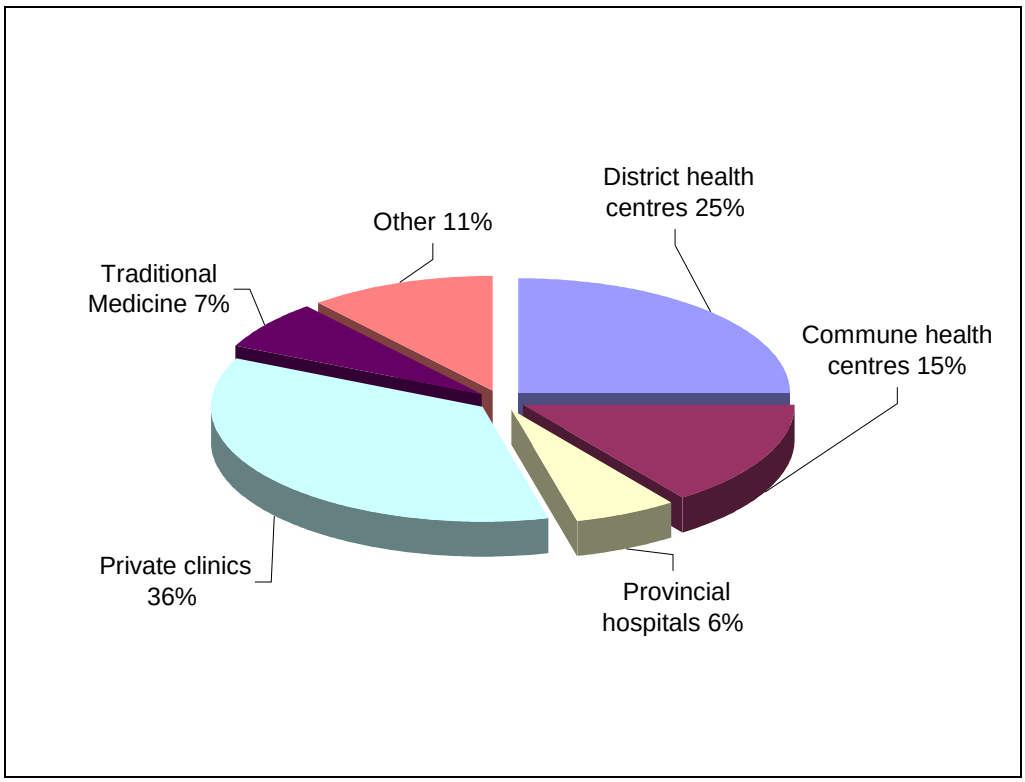

Figure 14. Malaria Treatment as Percentage of Households

While 80% of households interviewed were aware of the existence of malaria education activities in their villages, only 11% showed any interest in receiving malaria education in the future, preferring instead general health education (40%).

The main malaria prevention strategies suggested by households are: to destroy mosquito habitats (33%), and to use mosquito nets (27%). The use of mosquito nets may not be an effective strategy in cases where villagers contract malaria in fields or in forests. Similarly malaria habitat destruction around dwellings and in villages will not have any impact on contracting malaria while working in *chamkar* and forests.

IV. QUALITATIVE ANALYSIS OF CLIMATE HAZARDS BY PROVINCES SURVEYED

This section summarises surveyors' observations for each province where data collection was carried out. Observations are recorded by district. Once the fieldwork completed, all NAPA staff who participated in the survey were asked to recall their general impressions and understanding for each of the different areas they had surveyed. This exercise is a necessary complement to the formal analysis of the questionnaires as it provides a broad picture of the situation in the field in terms of climatic hazards. Valuable qualitative information and observations from the field constitute useful complements to quantitative questionnaires.

4.1. Banteay Meanchey

4.1.1. Mongkol Borey

- Floodwater from Tonle Sap Lake reaches annually a height of 4-5 m.
- All houses are built on stilts and are equipped with boats.
- Villagers have noticed changes in the intensity of floods and believe that they have become more unpredictable in recent years.
- According to villagers, floods last longer and are more pronounced because the recently rehabilitated national road does not have floodgates or culverts, and thus acts like a dike trapping floodwaters.

4.1.2. Preahnet Preah

- Drought is common in this district. Water shortages occur in the dry season as there is an insufficient number of wells or reservoirs. Some of the reservoirs have been emptied and used to cultivate rice.
- Drought has led some villagers to migrate daily to Thailand to work as labourers.

4.2. Battambang

4.2.1. Mong Russey

- This large district borders Tonle Sap Lake and is a traditional rice production area.
- Communes located by the lake are flooded annually.
- Communes located on the other side of the national road are not flooded, but suffer from severe drought. Dug wells do no yield water, as the water table appears to be lower. Villagers in these areas rely almost entirely on rainwater harvesting.
- Nikon Krom Commune is an example of changing flood and drought patterns in this district. This commune was traditionally a well-known rice basket with high agricultural output. Over the past four years, Nikon Krom has annually suffered from droughts and floods. Long lasting floods have prevented wet season paddy cultivation, whereas the absence of irrigation network prevents dry season rice cultivation. A pre-war canal is no longer usable because of lack of maintenance. Villagers suggest rehabilitating the canal and constructing reservoirs for flood and rainwater harvesting. Nikon Krom is fast becoming a deserted commune, as farmers migrate to more favourable areas.

4.3. Kampot

4.3.1 Banteay Meas

- This district suffers from water shortages.
- Only one pond has been rehabilitated for the whole of Prey Tonle Commune.
- Villagers request additional ponds and reservoirs to cope with drought.
- There have been problems with seawater intrusion in existing ponds, which may require the construction of contained or isolated water reservoirs.

4.3.2. Kampong Trach

- Drought is particularly severe.
- Villagers have to buy water from a few existing ponds at the cost of KHR 500 per drum.
- Wells cannot be constructed because of saltwater intrusion. Instead villagers use culverts to harvest rainwater (12x4 metres).
- Villagers believe that the construction of a sea dike on the Vietnamese side has exacerbated flooding in the district. The dike, constructed in 2001, prevents seawater intrusion, but also prevents floodwater from flowing out to sea.
- On the Cambodian side, a dike, several hundred metres in length and up to 2.5 metres in height, was constructed under the Khmer Rouge. The Cambodian dike does not have any floodgate or lock, which means that floodwaters cannot be drained. In several parts, the dike has been destroyed, for lack of maintenance. Additionally, fishers have also dug holes in the dike to install nets to capture fish from receding waters.
- There is no adaptation against flooding. Villagers usually remain at home. They also fear pirates who operate on fast boats during flooding seasons.

4.3.3. Kampot

- Trapeang Koh Commune has experienced heavy flooding in recent years. Villagers report a maximum rise of water levels by 20 metres overnight.
- Villagers blame deforestation for the increase in the magnitude of floods. A road originally built for transporting logs becomes a water canal during flooding, rapidly carrying large amounts of water into settlements.
- The combination of rainfall and rapid rise in water levels of local streams require all households to operate boats during floods.
- Farmers have adopted rice cultivars that can withstand up to one week of flooding. If flooding exceeds one week, rice harvests are destroyed.
- Farmers also find it difficult to time planting and germination with floods, which can result in whole harvests being lost.
- Because of uncertainties concerning floods, some farmers have diversified away from paddy to durian plantations.
- Malaria is reported in all communes.
- Villagers believe that they have contracted malaria mainly while logging in the surrounding mountainous areas. Mosquito nets cannot be used during work, but only at night.
- In villages with strict environmental regulations and cleaner surroundings, villagers believe that the chances of contracting malaria at home is lower.
- Other mosquito nets limitations include the following facts as observed by villagers: (1) mosquitoes strike at dust, before people turn to their nets, (2) some people think it is too hot to sleep under nets, (3) some people use nets as blankets when nights are too cold.
- There is a common belief that some villagers have contracted malaria by drinking dirty water. Some villagers also believe that there is a vaccine available against malaria, hence they are likely to request malaria shots for treatment.

- In settlements with malaria volunteers, there have been drops in malaria cases of up to 80%. However, in some cases, people have complained about the lack of professionalism and commitment of these volunteers.
- Villages located in areas close to protected forests have seen a decrease in malaria cases since the beginning of the logging ban, as villagers can no longer harvest timber.

4.4. Kandal

4.4.1. Kandal Stung

- This district is flooded yearly.
- Floods in Kompong Speu, an upstream province, is a tell-tale sign for local people that their villages will get flooded in a matter of days.
- Wealthy people have houses built on very high stilts, which remain above floods. The poorest have to live on the roofs of their houses during floods.
- Buffaloes, cows and other livestock are moved to roads, rail tracks and other flood safe areas.
- There is a newly built dike along Prek Thnaot River, but it has been heavily eroded and is not sufficient to control flooding. There is a floodgate on the river. During floods, this gate remains closed so as to protect downstream areas, thus worsening the situation for upstream areas. However, during the dry season, the gate also allows for some water retention in upstream areas, thus worsening droughts in downstream areas.
- During droughts, villagers pump water from the river or dig wells in riverbeds.

4.4.2. Ksach Kandal

- This district suffers from floods and drought.
- Villages in the area have been traditionally flooded, because of the proximity of the Mekong River. About three years ago, some villagers built an earth dike around their settlements and their agricultural fields. The dike has since then kept the village dry even during the floods of 2001. Villagers have also installed culverts inside the village so as to improve drainage. The dikes and culverts were totally self-funded, as villagers did not benefit from any outside support. Following this example of successful adaptation, other villages are building dikes to prevent flooding.
- Drought has been a yearly problem, as poorer villages cannot afford to construct wells. People thus have to walk several kilometres to the few existing pagoda ponds, or to the Mekong River.
- A Cambodian NGO, the Cambodian Research Centre for Development (CRCD), has just completed the construction of a reservoir to provide water for up to 1,000 people in the worst of the dry season. The reservoir has a capacity of 10,000 m^3 and is equipped with a floodgate. The reservoir is managed entirely by villagers. Water is to be used only for household purposes and home gardening. CRCD has encouraged villagers to plant local species of fruits and vegetables around the reservoir to stabilise its banks and to achieve food security.

4.4.3. Lvea Em

- This district is flooded for six months every year, and is therefore characterised by good traditional adaptation practises.
- All houses are built on stilts that are at least 6 m high. Richer households build their houses on concrete pillars, whereas poorer ones build houses on bamboo stilts. All houses are built on small earth mounds that rise a few metres above ground level.

- Livestock are given to caretakers in higher areas. Villagers have to pay others to raise their animals.
- Public buildings, including schools are also built on stilts.

4.5. Koh Kong

4.5.1. Kampong Seila

- Floods in this district are the result of water run-offs from surrounding mountain areas.
- A canal constructed under the Khmer Rouge used to carry water from mountains to agricultural fields. However, lack of maintenance has lead to the siltation of the canal, which is now unusable. Villagers suggest rehabilitating the canal to limit the impacts of floods and to provide water for irrigation.
- Villagers believe that deforestation in mountain areas have increased the magnitude of floods.
- Villagers have reported that commune authorities have sold mosquito nets supplied by the Cambodian Red Cross. The cost is KHR 1000 per net. This practise, although widespread, is illegal, as nets are distributed free of charge.
- Malaria education is provided, but some villagers dare not attend, as they are illiterate. In addition, those who attend have difficulties passing their knowledge to other members of their households.
- Villagers believe that logging in the mountains is the main cause of malaria infection.

4.5.2. Koh Kong

- Villages located in close proximity to mountain streams are flooded yearly. Water rises on average by 1-2 m over a fortnight.
- Houses are destroyed every year.
- There is no traditional adaptation measure. Villagers would like to build a dike to protect their houses, but there are no funds available.
- In one village, villagers have reported that the malaria volunteer has sold malaria drugs instead of distributing them free of charge. The volunteer is paid US $2 per training conducted and has received a motorbike to carry out his duties.
- Villagers believe that hunting and logging in forests are the main causes of malaria infection.

4.5.3. Sre Ambel

- This district is flooded every year as in Kampot District.
- Areas along streams and rivers are more heavily populated, although more prone to flooding. People prefer the proximity of a source of water and fish.
- Flooding only destroys houses that are not on stilts.
- District authorities report that they have benefited from substantial food aid from the Cambodian Red Cross. This aid has been kept in warehouses, as people have not needed it. Thus, there is a misconception among central authorities that the district has been heavily damaged by floods, whereas in fact, floods have only been an ordinary occurrence.
- Villagers traditionally observe clouds gathering over the surrounding mountains, which is a sign of coming floods. Animals are then moved to higher grounds.
- Villagers believe that deforestation has contributed to a worsening of floods in recent years.

4.6. Kampong Cham

Overall, the districts surveyed suffer more from drought than flooding. Paddy is mainly grown in the dry season.

4.6.1. Batheay

- This district is yearly flooded when Tonle Sap Lake overflows back into Tonle Sap River and the Mekong.
- Adaptation practises to flooding include the construction of dikes by NGOs and moving animals to roads and higher grounds. There are reported security issues, as bandits occasionally raid livestock.
- Because of insufficient rain, farmers have started planting paddy late in the dry season, and thus are vulnerable to floods as plants may still be too short to withstand submersion. This phenomenon is relatively recent and started appearing 4 to 5 years ago.
- In 2003, farmers switched from dry season rice to flood resistant varieties to adapt to changing climate. However, because there was only limited flooding that year, the harvest was lost.

4.6.2. Kang Meas

- Flooding is common in this district. Villagers usually prepare for floods at the onset of the wet season by stocking food and fodder.
- Few people would sell livestock before floods, although foraging becomes a problem once pastures have been submerged.
- There is not sufficient water for household use, or dry season rice cultivation. Wells are not usable during the dry season, as the water table is lower.

4.6.3. Srey Santhor

- This district shares the same characteristics as Kang Meas.
- It is too far from the river for dry season rice cultivation, yet remains flooded during the wet season.
- Villagers make large stockpiles of fodder before floods.
- There is no early warning of floods, just word by mouth communication from villages located upstream.

4.7. Kampong Chhnang

4.7.1. Bori Bo

- This district is yearly flooded by the combined waters from the Bori Bo and Tonle Sap Rivers.
- Villagers store fodder before floods and move animals to roads, dikes and higher grounds as water levels rise.
- During the dry season, farmers pump water from the rivers to irrigate their fields. However, local people have expressed concerns about rising costs of petrol, which makes irrigation economically viable only for paddy fields located close to rivers.

4.7.2. Kampong Tralach

- Flooding in this district occurs annually. Water levels rise slowly from the overflowing of the Tonle Sap River, which gives time for local people to move animals or to evacuate homes.
- Receding rice is cultivated with water retained by ponds during floods. Water pumping is also used to irrigate fields located close to the Tonle Sap River.

4.8. Sihanoukville

4.8.1. Prey Nup Commune

- Prey Nup Commune has experienced windstorms, which have damaged houses and crops. The winds were strong enough to destroy roofs. Villagers usually flatten crops to limit damage by winds, and stay indoors crouched on the floor.
- High tide areas have been abandoned for two years. Villagers initially tried to raise an existing dike, but the village chief kept on digging holes in the dike to fish for himself with nets as the waters drained out. The chief has encouraged villagers to rebuild the dike, evidently without any success.
- Villagers believe that the dike was an efficient way to prevent saltwater intrusion, but do not trust the village chief and others to make holes through the dike for fishing.

4.8.2. Cheungkor Commune

- The French NGO, GRET (Groupe de Recherche et d'Echanges Technologiques), has constructed several polders in this commune.
- The GRET Dikes have been built some 10 km from National Road 4 to prevent seawater intrusion. The dikes are large enough for two cars to drive side by side, which means that it is impossible for fishers to dig holes through them. In addition, the perception that the dikes are "owned by the French" has dissuaded vandals.
- Villagers report increased in agricultural productivity with decreased salinisation.
- The dikes have floodgates which allow for the drainage of water during the flooding season.
- The commune suffers from water shortages. Wells cannot be constructed due to the proximity of the sea. Villagers have to walk to water ponds 1km away to buy water at a cost of KHR 1000 per drum. Villagers and local authorities have suggested using a pipeline to transport water from surrounding mountainous areas.

4.9. Kampong Speu

4.9.1. Chba Morn

- This district has been flooded every year since 1991 by waters from the Prek Tnaot. River. Floods are usually of short duration. Villagers do not know of any floods prior to 1991. Flooding may be a consequence of deforestation in the watershed.
- Villagers seasonally move to higher grounds as flooding occurs.
- The Military Police have assisted in evacuation, in particular in cases of flash floods.
- Rice is harvested twice yearly, as a canal from the river allows for the irrigation of paddy fields.

4.9.2. Samraong Tong

- Floods have relatively little impact on this district.

- Farmers irrigate fields with a canal dug from the river. However fields located far away from the main canal would benefit from the construction of a network of smaller canals to expand irrigation.

4.10. Kampong Thom

4.10.1. Kampong Svay

- Tributaries of the Tonle Sap River yearly flood this district.
- Villagers report an increase in the frequency of floods in recent years.
- Adaptation measures implemented by villagers include: cultivation of flood resistant rice varieties (with stalks of 5 m length), preparation of boats before flooding, increase of stocks of food and firewood.
- Fishing is a major income earning activity during floods.
- Some villagers may take refuge in a catholic church located on higher grounds.
- Local pagodas regularly collect funds (rice money) to be disbursed to villagers during floods.
- During the dry season, further afar from rivers, ponds are the only sources of water. Wells are not constructed in this district because of floods during the wet season.
- Existing ponds store floodwater. However, villagers report that the quality of water is low, with health problems resulting from absorption of colloids in suspension. According to local people, deforestation is the main cause for lower water quality, as forests used to act as filters for floodwaters.

4.10.2. Prasat Sambo

- Water shortage has been an acute problem in this district.
- Reservoirs have been traditionally used to store water. However, lack of funding has prevented the maintenance of older reservoirs and the construction of new ones. This district is difficult of access, isolated from main roads and development activities.
- The main sources of water are seasonal, intermittent mountain streams.
- Wells do not yield sufficient water. Villagers believe that the water table may have fallen in recent years.

4.10.3. Santuk

- Livestock production is a significant traditional economic activity in this district, which suffers yearly from floods. Thus, local authorities and villagers have devised an ingenious livestock caring scheme to adapt to floods. Villagers in inundated areas give the care of their livestock, generally cows, to villagers located in areas not prone to floods. Transactions are subject to contractual agreements issued by commune authorities. The caretaker or "borrower" agrees to take good care of the animals, which he may use for agricultural work, such as ploughing fields. Partial reimbursement of the owner is guaranteed if the animals die of natural cause, while full reimbursement occurs if the animals are lost or stolen.

4.10.4. Stung Sen

- This district is a particularly striking example of a combination of successful and innovative flood adaptation measures implemented by local authorities and villagers.
- In the aftermath of the floods of year 2000, commune authorities established rice banks with storage capacities of 2 to 3 tons. Rice is contributed by villagers and redistributed as

needed to cope with floods or bad harvests. Rice banks also receive donations from governmental and non-governmental organisations.
- Local authorities forbid fishing in the 10 ha community lake. This ensures a stable fishstock for surrounding agricultural fields, as fish migrate in and out of the lake during floods.
- Local authorities have also established a 5 ha community forest, which was approved by central authorities only after a five-year application. The forest provides for additional food security, and prevents soil erosion in surrounding areas.

4.11. Kratie

4.11.1. Kratie

- Villagers practise rice cultivation along the river, in flood prone areas, and grow vegetables and fruits on hills, in drought prone areas.
- Floods are a usual occurence. Villagers find caring for livestock to be the most difficult adaptation measure. Only limited fodder can be stocked to last the entire flooding season.
- People have reported that they usually get 4 to 5 days advanced warning from local authorities before flooding occurs, which, in their opinion, is usually insufficient to prepare for the hazard.
- Water levels recorded by the Mekong River Commission are posted in public places, including commune offices and pagodas. However, villagers have difficulties understanding the data provided, and complain that posters only provide water levels without forecast about floods.

4.11.2. Preak Prasorb

- This district is entirely submerged by annual river floods, and suffers from water shortages during the dry season as the river dries up.
- There is no rice cultivation. Villagers only grow fruit trees and vegetables.
- Villagers believe that it is not possible to dig wells because of the proximity of the river.
- Households use culverts to store water for the dry season.
- Villagers report increased siltation of the river in recent years, and lower water volume.

4.12. Prey Veng

4.12.1. Kampong Trabek

- This district benefits from irrigation with water from a river. Villagers have gradually switched from flooded rice to dry season rice by pumping water from the river.
- Villagers and local authorities have complained that Section C2 of National Road 1, which was funded by the Asian Development Bank (ADB), acts as a retention dike for flood waters, because it is not equipped with culverts or floodgates. As a consequence, the rehabilitation of the road has resulted in changing flooding and irrigation patterns, making wet season rice cultivation too uncertain for farmers.

4.12.2. Sithor Kandal, Prey Veng, Pea Raing, and Preah Sdach

- These four districts present the same characteristics of heavy flooding by the Mekong River during the rainy season.

- Villagers have noticed changes in the intensity and frequency of floods over the past years. In some cases, farmers have adopted rice varieties that present longer stalks and are able to survive submergence to adapt to longer floods. The timing of planting, due to the lack of flood forecast, was disastrous. Combined with a lack of floodwater in drier years, rice harvests were lost.
- Farmers have also attempted to expand irrigation of dry season rice by digging wells reaching 30-40 m into groundwater resources. These wells provide enough water for about 4 ha of dry season rice. However, villagers have noticed that the water table has been lowered as a consequence of this irrigation practise. In some cases, wells cannot be used for more than a year. Salinisation problems have also been reported.
- Existing reservoirs and ponds have little storage capacity as a lack of maintenance has led to their gradual sedimentation. Villagers also blame deforestation for the increased sedimentation of reservoirs.

4.13. Pursat

4.13.1. Bakan

- The waters of Tonle Sap Lake annually flood this district. If floods occur slowly and gradually, wet season rice cultivation is possible. However, villagers have noticed that floods have become more unpredictable in recent years, making growing wet season rice an uncertain enterprise.
- Before the war, the area was also cultivated for dry season rice, using an irrigation network from the Pursat River. This is no longer possible, as the canal is heavily sedimented and unusable. Villagers have suggested the rehabilitation of the irrigation network as a potential adaptation measure to drought.

4.13.2. Kandieng

- This district is flooded by both the Pursat River and Lake Tonle Sap.
- The most difficult form of adaptation to flood for local people is to move livestock to mountainous areas. This involves several days of travel. Households may stay for several months in mountainous regions, until waters have receded. Some relatives remain at home to fish.
- Only wet season rice is cultivated. Despite the proximity of the river, farmers do not have enough money to pump water for irrigation.

4.14. Rattanakiri

4.14.1. Veun Sai

- Floods occur all year long, including during the dry season. Water rises and falls very quickly, with houses being flooded overnight.
- Villagers believe that the construction of the Yale hydroelectricity dam, located upstream in Vietnam, is responsible for their plight. The commissioning of the dam apparently coincides with the beginning of abnormal flooding patterns (dry season floods, overnight floods), and a sharp decrease in the fish catch.
- During the wet season, fluctuations of water levels are more pronounced.
- Malaria constitutes the main health problem in this district. However, according to villagers, the number of cases has declined since the introduction of mosquito nets.

- Villagers prefer malaria treatment by private doctors. A "malaria injection" costs KHR 100,000. State doctors are perceived to be less efficient because they do not usually give injections to malaria patients, and only prescribe pills.

4.14.2. Lumphat

- The Srepok River, which crosses this district, is a tributary of the Sesan River. Thus, flood characteristics are similar to those of Veun Sai.
- This district experiences water shortages further away from the river as there is no water storage structure.

4.15. Siem Reap

4.15.1. Chikreng

- This district experiences droughts and floods.
- Both dry and wet season rice is cultivated, making it a relatively well-off area. The proximity of Tonle Sap Lake allows for irrigation during the dry season.
- Fishers report decreasing fish catch, presumably due to overfishing and destruction of the inundated forest.

4.15.2. Krolanh

- This district is located far from Tonle Sap Lake and suffers from droughts.
- Isolation has left the area without development activities.
- Rice cultivation relies on rainfall, as there is no irrigation available.
- Villagers suffer from water shortages as there is an insufficient number of wells.
- Hunting and logging supplement farming activities.

4.15.3. Pourk

- In Keopor Commune, farmers do not cultivate wet season rice because of high water levels during floods. In the dry season, rice is cultivated with irrigation from the Western Baray, an elevated reservoir constructed around 1050. The Western Baray measures 7.9 by 2.2 km and had an initial capacity of 80 million m^3. However, because of lack of maintenance and sedimentation, its present capacity is estimated at only 2 million m^3. Nevertheless, this ten-century old reservoir still provides water for rice cultivation. According to farmers, the water is of high quality (in Khmer, the Western Baray is known as the "Clear Water Baray"). However, at the peak of the dry season, there may not be enough water for villages located too far from the Western Baray.
- At the height of Angkor, the combined water storage capacity of all Barays might have reached 155 million m^3, which would have provided enough water for a large metropolis and surrounding irrigated rice fields. Only two Barays remain in operation.

4.15.4. Svay Leu

- Phnom Kulen, the upper watershed of Siem Reap province, is located in this district. Malaria has been traditionally prevalent in this mountainous forested landscape.
- An estimated 70% of households have suffered the losses of children to malaria.
- Despite malaria programmes implemented by NGOs, villagers largely resort to traditional medicine. In particular, people may call upon spirits to protect them or cure them.

- The closest health centre is located in Siem Reap City, some 60 km away. Villagers are aware that children may receive free first world treatment at the famed Kantha Bopha Hospital, run by Swiss Dr Beat Krishner. However, the cost of travelling to the city is exorbitant for most.
- Authorities and NGOs have distributed mosquito nets. However, people contract malaria while farming in the forests. Slash and burn agriculture is a common practise, and thus puts farmers at risk.
- There is no water shortage in the area as wells and mountain springs provide enough for household consumption.

4.16. Svay Rieng

Mainly wet season rice is cultivated in Svay Rieng Province. Productivity appears to be generally good and is increased when water availability allows for a supplementary harvest in the dry season.

Svay Rieng City was flooded in 2003 and 2004, which, according to local knowledge, had never previously occurred.

Outside of farming seasons, villagers may work as day labourers in neighbouring Vietnam.

4.16.1. Kampong Ro

- This district's continuous supply of water partly depends on the goodwill of Vietnamese authorities. A river located on the Vietnamese side of the border provides irrigation water through a canal constructed by Cambodian authorities. However, the lock is controlled by Vietnam, which means that it remains open only if there is enough water for Vietnamese farmers. The canal is used to irrigate dry season rice fields.
- Farmers in this district have gradually abandoned wet season rice cultivation over the past decade, as the area has remained submerged by floods for increased periods of time. According to villagers, roads without culverts block water flow, in effect transforming the district into a large reservoir during floods.
- Adaptation to floods include building houses on stilts and moving animals to safer grounds.

4.16.2. Svay Chrum

- Villagers report that groundwater is salted and has a high metal content. Thus, wells constructed by NGOs have been abandoned.
- According to local people, building reservoirs would mitigate water shortages.
- Agricultural productivity is low as villagers have no control on water supply: there is too little water in the dry season and too much water during floods.

4.17. Takeo

4.17.1. Kirivong

- Villagers blame the construction of a floodgate in Vietnam for preventing drainage and worsening floods in this district. The floodgate was constructed to protect downstream areas, located in Vietnam, from getting flooded.
- During the dry season, farmers rely on small hand dug canals for irrigation. However, lack of maintenance of water reservoirs has lead to water shortages and drought.

4.17.2. Koh Andet

- Villagers report water drainage problems associated with two main structures: (1) a dike that encloses agricultural fields for water storage, and (2) a road that also acts like a dike against floods but does not include culverts for drainage.
- The dike is useful during the dry season for retaining water. However, during the wet season, it prevents water from draining, which extends the duration and magnitude of floods. Villagers upstream complain that downstream people are better protected from floods, and also benefit from water supply during the dry season. Villagers have also reported some taxation for water storage, although it is not clear whether this is legally sanctioned. The dike was built by the Ministry of Rural Development.
- The road prevents water from draining. Villagers suggest that the dike and the road need to be equipped with water control structures so as to allow for better drainage of the area.

4.17.3. Tram Kak

- Villagers have reported tornadoes in 2004. This is, from known local history, the first occurrence of this climatic hazard in the area.
- The district mainly suffers from drought. The main water sources are *trapeangs*, or small ponds. Existing canals have not been used for several years, as they are almost fully sedimented. No development of water sources is planned for the area.

V. CONCLUSIONS

- Local people have a high understanding of climatic hazards and of their causes. Villagers are clearly aware of changes in hydrological patterns resulting from the construction of dams, dikes and roads and from deforestation, which may increase the frequency and intensity of floods, and the sedimentation of water storage structures.

- Traditional resignation to climate change and to climate extremes should not be equated to preparedness and adaptation. People may be used to yearly losses of life, damages to property and agricultural fields, but a habit of acceptance does not imply successful adaptation. For large proportions of the population, coping mechanisms simply consist of praying for rain or planting as usual.

- The preparedness of villagers to extreme climate events is low, as is their adaptation capacity to climate change. There are cases where local communities are resourceful when dealing with climate hazards, but these are exceptions and usually coincide with settlements with higher social capital and stronger local institutions.

- Villagers may be aware of possible coping and adaptation mechanisms such as rehabilitating water storage structures and irrigation canals, building dikes and water control structures, strengthening dwellings against windstorm etc. However, the lack of financial resources has generally prevented local communities from implementing these projects.

- Much of the efforts of authorities have focused on post-disaster management, rather than on disaster prevention and adaptation to extreme climate events. While post-disaster management needs to be expanded to all victims, successful prevention and adaptation will require additional commitment from government and international organisations.

- According to observations by villagers, the frequency and intensity of floods, droughts and windstorms have increased since the year 2000 or so. There is anecdotal evidence that floods and windstorms now occur in areas that had traditionally been spared.

- In some cases, local communities have attempted to adapt to recently changing patterns of climate hazards. However, several cases of failed adaptation were recorded. Villagers have shifted planting dates without success, as there is no forecast of local weather. Others have switched to flood resistant rice varieties, but these could not survive periods of droughts. In some areas, farmers have constructed wells to pump groundwater to irrigate agricultural fields, but these have yielded water for a season only and subsequently lowered the water table.

- Accurate and reliable local forecasts of extreme climate events are non-existent in Cambodia. Villagers in downstream areas essentially rely on word of mouth from upstream areas to ready themselves for floods. Windstorms and high tides similarly find local communities unprepared. Information about water levels, which may be occasionally advertised in public areas, leave local people perplexed about how to interpret them.

- There is still much confusion about malaria and a number of erroneous traditional beliefs at the grassroots level. These include contracting malaria from drinking contaminated water, the existence of a malaria vaccine and the need for injections when diagnosed with malaria.

- Less than a third of households interviewed believe that the distribution of mosquito nets would be an efficient strategy against malaria prevention. Nets have been used as blankets

during colder nights. In addition, nets are of little use when villagers contract malaria while logging or collecting firewood in forests, or working in orchards and *chamkar*.

- For the majority of households interviewed, cost is the main factor determining the choice of malaria treatment. Almost half of households had to travel more than 5 km to receive treatment.

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APPENDICES

Appendix 1: NAPA Guidelines for Fieldwork

Step 1: Meeting with authorities at Provincial/District Level

- **Briefly explain the objectives of the research:**
  1. to understand the main types of climatic hazards in the area (flood, drought, windstorm, high tide, salt water intrusion, malaria);
  2. to understand coping mechanisms at the community level; and
  3. to understand existing programs and institutional arrangements for addressing climatic hazards.

- **Conduct the survey with the local authority**

- **Identify with interviewees *DISTRICT, COMMUNES, VILLAGES* that are most prone to climatic hazards:**
  1. ask interviewees for their personal judgement on which areas would be best for fieldwork;
  2. check with the NAPA site selection list prepared at CCCO;
  3. if there is a disagreement between the CCCO list and local authorities opinion, try to find out the reasons why and make note on the CCCO list; and
  4. always favour the sites recommended by local authorities over the CCCO list.

- **Collect supporting documents and reports available**

- **Ask for precise directions to the survey areas**

Step 2: Meeting with NGOs at Provincial/District Level

- **Briefly explain the objectives of the research:**
  1. to understand the main types of climatic hazards in the area (flood, drought, windstorm, high tide, salt water intrusion, malaria);
  2. to understand coping mechanisms at the community level; and
  3. to understand existing programs and institutional arrangements for addressing climatic hazards.

- **Conduct the survey with NGOs**

- **Identify with interviewees *DISTRICT, COMMUNES, VILLAGES* that are most prone to climatic hazards:**
  1. ask interviewees for their personal judgement on which areas would be best for fieldwork;
  2. check with the NAPA site selection list prepared at CCCO;
  3. if there is a disagreement between the CCCO list and NGO, try to find out the reasons why and make note on the CCCO list; and
  4. check with sites recommended by NGOs, always favour sites recommended by NGOs over the CCCO list.

- **Collect supporting documents and reports available**

- **Ask for precise directions to the survey areas**

Step 3: Make precise notes of the reasons for site selection in Stakeholder Meeting Table

Step 4: Meeting with authorities at Commune Level

- **Briefly explain the objectives of the research:**
  1. to understand the main types of climatic hazards in the area (flood, drought, high tide, windstorm, high tide, salt water intrusion, malaria);
  2. to understand coping mechanisms at the community level; and
  3. to understand existing programs and institutional arrangements for addressing climatic hazards.

- **Conduct the survey with local authority**

- **Identify with interviewees *VILLAGES* that are most prone to climatic hazards:**
  1. ask interviewees for their personal judgement on which areas would be best for fieldwork;
  2. check with the NAPA site selection list prepared at CCCO;
  3. if there is a disagreement between the CCCO list and local authorities opinion, try to find out the reasons why and make note on the CCCO list; and
  4. check with sites recommended by local authorities, always favour sites recommended by local authorities over the CCCO list.

- **Collect supporting documents and reports**

- **Ask for precise directions to the survey areas**

Step 5: Meeting with NGOs at Commune Level

- **Briefly explain the objectives of the research:**
  1. to understand the main types of climatic hazards in the area (flood, drought, windstorm, high tide, salt water intrusion, malaria);
  2. to understand coping mechanisms at the community level; and
  3. to understand existing programs and institutional arrangements for addressing climatic hazards.

- **Conduct the local authority survey**

- **Identify with interviewees *VILLAGES* that are most prone to climatic hazards:**
  1. ask interviewees for their personal judgement on which areas would be best for fieldwork
  2. check with the NAPA site selection list prepared at CCCO;
  3. if there is a disagreement between the CCCO list and local authorities opinion, try to find out the reasons why and make note on the CCCO list; and
  4. check with sites recommended by NGOs, always favour sites recommended by NGOs over the CCCO list.

- **Collect supporting documents and reports**

- **Ask for precise directions to the survey areas**

Step 6: Meeting with informal leaders (ELDERS, MONKS etc.) at VILLAGE Level

- **Briefly explain the objectives of the research:**
  1. to understand the main types of climatic hazards in the area (flood, drought, windstorm, high tide, salt water intrusion, malaria);
  2. to understand coping mechanisms at the community level; and
  3. to understand existing programs and institutional arrangements for addressing climatic hazards.

- **Check with interviewees that the village is most prone to climatic hazards**

- **Conduct the local authority survey**

- **Collect supporting documents and reports**

Step 7: Meeting with NGOs at VILLAGE Level

- **Briefly explain the objectives of the research:**
  1. to understand the main types of climatic hazards in the area (flood, drought, windstorm, high tide, salt water intrusion, malaria);
  2. to understand coping mechanisms at the community level; and
  3. to understand existing programs and institutional arrangements for addressing climatic hazards.

- **Check with interviewees that the village is most prone to climatic hazards**

- **Conduct the local authority survey**

- **Collect supporting documents and reports**

Step 8: Meeting with Households

- **Explain the objectives of the research in SIMPLE TERMS:**
  1. to understand the main types of disasters in the area (flood, drought, windstorm, high tide, salt water intrusion, malaria);
  2. to understand how local communities deal with disasters; and
  3. to document good local practises to deal with disasters.

- **Before the interview, check with respondents that they have personally dealt with disaster**

- **Explain that there is no right or wrong answer, and that the results will be used to help improve response to disasters**

- **Conduct the household survey**

- **<u>DO:</u>**

- be polite;
- be patient; and
- use simple words.

- **DONT:**
  - don't try to answer questions for villagers, if they cannot answer, skip the question;
  - don't use technical words; and
  - don't argue with villagers, just end the meeting if things go wrong.

Step 9: Fill in the Stakeholder Meeting Table

Appendix 2: Stakeholder Meeting Table

Non-health Sectors

[Province Name]	Province Level	District Name(s)	Commune Name(s)	Village Name(s)
Authorities interviewed				
NGOs interviewed				
Households interviewed (number)				
Reasons for selecting site				
Documents collected				

Health Sector

[Province Name]	Province Level	District Name(s)	Commune Name(s)	Village Name(s)
Authorities interviewed				
NGOs interviewed				
Households interviewed (number)				
Reasons for selecting site				
Documents collected				

Appendix 3: Survey Questionnaires