geres Cambodia

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PUBLIC PERCEPTIONS OF CLIMATE CHANGE IN CAMBODIA

FINAL REPORT

SUMMARY

The impacts of climate change in Cambodia could be severe compared to developed countries and even other developing nations in southeast Asia, not because Cambodia is subject to more frequent or intense climate change events, but due to its vulnerability, which is associated the dominance of agricultural industries in the economy and limited adaptive capacity arising from lack of financial and other resources.

This study documents Cambodian people's insights about issues that are commonly associated with climate change and the coping mechanisms they have implemented to deal with the issues. The information is largely qualitative and the analysis could therefore be subject to different interpretations in some cases; however, the analysis was conducted in the context of the overriding objective to provide an overall indication of the topics that were most widely discussed or assigned the greatest importance by participants during the discussions/ interviews.

People broadly agreed that changes in climate/ weather patterns have occurred and the impacts of these changes on the agricultural sector dominated discussions, which reflects the agricultural basis of the provinces' economies, the agricultural sector's fundamental reliance on weather patterns and the dominance of farmers among the studied population. Generally, people only identified changes and impacts that have occurred in the last 10-15 years and sometimes timeframes were unclear or unspecified.

The findings of the field research are compared to prevailing literature and related to the national and international climate change policy contexts. There were both discrepancies and clear alignments evident in the comparison of the literature review and the field research. One notable discrepancy identified was a potential disconnect between the perceived relative importance of drought and flood. The literature suggested that flood posed a greater threat to Cambodians than drought; however, the findings of the field research reveal less concern about the impacts of flooding and more preoccupation with the current problems caused by drought and water shortages.

This discrepancy could be a reflection of the fact that only four provinces were included in this studyor it could result from differences in timeframes or unsuitability of models used in climate projections; however, further clarification can only be achieved through further study.

The study also revealed that coordination among researchers and government reporting is not optimal, and there appears to be limited mechanisms to bank knowledge about the successes and failures of coping mechanisms associated with climate change. Translation of government policies/ plans into real, on-the-ground actions also appears to be lacking.

This study provides an invaluable record of the practical implications of climate change in people's daily lives, and identifies adaptive measures that have been implemented and their success rates. The information in this study can assist policymakers, NGOs and other climate change actors in understanding Cambodians' needs arising from climate change, so that they can develop practical and effective tools to facilitate climate change adaptation in Cambodia

CONTENTS

ACRONYMS

CCCO	Cambodia Climate Change Office
CDM	Clean Development Mechanism
COP/ MOP	Conference of the Parties to the UNFCCC serving as the meeting of the Parties to the Kyoto Protocol
DCA/ CA	DanishChurch Aid/ Christian Aid
ENSO	El Nino Southern Oscillation (El Nino/ La Nina events)
FGD	Focus Group Discussion
GEF	Global Environment Facility
GHG	Greenhouse Gas
GWP	Global Warming Potential
KI	Key Informant
LDC	Least Developed Country
LUCF	Land Use Change and Forestry
MOWRAM	Ministry of Water Resources and Meteorology
NAPA	National Adaptation Programme of Action
NGOs	Non-governmental Organisations
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION

The impacts of climate change in Cambodia could be severe compared to developed countries and even other developing nations in southeast Asia, not because Cambodia is subject to more frequent or intense climate change events, but due to its vulnerability, which is associated the dominance of agricultural industries in the economy and limited adaptive capacity arising from lack of financial and other resources.

Information on the current impacts of climate change in Cambodia is vital for government bodies, NGOs and other organisations to adequately address the issue. While some of the impacts in Cambodia have been documented in published literature, there is a shortage of information about on-the-ground observations made by people who are forced to deal with these issues every day and who have been adapting to changes in climatic patterns before climate change became the prominent issue that is today.

This study helps to fill this knowledge gap by documenting Cambodian people's insights about issues that are commonly associated with climate change. This knowledge provides an invaluable record of the practical implications of climate change in people's daily lives, and identifies adaptive measures that are already implemented by people and which may be replicated or improved. Furthermore, the information obtained during the study can assist policymakers, NGOs and other climate change actors in understanding Cambodians' needs arising from climate change, so that they can develop practical and effective tools to facilitate climate change adaptation in Cambodia.

The main objectives of the study are to:

- Obtain an in-depth picture of rural Cambodians' perception of climate change in their communities, including their ideas about the relationship between perceived climatic changes and local natural resource issues.
- Obtain an in-depth picture of coping mechanisms that are being implemented in rural communities in response to changes in climatic patterns.
- Compare perceived impacts of climate change in rural Cambodia with actual impacts identified in prevailing literature.
- Obtain an understanding of national climate change policies in Cambodia and their relationship with specific climate change impacts in Cambodia and the international climate change policy context.
- Formulate recommendations to guide the climate change policy/advocacy activities of NGOs and Cambodian government bodies, to ensure policy/ advocacy activities translate into real, on-the-ground benefits.

The purpose of this study is to determine what people think, not to judge whether they are correct. Sometimes the information appears contradictory; however, it is a direct representation of the thoughts discussed during the course of the research; no judgement about correctness or consistency of the information was made.

The information is largely qualitative and the analysis could therefore be subject to different interpretations in some cases; however, the analysis was conducted in the context of the overriding objective to provide an overall indication of the topics that were most widely discussed or assigned the greatest importance by participants during the discussions/ interviews.

2. STUDY METHODOLOGY

2.1 INTRODUCTION

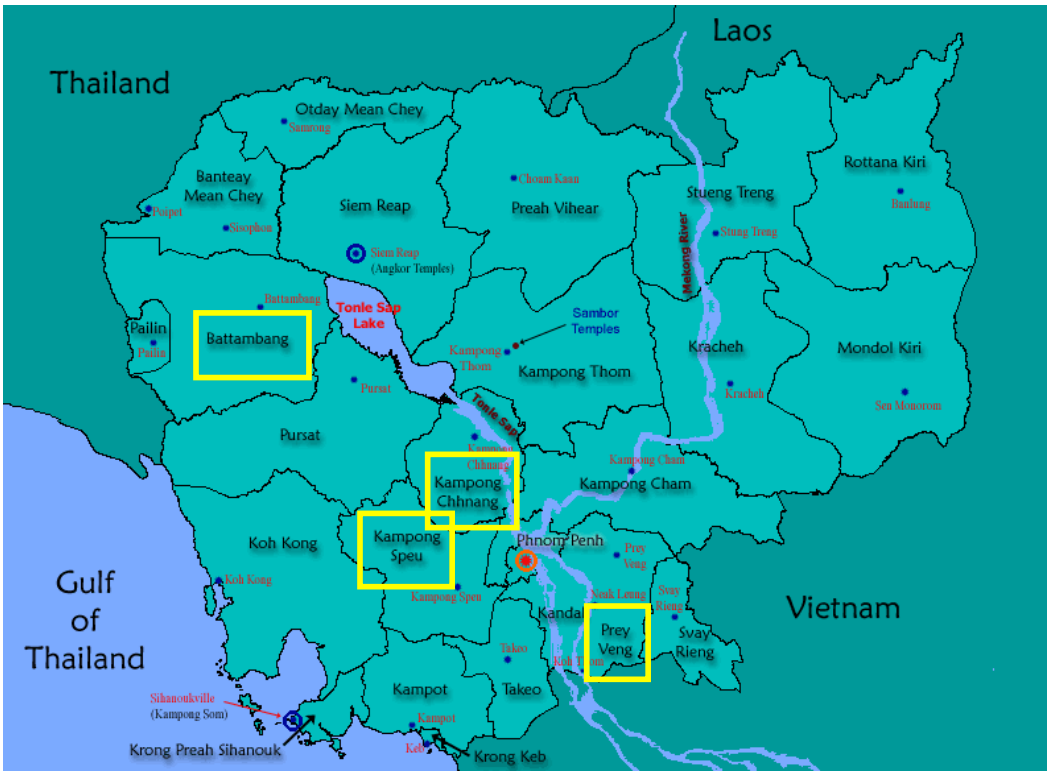
This study examines Cambodians' perceptions of changes in climate, impacts of these changes, and coping strategies of communities in rural areas. The findings are then compared to prevailing literature, and related to the national and international climate change policy contexts.

The study will focus on rural communities in four provinces in Cambodia (see Figure1):

1. Kampong Chhnang
1. Kampong Speu
1. Prey Veng
1. Battambang

The selection of these four provinces was based on the locations of DCA/CA food security programmes and different geographic and climatic conditions.

Figure 1[1]: Provinces included in research



In the course of the study, the following activities were undertaken:

1. Interviews, observation and focus group discussions, to gauge people's perceptions of climate change, impacts in their communities, as well as identify measures that people are taking to cope with these impacts. Information was obtained from

people representing various aspects of the communities, including local farmers and households, local authorities and community leaders.

1. The information was then compared with expected climate change impacts in Cambodia that have been identified in studies and other literature.
1. National policies that have been implemented or planned to address climate change impacts were investigated
1. The national policies are related to the impacts identified in the interviews/ focus groups and prevailing literature.
1. The international policy environment and its relationship with Cambodian climate change policy and practices were examined.
1. Recommendations to guide the policy and advocacy activities of NGOs and government bodies in Cambodia were formulated, based on the observations and findings from the field research, and the opportunities and constraints imposed by the international climate change policy context.

2.2 FIELD RESEARCH

The field research was intended to provide qualitative information about participants' perceptions and experiences. To preserve the qualitative approach, the field research primarily involved the following research techniques:

- Focus Group Discussions (FGDs), which provide insights into individuals'/ households' experiences and ideas.
- Key Informants (KIs), which capture both personal and community-level experiences.
- Case studies, to provide in-depth information at the individual/ household level, about changes/ impacts that were most prominent in discussions.

Field questionnaires were also used to identify broad trends and facilitate some quantitative analysis.

In total, 112 field questionnaire respondents, 16 focus groups and 44 key informants were selected for the research. The vast majority of participants were farmers (see Figures 2 and 3). Further detail about the field research methodology is presented in Annex I.

Figure 2: FGD participants, by occupation

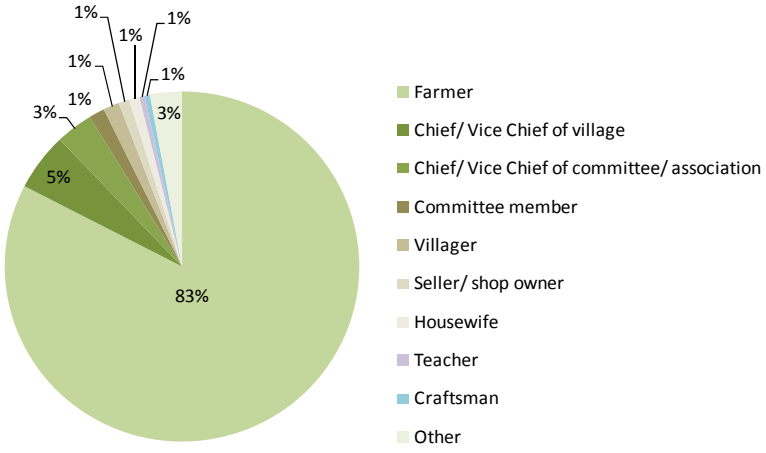
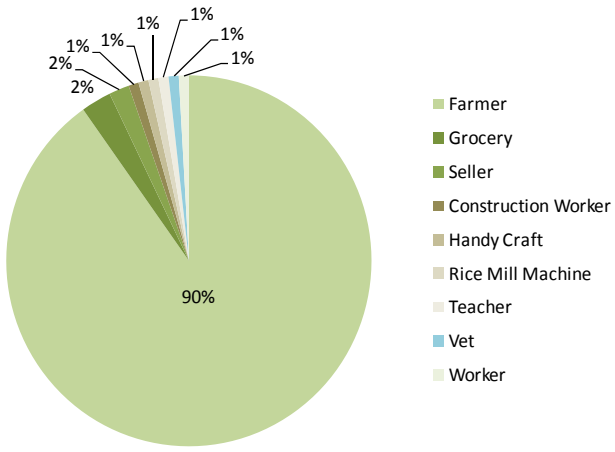


Figure 3: Field questionnaire participants, by occupation



2.3 LITERATURE REVIEW

To review current and predicted impacts of climate change in Cambodia, secondary information was collected, mostly from government departments, NGOs and research institutes. The national and international policies influencing Cambodia's climate change actions were elaborated based on GERES' detailed internal knowledge of national and international climate change policies and markets, updated according to current literature.

The information obtained from these sources provides context to the field data and allows the formulation of appropriate approaches for dealing with climate change in Cambodia through advocacy. Documented impacts of climate change and associated coping mechanisms in Cambodia are compared to the perceptions of local communities as conveyed in the interviews and focus group discussions.

3. LITERATURE REVIEW

3.1. CAMBODIA'S GHG EMISSIONS PROFILE

Up-to-date information regarding Cambodia's current greenhouse gas (GHG) emissions profile is limited. Reliable information is confined largely to the Cambodian Government's 2002 Initial National Communication to the UNFCCC, which is based on data from 1994; and the next Communication, expected in 2010, will focus on emissions in 2000. Still, it is useful to examine the available data. Table 1 outlines the categories of emissions (by sector) included in the inventory.

Table 1: Categories included in inventory

Energy	Fuel combustion activities; Energy industries; Manufacturing industries; Transport; Commercial/service; Residential.
Industry	Cement; Food and beverages; Pulp and paper.
Agriculture	Domestic livestock; Rice cultivation; Grassland burning; Agricultural residue burning; Agricultural soils.
Waste	Solid wastes; Domestic/commercial wastewater; Industrial wastewater; Human sewage.
Land Use Change and Forestry (LUCF)	Change in forest/woody biomass; Forest/land use change.

Figure 4: Cambodia's GHG emissions profile, by sector, excluding LUCF (1994)

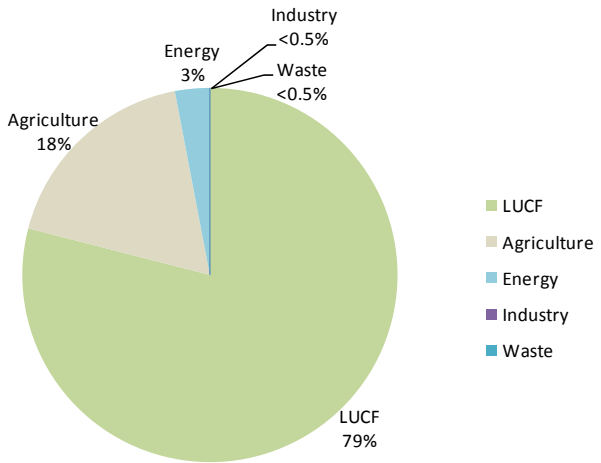
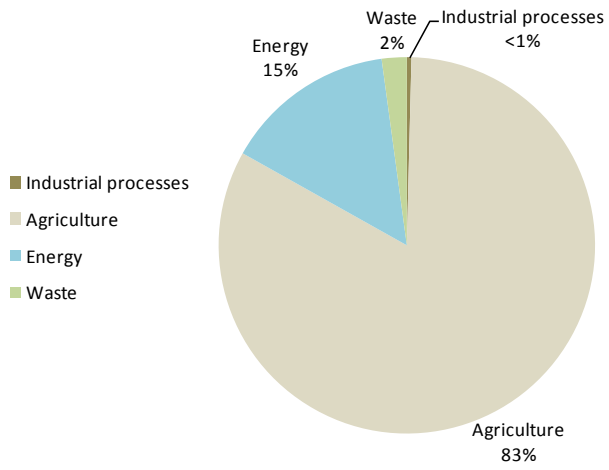


Figure 4 indicates that Land Use Change and Forestry (LUCF) was the largest emitter of GHGs in Cambodia in 1994. LUCF can emit a number of GHGs in different ways. In Cambodia, GHG emissions from LUCF result largely from commercial harvesting of wood for timber and for other applications (such as cooking); and from converting forested land for alternative uses, such as agriculture. GHG emissions are predominantly associated with burning and decay processes involved in these activities. Carbon dioxide (CO_2) is emitted in the largest amounts, followed by methane (CH_4) and nitrous oxide (N_2O).

GHG emissions from the LUCF category was not considered a net contributor to Cambodia's overall GHG emissions. While LUCF was responsible for a substantial proportion of Cambodia's GHG emissions, it was also a significant absorber of carbon; in fact, the 1994 inventory calculated that the LUCF sector sequestered sufficient carbon (more than 73,000 tCO_2e) to offset the total GHG emissions from every sector for that year. Importantly, however, illegal logging was not included in the inventory due to lack of data; thus, the balance between carbon emissions and sequestration may be different in reality.

Figure 5: Cambodia's GHG emissions profile, by sector, excluding LUCF (1994)



In terms of net contribution to GHG emissions, therefore, agriculture is the largest emitting category (see Figure 5). The agriculture sector is responsible for the emission of particularly potent GHGs, which results from several practices. In Cambodia, enteric fermentation[2], rice cultivation[3] and changes in agricultural soil properties[4] account for around 98% of emissions from the agriculture sector. All of these processes involve the release of GHGs that are more potent than CO_2, in terms of their Global Warming Potential (GWP)[5]. The main gases emitted as a result of these processes are CH_4, with a GWP of 21; and N_2O, with a GWP of 310.

Cambodia's GHG emissions are relatively low compared to other countries (see Table 2), mainly due to the lack of industry in Cambodia; however, government reports[6] indicate that Cambodia was a net emitter by 2000 (emitting 6.2 million tCO_2e). Projections of Cambodia's GHG emissions predict that total emissions would increase by more than 14% from 2000 to 2020, reaching nearly 44 million tCO_2e. The LUCF sector would be a net emitter, releasing 7.7 million tCO_2e (compared to its status as a sink in 1994 when net emissions from the sector were -17.9 million tCO_2e). LUCF would account for 63% of total emissions, followed by agriculture (27.5%) and energy (9%)[7].

Table 2: Comparative GHG emissions from different countries

Country	Year	Total emissions (million tCO_2e)	Emissions per capita (tCO_2e/ capita)
Cambodia	1994	-5	-
USA	2002	6,746	24
UK	2006	656	11
Australia	2000	535	27.5
China	1994	3,650	3
Thailand	1994	286	5

3.2 CURRENT AND FUTURE IMPACTS OF CLIMATE CHANGE IN CAMBODIA

3.2.1 Impacts to date

3.2.1a People's perceptions

A government survey[8] conducted in 2005 (hereafter referred to as the NAPA Survey) as part of Cambodia's National Adaptation Programme of Action (NAPA), involving 684 households in 17 provinces, gauged people's perceptions of five "climatic hazards": flood, drought, windstorm, seawater intrusion and high tide. All 17 provinces were found to have experienced both floods and droughts. Windstorms had affected 15 provinces. Flooding and drought were cited as the most severe climate hazards in all 17 provinces surveyed. According to the survey, together with flood information obtained from participants, either severe drought or flood has occurred every year since 2000.

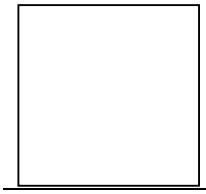
The survey found that:

- 50% of respondents believe 2003 was the most severe drought year, followed by 2004 (32% of respondents).
- 71% of people believed droughts had increased in frequency.
- 58% of respondents said that the frequency of floods had increased in recent years.

The survey report notes that, while the figures cannot be considered representative of Cambodia as a whole, they are noteworthy because the areas were selected for their vulnerability to climate hazards.

3.2.1b Droughts and floods

There is a lack of country-specific data on potential climate change impacts in Cambodia and it is still uncommon for particular events to be specifically or exclusively attributed to climate change. In Cambodia, the occurrence of drought and floods (outside normal seasonal fluctuations during wet and dry seasons) is generally regarded as common and the two phenomena can occur simultaneously in different parts of the country. Floods are often associated with typhoons and heavy rain in the Mekong basin and drought typically coincides with El Nino events. Moreover, the Mekong River basin is subject to significant spatial and temporal variability in rainfall distribution associated with the monsoon regime[9].



Some influencing factors unrelated to climate change have been identified as potentially impacting the severity of floods in Cambodia in

the past 15 years. For example, in the 2000 and 2001 floods, contributing factors identified include:

- Fast water flow from the Yaly Dam in Viet Nam into the Mekong River.
- Heavy rain in Phnom Penh and some other areas of the country, combined with the fact that waterways are narrower downstream, meant that the water flowed down significantly slower than its normal flow.
- Construction of the Phnom Penh-Kampong Cham road (completed in 1999) affected the hydrological pattern of flooding across parts of four provinces (Kandal, Kampong Cham, Kampong Thom & Kampong Chhnang)[10].

Thus, without further studies, it is impossible to link specific events with the occurrence of climate change. Nevertheless it is worthwhile examining some phenomena that may be associated with climate change in Cambodia.

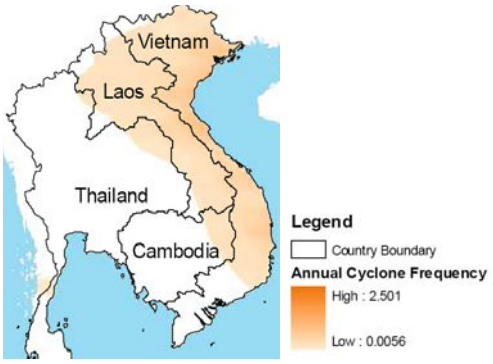
Appendix 1 summarises the findings of a literature review relating to extreme weather events in Cambodia in the past 20 years (there is limited detailed data preceding the late 1990s, however)[11]. According to the literature, the most common extreme weather events in Cambodia are droughts and floods; flooding has been cited as the "main" climate hazard affecting Cambodia[12].

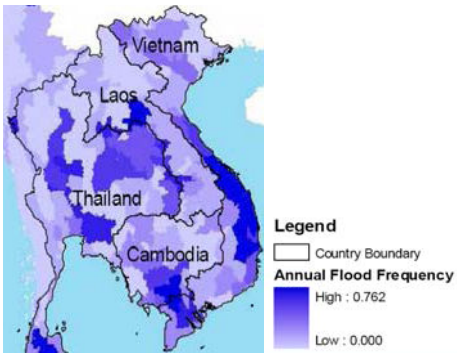
While severe flooding is a relatively common occurrence in many parts of Cambodia, in the past, extreme floods with significant negative impacts occurred only every five years, or less frequently (in 1961, 1966, 1978, 1984, 1991 and 1996). Since 1999, however, severe flooding has been occurring more frequently, with the most damaging flood occurring in 2000[13].

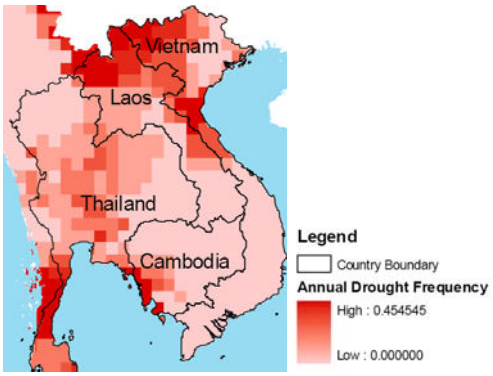
It is important to note that the droughts and floods identified are those that occur outside Cambodia's normal seasonal patterns. Cambodia naturally experiences an annual "dry season" between November and April, which does not constitute drought; and the annual "wet season" (from May to October) typically causes the inundation of large tracts of land in the floodplain areas – an important process that assists in maintaining biodiversity, fish stocks and soil fertility. Even the flooding caused by extreme weather events can provide positive impacts; for example, it has been reported that the 2000 floods, which are widely reported as the "worst" floods in 70 years, were accompanied by natural fish spawning, increase in bio-diversity, soil nutrients, new land accretion and natural flushing[14].

A recent report[15] mapping Southeast Asian countries' vulnerability to climate change impacts also indicated Cambodia's susceptibility to droughts and floods. The report traced the occurrence of certain climate events in the region from 1980 to the first couple of years of this century. As demonstrated in the maps in Figure 6, Cambodia is not particularly prone to cyclones; however, flood and drought frequencies in certain areas of the country are quite high.

Figure 6: Vulnerability of Cambodia to various climate change hazards[16]







3.2.1c Agriculture

Generally, the literature suggests that the indirect impacts of Cambodia's susceptibility to droughts and floods are most severe within the agricultural sector, which involves significant flow-on effects, especially because agriculture accounts for around 29% of Cambodia's GDP and 59% of employment[17].

Rice is the primary crop grown in Cambodia (accounting for around 90% of cultivated land[18]) and is the main staple of Cambodians' diet. Production losses generally occur as a result of floods and drought. Overall, government reports[19] state that flooding accounted for more than 70% of rice losses during 1996-2000 and drought only accounted for around 20% of losses during the period. Appendix 2 provides detail about the impacts of floods and drought on rice yields in several provinces.

While production losses from floods and droughts have been connected with El Nino and La Nina (ENSO) events (in 1996, 1997 and 1998 especially), flooding and drought episodes in the past 10 years that are not associated with ENSO events have also destroyed crops at certain times and endangered food security[20]. For example, the 2002 flood affected 45,003 ha of rice and created food shortages for 477,472 people and a drought during the same year damaged 62,702 ha of rice, causing food shortages among 154,069 families.

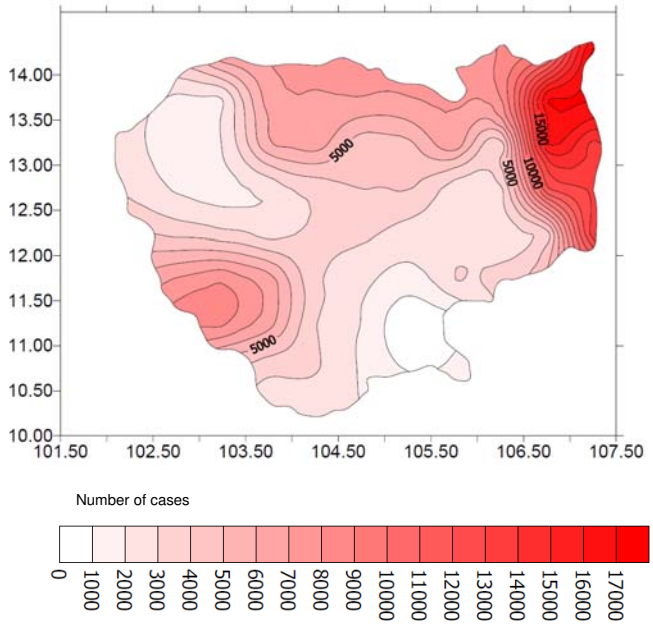
It is relevant to note that in recent years, non-climate related events have impacted the agricultural sector in Cambodia as well. The global food crisis, resulting from sudden price increases from 2006 to mid-2008, stimulated agricultural production in Cambodia; however, the current crisis has tempered these positive developments[21]. The price of many agricultural commodities has declined, due to lower demand and other factors. Decreased demand resulted in surplus harvests, creating financial difficulties for farmers. Furthermore, the boundary dispute with Thailand last year and the associated imposition of protectionist policies impeded cross-border trade. Nevertheless, the agricultural sector in Cambodia was not as severely impacted as other sectors in the country, with government statistics indicating 4.5% growth in the sector in 2008[22].

3.2.1d Vector-borne diseases

There is limited literature attributing current or past vector-borne disease outbreaks in Cambodia directly to climate change, although broader scientific literature relates persistent pools of stagnant water remaining after flooding, unseasonal rainfall and rising temperatures to increased mosquito breeding and therefore increased cases of dengue fever and malaria[23]. One survey[24] conducted by the Cambodia Climate Change Office (CCCO) in 2007 linked increased incidences of malaria and dengue fever to climate change impacts, particularly irregular flooding, which allows large quantities of stagnant water to increase mosquito breeding; and excessive logging, which forces mosquitoes into villages.[25]

Cambodia is purported to experience the highest death rate from malaria in the region; a situation that has been attributed to low living standards, limited education, hygiene standards, traditional beliefs and other social issues[26]. In terms of geographic distribution, the number of malaria cases in highland provinces is typically higher than in lowland and coastal provinces[27] (see Figure 7).

Figure 7: Distribution of malaria cases, 2000[28]



There are reports[29] that the number of malaria-related deaths in Cambodia has generally declined since the late 1990s due to the introduction of improved drugs; and the total number of malaria cases also generally decreased from the late 1990s until around 2008. From early 2009, however, evidence[30] has emerged that the number of cases and the mortality rate is increasing, due to a number of issues (many of which are unrelated to climate change), such as drug resistance; prevalence of counterfeit medicines; migration patterns favouring remote, forested areas; government delays in distributing mosquito nets; and unseasonal rainfall, which is the only potentially climate change-related cause.

3.2.2 Future impacts

As part of the preparation of Cambodia's NAPA, the Cambodian Government formulated some forecasts of climate change impacts in the country. The NAPA provides general information about potential future impacts of climate change in Cambodia. The following are relevant to this study:

- increased frequency and intensity of floods (causing severe damage to rice harvests); and
- increase in the geographic scope of vector-borne diseases (especially malaria).

The NAPA is partially based on a 2001 report that was conducted as part of Cambodia's Initial Communication, entitled *Vulnerability and Adaptation Assessment to Climate Change in Cambodia* (hereafter referred to as the V&A Report), which provides more detailed forecasts using modelling. The baseline used is the period 1961-1990. The report focuses on impacts in three sectors: agriculture, forestry and human health, using two models that apply two scenarios:

- Scenario 1: Higher global GHG emissions[31]
- Scenario 2: Lower global GHG emissions[32]

Importantly, the report acknowledges that the models employed in the projections are not particularly suitable for Cambodian conditions and that corrective factors needed to be applied.

3.2.2a Temperature and rainfall

According to the projections, temperatures in Cambodia could increase by 0.3-0.6°C by 2025 and 0.7-1°C by 2050, compared to baseline levels (see Table 3). After 2050, temperature increases are expected to accelerate.

Annual rainfall in Cambodia is generally expected to increase with climate change. Lowland areas are expected to experience the greatest increases. The higher emissions scenario produced changes of greater magnitude. The two modelling systems produced different results from 2100, when one model predicted rainfall would start to decrease (see Table 4).

Table 3: Projections of temperature increases in Cambodia (°C), compared to 1961-1990[33]

Scenario	2025	2050
Higher emissions	0.3-0.6	0.7-1.0
Lower emissions	0.45-0.6	0.75-0.9

Table 4: Projection of increases in rainfall in Cambodia, compared to 1961-1990[34]

Geographic scope	2025	2050
Lowland areas	4-8%	8-12%
Highland and coastal areas	0-4%	2-6%

3.2.2b Agriculture: Rice production

With increased atmospheric concentrations of CO_2, rice yields are expected to increase. Notably, according to the V&A Report, wet season rice yields are expected to surpass dry season yields, due to changes in rainfall patterns. However, climate change could create increased variability in yields, especially considering historical variability in Cambodia has been significantly correlated with the occurrence of floods and flooding is expected to increase in frequency and intensity as a result of climate change[35]. The V&A Report forecasts that lowland areas (the main rice growing areas) would be particularly likely to

experience increases in rainfall and frequency/ intensity of floods, rendering wet season rice especially susceptible to destruction[36].

Rice production in Cambodia's four main rice-growing provinces (Battambang, Prey Veng, Takeo and Kampong Cham) is expected to exceed local demand and fulfil 56% of national demand by 2025 and 65-67% of national demand by 2050 (compared to estimates of 40% in 2000)[37].

3.2.2c Vector-borne diseases

The indications from the V&A Report regarding malaria incidence are uncertain and highly variable due to data limitations. The lack of suitability of the models applied may have exacerbated the variability of projections as well.

Overall, the V&A Report found that the number of malaria cases in highland provinces is typically higher than in lowland and coastal provinces (based on analysis of 1996-1999 data).

The report only includes projections of malaria incidence to mid-century, predicting that by 2050, the geographic distribution of malaria incidences will be largely similar to the baseline, except that the northwestern region will become the second lowest area for malaria incidences. The report attributes this to the fact that the models did not capture the variability of malaria cases in these provinces, since malaria data from remote areas, including the most high-risk regions, were not incorporated in the projections.

Quantitative estimates of changes in malaria incidence vary greatly. The higher emissions scenario returned results that indicate decreases in expected malaria cases in all provinces in Cambodia by 2050; from 1% to 62% decrease. The lower emissions scenario generally predicts increases in malaria cases; from 1% to 16% increases, with some provinces experiencing 0% changes.

The V&A Report cites research[38] identifying rainfall and temperature as the most significant climate factors affecting malaria incidence in low altitude zones, and changes in minimum temperature as triggering exponential changes in malaria incidence in high altitude areas.

The report associates variability of malaria cases in Cambodia with changes in four factors; wet season rainfall, dry season rainfall, mean annual temperature and percent literate people in the province. Based on an equation applying these variables, the V&A Report found that, in Cambodia, the number of malaria cases is negatively correlated with dry season rainfall, mean annual temperature and literacy levels; and positively correlated with wet season rainfall.

Recent research (see section 3.2.1d) indicating an increase in the number of malaria cases and deaths over the past 1-2 years, after nearly a decade of steady decrease, indicates the uncertainty involved in the V&A Report's projections about malaria incidences (and indeed the other climate change impacts discussed in this report), since the increase has been largely attributed to unforeseeable events, such as drug resistance and delays in government distribution of mosquito nets.

3.3 VULNERABILITY AND EXISTING COPING MECHANISMS

3.3.1 Vulnerability

Downstream impacts of climate change, such as changes in malaria incidences and agricultural production, reflect the vulnerability of certain sectors and geographical regions in Cambodia. As an LDC, Cambodia is immediately highly vulnerable to climate change, due to its limited capacity to invest resources in adaptation; and with an economy that is based largely on agriculture – an industry that fundamentally relies on climate patterns – its vulnerability is further intensified.

The V&A report provides the most comprehensive study of vulnerability to climate change in Cambodia. Its approach is both sectoral and geographical, focusing on agriculture, forestry, human health and coastal zones. The report does not specifically define "vulnerability"; rather it is indirectly addressed as a function of projected impacts and their expected severity.

As discussed in 3.2.2b, the agriculture sector could experience increased rice yields in some areas; however, expected increases in rainfall and frequency/ intensity of floods pose a significant threat to wet season rice in lowland areas. Increased incidence and intensity of droughts and floods could increase yield variability in general[39].

In terms of human health, the V&A report cites research that concluded that areas near the current limits of malaria distribution are likely to be most vulnerable to climatic changes[40]. Certain areas were also separately identified as more "sensitive" to malaria outbreaks (see Table 5), based on the classification system applied by Cambodia's National Malaria Control Center[41]. The most sensitive regions cover around 4.5% of Cambodia's population.

Table 5: Regional sensitivity to malaria

Region	Sensitivity to malaria
Northeastern & northwestern provinces & rubber plantations	Most sensitive to malaria
Central area	Moderately sensitive to malaria
Remaining areas	Least sensitive to malaria

Further study is being conducted by the Cambodian Government to assess the vulnerability of other sectors, as part of the Second National Communication.

Cambodia's NAPA identifies Prey Veng, Battambang and Takeo respectively as the three most vulnerable provinces to floods; and Battambang, Prey Veng and Bantey Meanchey respectively as the three most vulnerable provinces to droughts (see Figures 9 and 10).

Figure 9: Provinces' vulnerability to floods[42]

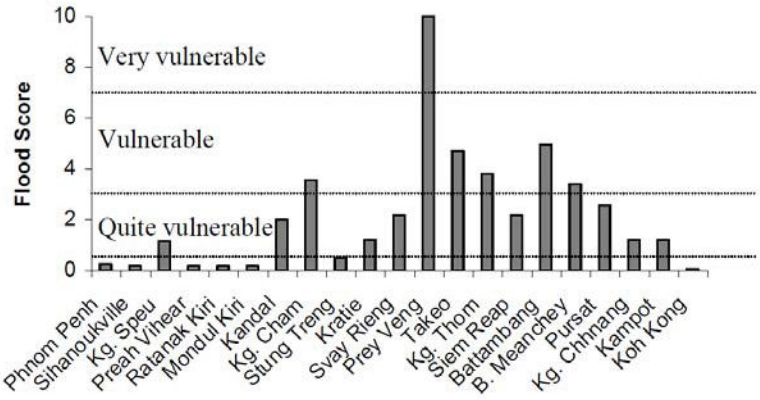
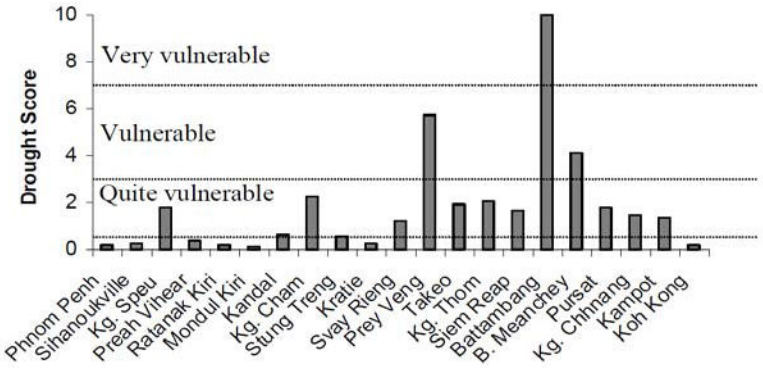


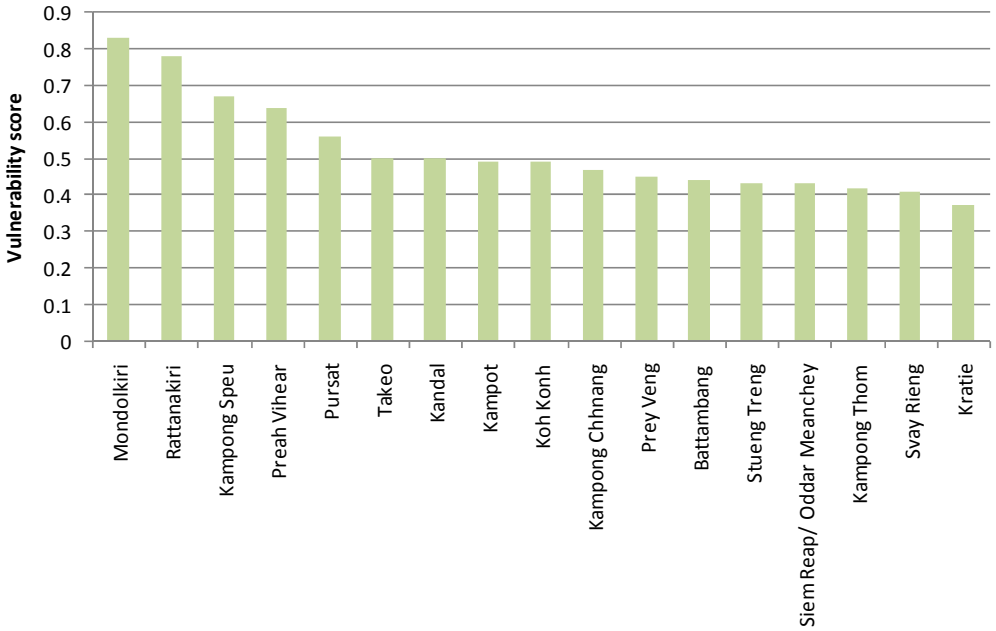
Figure 10: Provinces' vulnerability to drought[43]



As mentioned in section 3.2.1b, a recent report[44] mapping Southeast Asian countries' vulnerability to climate change impacts found that Cambodia is most prone to floods and droughts, compared to other potentially climate change-related events; however, its exposure to climate hazards was relatively low compared to most other countries in the region (see Figure 6). In assessing the vulnerability of the countries, the report surmised that vulnerability is a function of the country's exposure, sensitivity and capacity to adapt to climate change (vulnerability = f{ exposure, sensitivity, adaptive capacity})[45]. In spite of its comparatively low exposure to climate hazards, Cambodia was found to be one of the most vulnerable countries in the Southeast Asia region, due to its low adaptive capacity. The report also ranked 17 of Cambodia's provinces in terms of their vulnerability to climate change (see Figure 8).

Four provinces in Cambodia were ranked among the top 15 most vulnerable areas in the study (which included 530 sub-national areas); Mondolkiri (ranked 4th), Rattanakiri (ranked 6th), Kampong Speu (ranked 11th) and Preah Vihear (ranked 13th).

Figure 8: Vulnerability ranking of provinces in Cambodia[46]



3.3.2 Coping mechanisms

The NAPA Survey[47] canvassed mechanisms employed by Cambodians to cope with drought, flooding and malaria. The results are summarised in Table 6.

The survey report states that while people have a high understanding of climatic hazards and the impacts of the construction of dams, dikes, roads and deforestation, the preparedness and adaptive capacity of villagers to cope with extreme climate events is generally low. Furthermore, according to the report, authorities' efforts so far have focused on post-disaster management, rather than on disaster prevention and adaptation to extreme climate events. The report also reports several failed cases of adaptation, including shifting planting dates, which was unsuccessful due to lack of forecasting of local weather; switching to flood resistant rice varieties, which could not survive periods of drought; construction of wells to pump groundwater to irrigate agricultural fields, which yielded water for one season only and lowered the water table.

Table 6: Adaptation measures identified in Cambodia's NAPA

Event/ hazard	Frequency	Level of preparation	Adaptive measures
Flood		20% of villagers made no preparation 17% planted crops as usual	Building elevated enclosures for livestock, increasing the household's foodstock, increasing feedstock for animals, and preparing boats, planting bamboo along watercourses to reduce erosion and sedimentation[48].
Drought	81% of households experienced water shortages for agricultural use 54% of households experienced water shortages for personal use	24% organise religious ceremonies 16% plant crops as usual 17% reduce water consumption	Reduce water consumption, eg., using a wet cloth for bathing.
Malaria		Low, due to confusion about the causes of malaria. Less than one third of households believed that mosquito nets would be an efficient strategy against malaria.	Destroy mosquito habitats and use mosquito nets.

3.4 POLICIES AND ACTIONS

Up-to-date information about Cambodia's climate change policies/ actions is limited in the public sphere. There appears to be lack of information post-2005. Nevertheless, it is useful to examine the policies, actions and programmes developed from the late 1990s until 2005.

3.4.1 National Communications

Direct climate change policies (i.e. policies that are primarily or solely dedicated to addressing climate change) in Cambodia are limited, which may be associated with the fact that Cambodia, as a developing country, has not been assigned emissions targets under the international climate change policy frameworks. Most of the policies that contribute to climate change mitigation/ adaptation are not directly aimed at climate change; rather mitigation/ adaptation activities are implemented to fulfil other primary goals.

The main activities directly related to climate change concern reporting and some planning. As a signatory to the UNFCCC, and as a non-Annex I country under this convention, Cambodia is required to report its GHG emissions at intervals stipulated by the UNFCCC. Calculation of these emissions inventories, known as National Communications, must follow rules laid out by the UNFCCC. Cambodia's first National Communication was submitted to the UNFCCC in 2002 and is based on data from 1994. The second National Communication is expected to be completed in 2010 and will focus on Cambodia's 2000 emissions.

3.4.2 National Adapatation Programme of Action (NAPA)

According to the UNFCCC, NAPAs provide "a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for which further delay would increase vulnerability and/or costs at a later stage"; and the main content of the NAPAs should comprise "a list of ranked priority adaptation activities and projects, as well as short profiles of each activity or project, designed to facilitate the development of proposals for implementation of the NAPA".

Cambodia's NAPA was completed in 2006. The four objectives identified in Cambodia's NAPA are:

1. *to understand the main characteristics of climate hazards in Cambodia (flood, drought, windstorm, high tide, salt water intrusion and malaria);*
1. *to understand coping mechanisms to climate hazards and climate change at the grassroots level;*
1. *to understand existing programmes and institutional arrangements for addressing climate hazards and climate change;*
1. *to identify and prioritise adaptation activities to climate hazards and climate change.*

Cambodia's NAPA identifies 39 priority adaptation projects in different fields and sectors (see Figures 11 and 12). Projects were prioritised according to their impacts on various criteria, such as death/ casualty, human health, biodiversity, appropriate technology, responsiveness to immediate needs of affected communities, food security and agriculture and sustainability. The timeframes for most of the projects have now expired; updates regarding the success of the projects were not detected in the available literature.

Figure 11: Adaptation projects identified in the NAPA, by sector

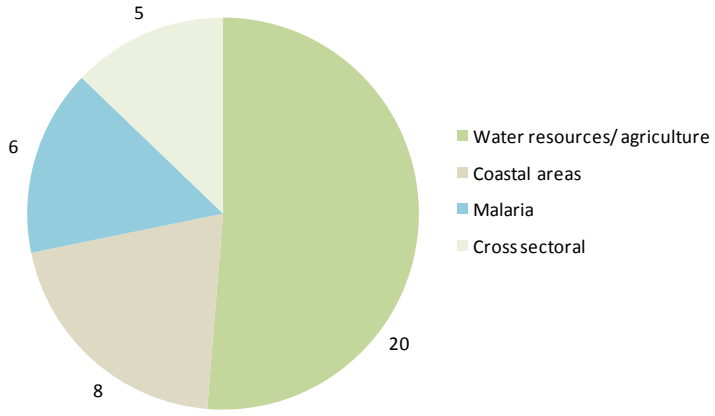
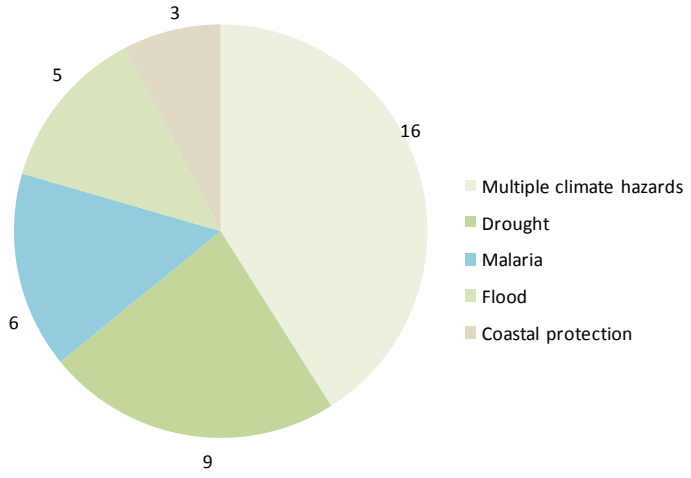


Figure 12: Adaptation projects identified in the NAPA, by climate hazard



The NAPA also states that, with donor assistance, 98 projects (with a total value of US$328 million) were implemented to address climate hazards from 1995-2003, focusing on "institutional strengthening, infrastructure development, and human resource development". The NAPA also detected a tendency for national policies and programmes to focus mainly on post-disaster emergency relief, rather than integrating global policies on mitigation and adaptation.

3.4.3 National Action Plan on Climate Change

A copy of the National Action Plan on Climate Change document, released in 2001, does not appear to be publicly available and minimal reference to the document in a 2005 analysis[49] of Cambodia's climate change policies implies that it is assigned limited credence. It is purported to integrate climate change concerns into other national plans/programmes, develop adaptation responses to climate change impacts, design mitigation measures which are "no regrets" in character, and catalyse the consensus of

relevant stakeholders[50]. Table 7 summarises the information about the Plan that is available in the public sphere.

Table 7: Summary of National Action Plan on Climate Change[51]

Sector	Recommendations
Agriculture	1. promotion of least GHG emission agricultural practices 1. improvement of consumption of non-rice staple foods (crop diversification) 1. expansion of the best available rice planting systems for suitable land areas
Forestry	1. mitigation of GHG emissions through forest and land management planning reform 1. reforestation of damaged areas or tree planting in rural and urban areas 1. strengthening research capacity in the areas of climate change mitigation and adaptation 1. conserving forest carbon through the improvement of protected areas management and forest resource management.
Human health	1. promotion of curative and preventive measures for vector-borne diseases 1. promotion of emergency response systems for sporadic climate change disasters 1. promotion of literacy 1. comprehensive study on vulnerability and adaptation (V&A) to climate change in Cambodia's health sector.

3.4.4 Clean Development Mechanism (CDM)

In recent years, the Cambodian Government has developed an institutional framework to support the evolution of the Clean Development Mechanism (CDM)[52]. In 2003, the Ministry of Environment was appointed Cambodia's Interim Designated National Authority (DNA) [53] and the Cambodian Climate Change Office (CCCO) was established under the Ministry of Environment to serve as the Secretariat of the DNA. In 2006, the National Climate Change Committee was established to serve as a policy-making body responsible for coordinating the development and implementation of climate change policies and measures in Cambodia. The current structure of Cambodia's climate change policy administrative framework is outlined in Appendix 3.

The DNA assesses proposed CDM projects against the sustainable development criteria identified by the Cambodian Government and provides written approval for proposed CDM projects. The sustainable development criteria of the Cambodian Government are embodied in a "sustainable development matrix", which is used to assess the contribution of a potential CDM project in four areas: economic, social, environmental and technology transfer. The approval process for CDM projects in Cambodia is illustrated in Appendix 4. Appendix 5 outlines the laws and regulations that apply to CDM projects that involve the generation of electricity or afforestation/ reforestation.

3.4.5 Miscellaneous and indirect policies/ actions

The 2005 analysis of Cambodia's climate-related policies[54] identifies a number of programs that have been implemented to mitigate the impacts of droughts and floods. According to the analysis, from 2000-2005, at least 10 types of projects were implemented to address floods and typically involved construction of water culverts and the rehabilitation of roads

and bridges that had been damaged by floods. Some roads were also constructed to prevent or reduce flood damage in agricultural areas.

In terms of drought, the analysis states that several programmes from 1999-2003 were implemented, including:

1. improvement of irrigation systems
1. rehabilitation of pumping stations and water pumps
1. water supply and sanitation
1. establishment of Farmer Water User Communities (FWUC).

According to the analysis, the Ministry of Water Resources and Meteorology (MOWRAM) intended to implement 290 irrigation rehabilitation projects from 2001-2005, covering more than 500,000ha of wet season rice and around 150,000ha of dry season rice. By 2003, 315 irrigation projects had been implemented, covering more than 150,000ha of paddy rice (nearly 90,000ha wet season and more than 60,000ha dry season)[55].

Some other policies and measures that are not directly aimed at climate change but assist in mitigating its impacts are outlined in Table 8.

Table 8: Summary of various policies/ legislation indirectly associated with climate change issues

Policy/ legislation/ action	Dates	Climate change aspects
Second Five Year Socio-economic Development Plan (SEDP II)	2001-2005	States that extreme climate events such as flood and drought are two of the main contributors to poverty in Cambodia.
National Poverty Reduction Strategy	2003-2005	Acknowledges the need for: 1. capable human resources and institutional structures within the National Committee for Disaster Management (NCDM) in anticipation of emergency relief, and mitigation of impacts; 1. improved weather and hydrological forecasting; 1. prevention of degradation of watersheds; and 1. a long-term flood management and mitigation strategy. In terms of forestry: • Enforcement of the Cambodian Forestry Law, including protected forests demarcation, elimination of illegal logging and enlargement of natural forest conservation areas for eco-tourism.
Formation of Ministry of Water Resources and Meteorology (MOWRAM)	1999	Five programmes: 1. Management of water resources information 1. Water resources management and development 1. Flood and drought management 1. Water legislation and sustainability 1. Human resources development. Actions: • Development of a flood management and mitigation strategy based on an assessment of the communities and assets at risk and on estimates of cost of flood damage.

Policy/ legislation/ action	Dates	Climate change aspects
		• Assess the likely future impacts of climate variability, particularly drought.[56]

3.4.6 Cambodia's place in the international climate change policy framework

As a developing country, Cambodia is classified as a non-Annex I[57] country under the UNFCCC and is therefore not subject to emissions reduction targets under the Kyoto Protocol. Cambodia is, however, eligible to host emissions reduction projects under the CDM (see section 3.4.4). In addition, as a signatory to the UNFCCC, Cambodia is required to periodically report its national GHG emissions to the Convention (known as "National Communications" – see section 3.4.1); and as an LDC, Cambodia was also obliged to develop a National Adaptation Programme of Action (NAPA), submitted in 2006 (see section 3.4.2).

Cambodia's status as an LDC also entails eligibility for funding under the UNFCCC's "financial mechanism", the Global Environment Facility (GEF). The GEF manages two funds under the UNFCCC — the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). Cambodia benefited from these funds in the development of its national communications and its NAPA.

Cambodia has not been particularly prominent in negotiations regarding a post-Kyoto Protocol international framework to address climate change. Negotiations have largely been overshadowed by an apparent impasse between developed nations such as the US and rapidly industrialising nations such as India and China, regarding an equitable mechanism for incorporating emissions from industrialising nations into a framework to reduce emissions, without compromising economic development.

4. FIELD RESEARCH[58]

4.1 SUMMARY

People broadly agreed that changes in climate/ weather patterns have occurred and the impacts of these changes on the agricultural sector dominated discussions. This reflects the agricultural basis of Cambodia's economy, the agricultural sector's fundamental reliance on weather patterns and the dominance of farmers among the studied population.

Generally, people only identified changes and impacts that have occurred in the last 10-15 years (and most commonly during the last 2-3 years) and sometimes timeframes were unclear or unspecified.

There were some discrepancies between the findings of the different research methods; the KI and FGD returned similar results, but the results of the field questionnaire diverged on the topics of malaria incidence and changes in living standards.

It is important to consider the qualitative nature of the study when examining the findings; the study reports the thoughts that were communicated during the field research, but there is no quantitative information about exactly how many people agreed with certain statements. Rather, the findings present an overall representation of thoughts and ideas that were raised during the research.

4.2 PERCEIVED CHANGES IN CLIMATE/ WEATHER PATTERNS

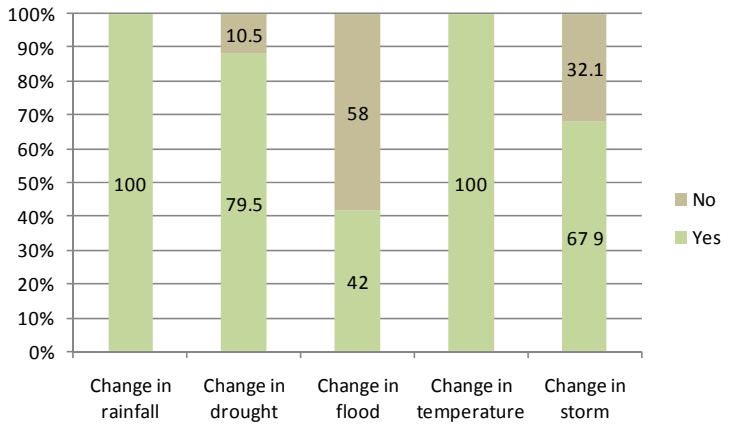
The field research uncovered a general consensus that changes in climate have been occurring. The majority of people involved in the research noticed changes in rainfall, drought, temperature and storm patterns. Flooding was the only event that was not consistently identified as altering over time. The findings are summarised in Table 9 and Figure 12.

Table 9: Summary of perceived changes in climate/ weather patterns (based on FGDs and KIs[59])

Change	Keywords	Prevalence in discussion	Perceived severity[60]
Rainfall	Irregularity/ changed patterns		
	Decrease		
Flooding	Frequency and severity		
Temperature	Increase		
Drought	Frequency and duration		
Wind	Irregularity and strength		
Storms	Strength		
	Increased frequency		

High
Medium
Lower
Lowest

Figure 12: Perception of changes in climate/ weather patterns in percentage of respondents (findings of field questionnaire)



4.2.1 Rainfall & flooding

Every respondent noted that rainfall patterns had changed, with irregularity and decrease in rainfall the most frequently cited changes. Many people reported that rainfall generally occurs earlier in the season now.

Changes in rainfall patterns and/ or quantity generally attracted the most discussion and were frequently identified as impacting most severely on people's lives.

In all provinces except Prey Veng, flooding was generally considered a less severe event than drought and changing rainfall patterns. Prey Veng was the only province in the field research where flooding was considered among the most severe impacts on lives and communities, particularly from 2000 to 2003. For example, during the 2000 floods:

- Mr. Khiev Sambath[61] said that 80% of rice cultivation areas were destroyed in Prey Veng.
- Mr. Neang Sarin[62] reported that 30 cows were killed and food shortages and disease increased in the community.

People in Prey Veng also reported that family members had been forced to move away to find alternative labour as a result of the 2000 floods and the introduction of several coping mechanisms was attributed to these floods.

4.2.2 Drought

Drought was consistently identified as a climate/ weather-related change and many people said it caused the most severe impacts on lives and communities, and drought was often the cause of financial difficulties, due to diminished crop yield and increased expenditure. For example, Mr. Neang Sarin[63] of Prey Veng, said that drought in 2009 has decreased rice yields and forced him to buy 60 litres of diesel to pump water to 1ha of rice paddy.

Frequent and persistent drought conditions were widely reported. It appears that Kampong Speu is particularly affected by drought; some FGD participants reported that drought conditions started in 1993 and became particularly severe in 1996-1998 and 2008. One participant in the FGDs reported damage to 90% of their crop during the 2002-2003 drought and Chea Ratha, Head of the District Agricultural office in Korng Pisey

Kampong Speu, identified drought in 2008-2009 as impacting most severely on his community, compared to other climate change impacts discussed.

Mitigation of drought impacts and water shortages was the primary aim of a large proportion of coping mechanisms reported.

Case study 1: Drought

Mr Om Venn, of Kork Dangkor village in Kampong Seu, said he has been dealing with the impacts of frequent and prolonged drought since around 2003. In the past three years, the situation has become particularly challenging, Mr Om said, noting that all farmers have been encountering drought "late in the season".

While Mr Om acknowledges that the area has never been exceptionally productive, in the last five years, he said that drought has caused failure during seedling transplantation, increased pest populations, depleted soil quality and decreased rice yield – from around 1020kg/ 0.5ha before 2003, to 75kg/ 0.5ha in 2004-2005.

Mr Om has been forced to more than double the quantity of chemical fertiliser used in order to deal with the depleted soil quality. Furthermore, he had to borrow money from other villagers to buy rice (for consumption). To manage the increase in insects, Mr Om uses lamp lighting to lead the insects away from the crops.

In 2005, Mr Om started planting corn in the front garden of his house in order to manage the lack of food and to generate some more income. He also started cutting firewood in the mountains in 2005 to supplement the family's income.

To manage water shortages, Mr Om started pumping water from a pond to his rice field in 2005; however, there is insufficient water to provide all his fields, so only those close to the pond are irrigated.

Mr Om noted some future plans to increase the water available for agriculture. In 2010-2011, he said that there are plans to rehabilitate a dam, which will require the assistance of all the villagers. He said that rehabilitation of dams in other places has been successful because it allowed farmers to plant rice twice per year.

Mr Om acknowledged that the main barriers to rehabilitating water storage infrastructure in the community include reliance on the cooperation of all villages and the cost involved.

4.2.3 Temperature

There was a general consensus that temperatures have increased over time, although during the KI interviews there was one report of stable temperatures and one report of decreasing temperatures. One participant in Battambang reported temperatures of up to 45°C; and a representative[64] of the Provincial Department of Water Resources, Hydrology an Weather Forecasting in Prey Veng reported that temperatures have increased by around 2°C (timeframe was not stipulated).

Mostly, increased temperatures were not regarded as severely impacting lives or communities, but causing discomfort and difficult working conditions. People in Kampong Speu reported particular difficulty in coping with the discomfort caused by temperature increases.

Rapid changes in temperature in short periods of time were also reported among the focus groups and associated with stomach diseases and fever.

4.2.4 Storms & wind

Changes in storm activity and wind patterns were frequently reported but generally did not generate significant discussion.

Storms were widely regarded as increasing in strength and frequency and some isolated incidents involving particularly severe damage to houses and crops were discussed in more detail (for example, a storm in Kampong Trabek district, Prey Veng, damaged 17 houses this year). Concern about increase in thunder/lightning and the associated danger was also raised occasionally.

Changes in wind patterns were discussed more frequently than storm activity. Increased wind strength was widely reported and isolated incidents of damage to houses and crops generated discussion. Changes in wind directions and their impact on rainfall were mentioned by some FGD participants, who deduced that the changes have contributed to decreased rainfall.

4.2.5 Causes

Deforestation was by far the most frequently noted cause of the identified changes in climate/ weather patterns, at the community level and individual/ household level (see Figures 14 and 15). In particular, deforestation was associated with reduced rainfall and the role of forests in mitigating the impact of strong winds was frequently noted. One FGD in Prey Veng specifically mentioned deforestation caused by land clearing for farming purposes, which occurred from 1986-2007. In Kampong Speu, people noted significant forest losses (again for farming purposes) in 1979-1980

Following deforestation, industrial air pollution was the most commonly identified cause of the discussed climate/ weather pattern changes.

Two people suggested greenhouse gas emissions/ greenhouse effect specifically as a contributor to the changes in weather patterns; Mr. Khiev Sambath, Vice-chief of the Provincial Department of Agriculture, Forestry and Fishery in Prey Veng and Mr Lor Bunnath, LWF Project Manager, Mean Nork Village, Kampong Chhnang. These participants also identified ozone depletion as a cause.

The identification of "the greenhouse effect" as a broad phenomenon may reflect the results of awareness-raising activities by government and/ or non-government institutions and indeed, Mr. Phea Ea, from the Provincial Department of Water Resources, Hydrology and Weather Forecast in Prey Veng, said he learned about the climatic impacts of industrial pollution from a "workshop".

Very few people suggested that the observed changes in climate/ weather patterns may be part of natural cycles.

Figure 14: Perceived causes of changes in rainfall (field questionnaire)

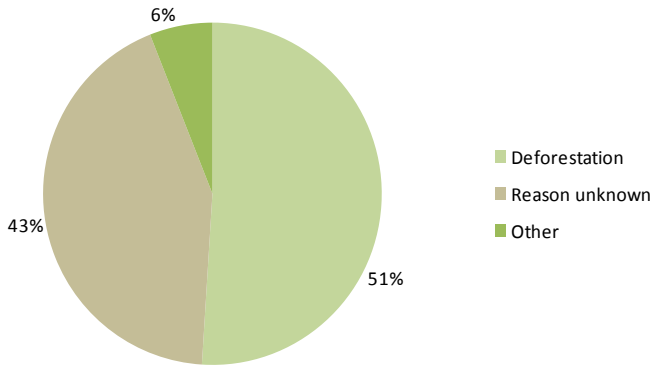
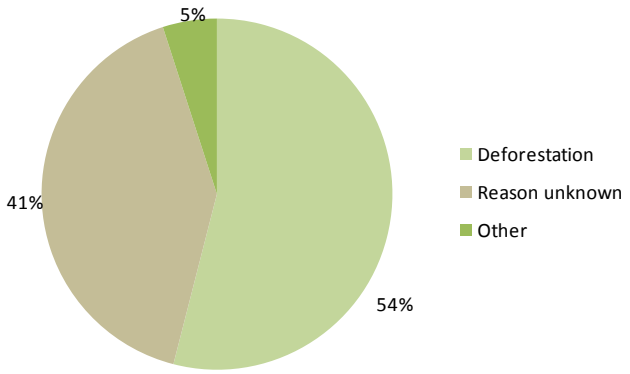


Figure 15: Perceived causes of changes in drought frequency (field questionnaire)



4.3 PERCEIVED IMPACTS OF CHANGES IN CLIMATE/ WEATHER PATTERNS

Impacts affecting the agricultural sector generated significant discussion and were typically cited as impacting more severely on communities than other impacts. People expressed greatest concern about impacts associated with irregular rainfall and water shortages for agricultural purposes (see Table 10).

Table 10: Summary of perceived impacts of changes in climate/ weather patterns (field research)

Change	Keywords	Prevalence in discussion	Perceived severity[65]
Agriculture	Decreased yield	Medium	Medium / High
	Depleted soil quality	Medium	Medium
	Increased pests	Medium	Lower
	Decreased fish stocks	Lower	Lowest
Disease	Increased incidence	Lower / Medium	Lower
Wildlife	Loss	Lower	Lower
Labour & living standards	Migration/ alternative employment	Lower	Medium
	Decreased living standards	Lower	Lower
Water	Shortage (agricultural purposes)	High	High
	Lack/ deterioration of infrastructure	Medium	Medium
Food	Shortage	Lowest	Lower

High, Medium, Lower, Lowest

4.3.1 Agriculture

Decreased crop yields and water shortages for agricultural purposes were identified most commonly and discussed most widely. These effects were also typically regarded as impacting most severely on lives and communities. Most of the reported impacts on agriculture were intertwined and influenced by alteration of practices in response to various impacts; for example, in Prey Veng, deteriorating soil quality was typically associated with a cycle involving decreased crop yields, increased fertiliser use, and further decline in soil quality.

4.3.1a Yield

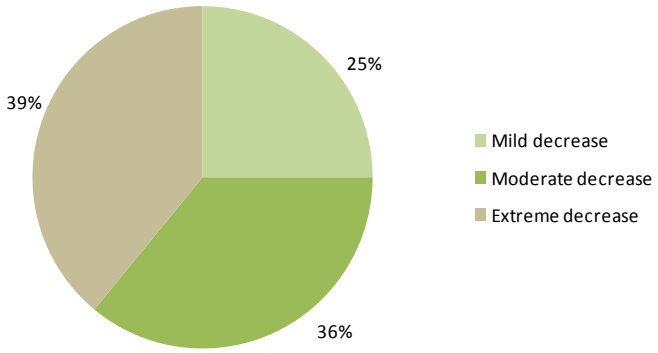
Decline in yield was noted generally in the past five years and broadly attributed to water shortages from drought conditions and irregular rainfall (especially early rainfall). For example:

- In Kampong Speu, one focus group reported that rice yields decreased to 30% due to drought in 2002-2003 and Pol Sam At[66] reported that rice production has decreased due to irregular rainfall (and drought) over the past 4-5 years.
- Production decreases of 20-30% in 2007-2008 were reported in Kampong Chhnang, and people expected even greater losses in 2009, due to water shortages.
- In Battambang, there were reports that water shortages impeding rice and vegetable production had severely impacted people's lives since 2005.
- There were reports in Kampong Chhnang that rice production decreased sharply in 2006 because of drought.

Increased incidence of pests and poor soil quality were other issues identified as causing yield decreases.

The field questionnaire found that 57% of people had experienced decreases in crop yields in recent years, due to drought, irregular rainfall, depleted soil quality and excessive use of chemical fertilisers. The perceived severity of the yield decrease varied (see Figure 16).

Figure 16: Degree of crop yield affected (in percentage of respondents)



Impacts on the quality of rice produced were reported by two focus groups in Prey Veng. Mr Khiev Sambath of the Provincial Department of Agriculture, Forestry and Fishery said that the quality of dry season rice was diminished this year due to early rainfall, adding

that the rainfall also impeded harvesting and transportation of the rice. Notably, Mr Khiev also reported that the early rainfall allows planting twice per year (instead of once) for wet season rice farmers, so their total yearly production has increased.

4.3.1b Soil quality

Declining soil quality, in terms of lack of fertility and "hardening", was a problem frequently identified and mainly attributed to water shortages from decreased rainfall/ drought.

In Kampong Chhnang, people reported that soil quality has changed considerably since 2006, adding that farmers are forced to use chemical fertilisers and around 98% of rice fields are subject to chemical fertiliser application. Furthermore, they said that the soil has become hard, resulting in crop production decreases of 40-50%. Kampong Chhnang FGDs reported that declining soil quality severely impacts on their lives. The role of forests in maintaining soil quality was noted by people in Kampong Chhnang as well and in the field questionnaire, respondents frequently identified deforestation as a major cause of depleted soil quality.

The need to increase use of chemical fertilisers was noted by people in Prey Veng and Battambang, yet overuse of chemical fertilisers (and pesticides) was commonly blamed for reduced soil quality.

4.3.1c Pests

There was general agreement that problems associated with pests (especially insects and worms) have intensified, but it was rarely associated with a particular aspect of climate/ weather-related change; rather it was mostly perceived as an impact of alterations to agricultural practices in response to the climate/ weather-related changes. Typically, increased use of fertilisers and pesticides was identified as the main cause of increased pests.

Aer Phiseth, Head of the Provincial Water Resource Department in Kampong Speu said that increased insects have prevented cultivation of dry season rice, despite availability of irrigation systems. Mr. Neang Sarin, Chief of Water Use Community in Thmey village, Prey Veng province, reported that this year 50-70% of rice production during the dry season was destroyed by insects, which in turn forced farmers to increase the use of chemical fertilizers and pesticides. Problems with pests were generally perceived to have intensified in the last 2-4 years.

4.3.1d Fish stocks

At the community level, fish stocks generated relatively little discussion, perhaps because the interviewees did not perceive the industry as being affected by climate/ weather changes. Indeed, non-climate related issues were implicated as the main causes of fish stock declines among the FGDs; however, the issue still generated a moderate amount of discussion in the groups.

The FGDs generally noted a pattern of decline in fish stocks, especially in the last four years. Illegal fishing was typically identified as the primary cause, and other events that are not directly related to climate/ weather changes, such as destruction of flooded forests and fertiliser runoff, were also suggested. In Battambang, the filling-in of Anhchanh Lake (since 2005) was identified as a cause of fish stock declines.

In terms of climate/ weather pattern changes, lack of rainfall and drought were identified as potential causes of fish stock decline; however, it was not regarded as a major contributor to the problem. In Kampong Speu, some people said that in 2007, fish stocks in fact increased in a nearby dam.

4.3.2 Disease

Changes in disease incidence generated a significant amount of discussion, but in general it was not perceived as severely impacting on individuals/ households or communities – only one FGD in Kampong Speu said increased incidence of disease (human and animal) had featured among the most severe impacts.

In general, people agreed that incidence of disease among humans and animals had increased. For humans, diseases such as flu, fever, coughs, stomach aches and intestinal illnesses, respiratory ailments, dengue fever and malaria were primarily discussed. For animals, specific diseases were rarely identified, apart from foot and mouth disease in cattle.

The increases in disease were widely attributed to increased temperatures, rapid changes in temperature, water shortages, chemicals in food and poor sanitation. In Kampong Speu, it was suggested that diseases may be increasing because drought is forcing people to work in the forests instead of farming. Similar ideas emerged in Kampong Chhnang, were participants estimated an 80% increase in malaria cases for people who spent time in the mountains; increased cases of malaria in people who did not enter mountain areas were also noted.

Incidence of malaria and dengue fever generated mixed reports. While there was considerable discussion regarding a perceived increase in the overall number of cases, there were also arguments that cases have declined, and suggestions that awareness-raising about prevention, were responsible for the decline. The field questionnaire found that 68% of respondents believed malaria cases have been decreasing due to increased used of mosquito nets and clearing of nearby forests; but 67% believed dengue fever incidence had increased due to higher mosquito populations.

Notably, people in Prey Veng and Kampong Speu reported increased difficulty in treating diseases. In Prey Veng, there were reports that the supply of traditional medicines has declined and they had encountered problems in curing animal diseases over the past 4-5 years. In Kampong Speu, there were reports that in the past, “Gnom” disease (which affects plants) was cured naturally through applying ash in rice paddies, for example; however, they are now forced to use pesticides to treat the disease.

Case study 2: Malaria

Ms. Kim Heach, of Spean Dek village in Kampong Chhnang, said that malaria incidence has considerably increased in the past five years. In her family specifically, her husband had malaria three times and her son had malaria once during the past 10 years – with the most recent outbreak occurring in 2006. She said that they both contracted the disease in the forest; while her husband collected wood for charcoal and while her son played in the forest.

Initially, they relied on traditional Khmer medicine to treat malaria, but admitted that traditional medicine is not as effective as conventional treatment received at hospitals.

The incidence of malaria in Ms Kim's family has placed considerable financial pressure on the family. For each outbreak of malaria, they had to spend around US$125 on medicine, doctor services, transportation and food. At different times they have been forced to sell a cow and borrow money from Vision Fund in order to pay for the treatment.

Ms Kim also noted that significant time is spent by both patient and carer during the recovery period; for each outbreak, around three months rest is required for the patient.

During outbreaks of the disease, the family lost considerable income, not only through spending money on treatment, but through lost time and labor. Two sons went to work in Thailand in 2007 due to the family's low income and low rice production.

Ms Kim said that in the past, there was a lot of confusion about the cause of malaria and people were therefore unable to effectively prevent and treat the disease. Since media campaigns were intensified in the past 10 years, Ms Kim said that they are now aware of the benefits of putting 'Abet' (a mosquito pesticide) in water jars and using mosquito nets when sleeping.

4.3.3 Wildlife

Loss of wildlife was not discussed in great length compared to other impacts. General losses of wildlife were acknowledged and associated with deforestation. In Kampong Speu, significant loss of forest from 1979-1980 was noted (especially Tbeng tree, Khlong tree, Trach tree, So Kram tree, Kokoh tree, Thnong trees, Kralanh tree) and attributed to land clearing for farming purposes. It was reported that the forest clearing has resulted in the loss of ancient medicines and herbs. Residents of Kampong Speu also noted that the availability of wild vegetables, bamboo shoots, and mushrooms has decreased due to lack of rainfall and increasing human population; and the population of various animals and birds has declined over the years, due to lack of water and illegal hunting.

Similar views were relayed during discussions in Prey Veng and Kampong Chhnang; decrease in the populations of certain animal and plant species over an 8-10 year time period, mostly due to hunting and deforestation for farmland expansion.

4.3.4 Lifestyle, labour & living standards

There was broad consensus that labour patterns and living standards are being affected by changes in climate and the associated impacts, although there was limited discussion about the topic at the community level (KIs).

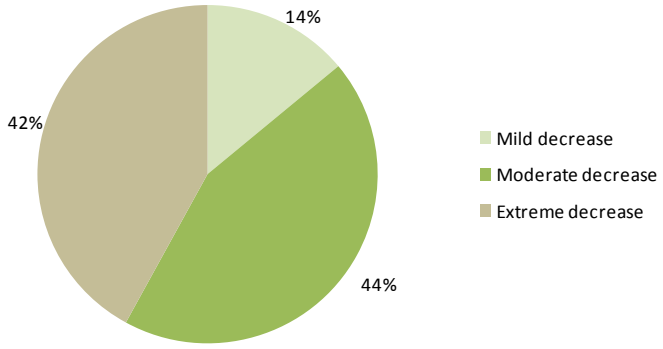
At the individual/ household level, people emphasised an emerging trend for people to abandon farming for other more profitable jobs, mostly due to the severe impact of drought and water shortages on crop yields. Often, these changes in employment require relocation to another area. Even if farmers do not completely cease farming activities, it was reportedly common for them to diversify their income sources with alternative work, such as timber cutting, factory and construction work, usually outside the village. People in one village in Kampong Speu said that 70% of people in the area had moved out of the villages to work in factories or construction.

There were also reports that people were selling their land in order to generate some income. In Prey Veng, the case of "Ms. Saly" was cited; her family sold their land and left the village to find alternative labour, which impacted negatively on the happiness of her family.

While migration to find alternative labour was generally successful in generating more income, there were some negative implications. For example, in Prey Veng, one of the focus groups noted that four or five families in the area had stopped rice farming due to lack of labour availability; and in Kampong Speu, it was reported that disease in the area increased when people started to find labour in forest industries instead of the agricultural sector.

In Prey Veng, it was reported that the standard of living for most people in the area had declined in 2008-2009, due to difficulty in growing crops. Some people in Kampong Chhnang said that living standards started to decline in 2005, due to increased expenditure and decreases in household income, which started in 2001. 87% of people who responded to the field questionnaire reported decreases in household income of various degrees (see Figure 17).

Figure 17: Degree of income affected (in percentage of respondents)



In terms of living standards, however, more than half of respondents to the field questionnaire said they had experienced improvements in recent years due to a range of factors, such as purchase of a plowing machine, support from NGOs, and obtaining high yields from dry season rice. For the 40% of respondents who reported declines in living standards, the contributing factors identified were drought, small farm land area and insufficient labour for farming.

4.3.5 Food and water shortages

Water shortages were widely reported and associated with drought and irregular rainfall patterns. There were several accounts of canals, wells and reservoirs drying up and people being forced to travel longer distances and dig deeper wells to access water.

In Prey Veng, people reported that they must dig wells up to 45 metres in depth to access water, compared to 8-9 metres in the past. In Kampong Chhnang, one focus group said they are forced to dig 20-25 metres, compared to 4-5 metres in the past; and another group reported that 2-3 metre depths were sufficient in the past, but now they must reach depths of 7-8 metres. People in Kampong Speu reported walking 300 metres-4 kilometres to access water in times of drought. In Battambang, there were reports of conflict among villagers over access to water.

Most of the discussion about water shortages referred to insufficient water for agricultural activities. In Prey Veng, it was reported that only farmers with a water pump are able to plant rice and in Kampong Speu, there were accounts of farmers hiring water pumps to water rice fields, at a cost of 7,000-10,000 riel/ hectare.

Thirty families in Battambang were reportedly experiencing food security problems due to drought at the time the research was conducted, and food shortages (especially in 2007) were reported as most severely impacting communities in Kampong Chhnang[67].

4.4 COPING MECHANISMS IMPLEMENTED AND THEIR EFFECTIVENESS

The majority of coping mechanisms implemented, planned and recommended relate to mitigating impacts on the agricultural sector. There is clear emphasis on rehabilitation and/or expansion of infrastructure to provide water for agriculture, as well as altering farming practices. The main findings are outlined in Table 11.

Sweeping dismissals of some coping mechanisms were made based on the absence of certain prerequisite conditions and the occurrence of events that prevent success. In addition, while some mechanisms were considered successful, it was also noted that they may involve negative impacts as well:

- It was reported that migration for alternative employment is only successful if there are no other underlying problems in the family (such as health problems); and lack of alternative jobs is impeding the success of migration. It was also noted that loss of labour through migration out of communities has created labour shortages in the agricultural sector.
- Agricultural mechanisms were often only assigned a chance of success if sufficient financial and water resources were secured. Irregular rainfall, "natural disaster", drought and lack of water were reported to preclude success from any agricultural coping mechanisms in some areas. Furthermore, while measures such as farming in the dry season, delaying sowing time and fertiliser application were reported to be effective in some cases, there were also incidents of insufficient funds, drought and water shortage preventing success from these measures.

Table 11: Summary of coping mechanisms and their success (field research)

Category	Mechanism	Prevalence in discussion[68]	Reported success[69]
Agriculture	Rehabilitation/ expansion of irrigation systems		
	Establish community-based water management systems		
	Construction of dams, ponds, canals, wells.		
	Use water pumping machines		
	Increase the number of planting times		
	Change crop varieties		
	Multi-cropping		
	Increase/ decrease chemical use		
	Use natural fertiliser		
	Change planting/ transplanting/ sowing/ harvesting times		
	Change crop types		

Category	Mechanism	Prevalence in discussion[68]	Reported success[69]
	Training in alternative techniques		
	Change from organic to intensive agriculture		
Lifestyle & Labour	Change working times		
	Migration		
	Behavioural changes (adapt clothing, spend time indoors etc.)		
	Store provisions (food, water, firewood, animal feed)		
	Harvest water		
Education & awareness	Awareness about problems associated with climate/ weather changes		
Communication & collaboration	Consultation with authorities		
	Share money & labour among community to build infrastructure (roads, ponds, wells and irrigation systems)		
	Village meetings		
Forestry	Reforestation		
	Protection of remaining forests		

Prevalence in discussion

- Highest prevalence
- Moderate prevalence
- Lower prevalence

Perceived success

- Success reported
- Moderate success reported
- Slight success reported
- Failure reported

5. DISCUSSION

5.1 SUMMARY

The purpose of this discussion is to compare Cambodians' perceptions of climate change with the prevailing literature and to relate climate change policies (both international and domestic) to these perceptions and to Cambodia's place in the international policy context. Changes and impacts concerning floods, drought and the agricultural sector are focused upon because they generated the most discussion during the field research.

There were both discrepancies and alignments evident in the comparison of the literature review and the field research. One notable discrepancy identified was a potential disconnect between the perceived relative importance of drought and flood. The literature suggested that flood posed a greater threat to Cambodians than drought. The findings of the field research, however, reveal less concern about the impacts of flooding and more preoccupation with the current problems caused by drought and water shortages. This disconnect was translated in the coping mechanisms identified in the field research and the projects included in the NAPA.

The discrepancy could be a reflection of the fact that only four provinces were included in this study or it could result from differences in timeframes; further clarification can only be achieved through further study.

5.2 COMPARING THE FINDINGS

Comparison of the changes/ impacts identified in the literature with those reported during the field research faces several limitations:

- The nature of the field research questionnaires/ interviews meant that words such as "frequency" or "intensity" that would lead responses were avoided, since the aim was to allow people to structure their own thoughts. This sometimes impedes comparison of field research with more structured data from the literature.
- Alignment of timeframes; many people reported changes/ impacts in the last year or two, but the majority of available literature focuses on earlier timeframes.
- The available literature concerning climate/ weather pattern changes in Cambodia so far focused mainly on rainfall, flooding, drought, agriculture and vector-borne diseases, so only these changes and impacts can be related to the field research.
- Changes in general climate/ weather patterns (eg. rainfall levels, onset of wet and dry seasons) were difficult to compare because no comprehensive compilation of this data was detected in the literature review; this is unfortunate because changes in patterns were widely reported by participants in the field research.

In addition, it is important to keep in mind the non-climate related events that have been identified in the literature as affecting various sectors; for example, the impacts of the global financial crisis on the agriculture sector and the benefits of improved medicines in treating malaria. These events were generally not identified by participants in the field research, which could be due to lack of awareness or the nature of the survey, which directed the discussion more towards climate/ weather-related issues.

It is also important to consider the findings in the context of their limitations; perhaps most importantly, the limited geographic scope. The study focussed on only four provinces, so the overriding trends identified in the literature may not be applicable to these provinces specifically and may explain some discrepancies between the literature and field research.

5.2.1 Changes in climate/ weather patterns

5.2.1a Floods and drought

Information about severe floods in the literature review rarely identified specific provinces that were worst affected, so it is difficult to compare the information with reports from the field. Generally, however, the literature review placed more emphasis on the frequency/ intensity of flooding than the field research. The exception is Prey Veng province, where field research participants considered flooding among the more severe impacts on their lives/ communities.

Highlights from the literature review include:

- Several sources indicated that since 1999, severe flooding has increased in frequency[70]
- The 2005 NAPA survey identified flood as the "main" climate hazard in Cambodia.
- Several government reports state that flooding accounted for more than 70% of rice losses during 1996-2000 and drought only accounted for around 20% of losses during the period.
- Increased flood frequency/ intensity was identified in the NAPA as posing one of the greatest climate-related threats in Cambodia (drought was not identified).
- Forecasts indicate increased rainfall in Cambodia, as a result of climate change.
- While the NAPA includes more drought-related projects than flood-related, measures relating to the four provinces studied reveal a higher concentration of flood projects.

In terms of the field research, however, less than half of the field questionnaire respondents reported that the frequency of flood has changed and 21% reported that there is less flooding now, compared to previous years. Furthermore, there was generally limited concern about flooding and even reports of decreased flooding incidence/ severity in the field research in all provinces except Prey Veng. For example:

- In Kampong Speu, there were reports that, apart from the 2000 floods, flood levels are lower than in previous years.
- Aer Phiseth, Head of Provincial Water Resource Department in Kampong Speu, said that floods were not so frequent or severe.
- There were reports in two villages in Battambang that flooding no longer occurs due to the construction of a dam.
- There were reports that flooding is not a significant problem in Kampong Chhnang.

There were also reports that lack of floodwaters was causing problems, as opposed to more frequent or intense floods (see Case Study 3, for example).

Case study 3: Flooding patterns

Mr Sok Heng, of Uddong in Prey Veng, has noted that flood patterns have changed in the past 5-10 years, causing problems with his crop production. Mr Sok implied that flooding is important for rice production in his area and changes in flooding patterns are causing problems.

Mr Sok recalls an extreme flood in 2000-2002, which destroyed mango trees, bananas and other vegetables (but not rice, because it is usual for rice to flood in the area). But generally, Mr Sok observes that less frequent and intense floods are causing the greatest difficulty.

In 2006, Mr Sok said that the absence of flooding meant that the usual deposition of fertile mud did not occur, leading to increased diseases in crops and decreased yield. Compared to pre-2005 production, rice yields decreased from 2 tonnes to 1 tonne, beans dropped from 0.5 tonnes to 0.3 tonnes, corn production decreased by 1 tonne (down to 5 tonnes) and sesame decreased by 0.4 tonnes (down to 0.2 tonnes).

Mr Sok also noted that the absence of flooding and the associated natural increases in fertility of the soil forced him to increase the use of chemical fertilisers since 2006. This has involved considerable increases in expenditure compared to pre-2005, the impacts of which have been exacerbated by a general increase in the price of goods. Before 2005, Mr Sok only spent 1 million riel (US$244) on farm-related expenses, including seed, chemical fertiliser, fuel oil and labour; in 2006, the expenditure increased to 3 million riel (US$732).

In 2006, Mr Sok was forced to borrow US$5,000, due to financial difficulties caused by decreased crop production, which he largely attributed to lack of flooding and associated problems. In addition, four children in the family left school in order to find jobs to supplement the family's income and five family members migrated to work in garment factories in Phnom Penh.

The main mechanisms that Mr Sok has implemented to cope with these problems are the use of chemical fertilisers and pesticides and switching crops. Mr Sok said that use of chemicals was not successful due to the expenses involved and because he did not know how to use them appropriately and they made the soil hard.

Lack of capital and water were identified by Mr Sok as major impediments to successfully adapting to the changes in flooding patterns.

There were also notable differences between reports about the frequency of floods in all provinces except Prey Veng (see Table 12). Discrepancies may be explained by the literature's general association of severe floods with heavy rainfall in the Mekong Basin. Prey Veng is situated around the Mekong River and reports of flood from this province generally correspond with the reports identified in the literature review; however, the other provinces studied are either situated on the Tonle Sap river/ lake or devoid of major watercourses and flood pattern reports from these three provinces differ from the literature.

Discrepancies between the literature and field reports may also be attributable to the fact that the study only focused on four provinces. Further study is required to determine the true cause.

Table 12: Comparison of perceived frequency of floods (literature review and field research)

	Year																
	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09
Literature review																	
Field: P. Veng																	
Field: K. Speu																	
Field: B'bang																	
Field: K. Chhnang																	

In terms of drought, the field research generally corresponded with the literature review in terms of perceived increase in frequency of drought.

According to the literature review, Battambang, Prey Veng and Kampong Speu were among the provinces that have been worst affected by drought in the past 15 years (see Table 13) and Table 14 compares the reported timing of droughts in the literature review and field research. Two main discrepancies are evident:

- The literature review does not identify Kampong Chhnang as a severely-affected province during the droughts, yet there were some reports in the field research of more frequent and persistent drought conditions in the province since 2004 and crop destruction due to drought during 2002-2003 – years that were identified as severe drought years in the literature review.
- Drought in Kampong Speu was generally under-reported in the literature, compared to the findings of the field research

Further study would be required to determine whether these discrepancies reflect unreliability in people's recollections of timeframes, gaps in government reporting systems or other causes.

Table 13: Regional distribution and impacts of drought (literature review)[71]

Drought year	Worst affected provinces	Impact
1994	**Prey Veng, Battambang, Kampong Speu**, Svay Rieng, Kampong Thom, Kandal, Takeo.	Loss of nearly 70% of Cambodia's total rice harvest
2002-2004	**Prey Veng, Kampong Speu,** Takeo, Kandal, Oddar Meanchey.	At least 62,702ha of rice affected.
2009	**Prey Veng, Battambang,** Pursat, Kandal, Takeo, Kampong Thom.	Battambang – 13,706ha rice affected; Prey Veng, 8,527ha of rice affected.

Table 14: Comparison of perceived frequency of droughts (literature review and field research)

	Year																
	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09
Literature review																	
Field: P. Veng																	
Field: K. Speu																	
Field: B'bang																	
Field: K. Chhnang																	

5.2.2 Agriculture

The potential discrepancy between perceived importance of drought and floods was also evident in the findings in the agricultural sector. The views expressed in the field research generally demonstrated less concern about the impacts of flooding on agriculture, attributing most of the problems in the sector to drought, irregular rainfall and water shortages.

The effects of drought on the agricultural sector were cited as the most severe impacts on communities by at least one KI in every province. For example:

- Mr Khiev Sambath[72], of Prey Veng, said that drought impacted most severely on his community, stating that irrigation systems are able to supply water to just 25% of the province's cultivated area.
- In Battambang, KIs said that drought most severely impacts communities due to its affects on rice production, citing 2004 as a particularly difficult year.

Data from MAFF[73] supports the views of the field research participants in Battambang, Kampong Speu and Kampong Chhnang. The data states that in these provinces, more rice area was affected by drought than flooding during the 1990s (see Table 15), although floods were generally more frequent than droughts. The data also indicates, however, that floods affected larger areas of rice fields (compared to drought) in several other provinces (see Appendix 2).

Table 15: Frequency of floods and droughts and total rice area affected during (from 1991/92 to 2000)

Province	Years of flood over a decade	Average rice area affected (ha)	Years of drought over 9 years	Average rice area affected (ha)
Prey Veng	10	42,270	9	23,275
Kampong Speu	9	6,485	8	6,899
Battambang	10	22,304	9	45,917
Kampong Chhnang	9	4,860	9	6,622

Water shortages and insufficient rainfall were also regarded by some field research participants as impacting more severely on crop production than flooding (and other

events). For example, Mr Ung Vong Dorn[74], of Kampong Chhnang said that insufficient rainfall for agricultural activities had impacted more severely on his community than other climate-related events.

There was only one mention of flooding impacting crop production; Mr Khiev Sambath[75] of Prey Veng said that the particularly severe 2000 floods destroyed 80% of rice cultivation areas in the province. Representatives[76] of government bodies in Kampong Speu said that floods are not as frequent as droughts and impact less on the community.

These discrepancies could reflect the fact that the study only focussed on four provinces; further research would be required to determine the true cause.

5.3 COPING MECHANISMS &THEIR EFFECTIVENESS

While the field research indicates that a range of coping mechanisms are being practised, their nature and reported success rate would suggest that Cambodia is generally ill-equipped to cope with the predicted changes in climate/ weather patterns. Table 16 summarises the coping mechanisms identified during the field research according to the categories of future impacts/ changes identified in the literature review.

Table 16: Summary of coping mechanisms identified during field research, according to categories of changes/ impacts identified in literature review

Impact/ change	Mechanism	Success
Increased temperatures	Change working times	
	Behavioural changes (adapt clothing, spend time indoors etc.)	
Increased rainfall/ frequency and intensity of flooding & Increased variability of rice yields	Store provisions (food, water, firewood, animal feed)	
	Increase the number of planting times	
	Change crop varieties	
	Change crops planted	
	Change planting/ transplanting/ sowing/ harvesting times	
	Training in alternative techniques	
	Multi-cropping	
Increased incidence of malaria		
General	Migration for alternative labour	
	Awareness about problems associated with climate/ weather changes	
	Consultation with authorities	
	Village meetings	
	Share money & labour among community to build infrastructure	

Many of the coping mechanisms identified in the field research do not correspond with expected changes in climate and associated impacts reported in the literature review, mainly because many of the coping mechanisms responded to the impacts of irregular rainfall and drought/ water shortages on the agriculture sector and the literature in fact predicts that, overall, rainfall in Cambodia will increase.

According to the literature review, lowland areas (the main rice growing areas) are particularly likely to experience increases in rainfall and frequency/ intensity of floods. All four provinces surveyed cover lowland areas and may therefore require a completely revised approach to adaptation.

The coping mechanisms identified in the literature review were confined to those observed during the 2005 NAPA Survey[77]. Compared to the mechanisms reported in the field research, there were some additional measures related to flooding, and far fewer measures for drought. This discrepancy may be linked to the broader geographic scope of the NAPA (17 provinces).

Both the literature review and field research revealed that coping mechanisms for vector-borne diseases are lacking.

5.4 RELEVANCE OF INTERNATIONAL AND NATIONAL POLICIES

5.4.1 Mitigation

5.4.1a CDM & the carbon market

The Cambodian Government has set in place the administrative infrastructure necessary to allow CDM projects to be hosted in Cambodia. So far, there are few operational CDM projects, although four have been approved by the government and registered by the UN (see Table 17)

Table 17: CDM projects in Cambodia[78]

Name of CDM project activity	Type of project	Additional information	Approval date	Annual emissions reductions (tCO_2e)	Status
Bio Cogen Rice Husk Power Project	Biomass	Rice husk	Jan 2006	5,1620	Registered
TTY Cambodia Biogas Project	Biogas	Animal waste	July 2007	50,036	Registered
Methane fired power generation plant in Samrong Thom Animal Husbandry	Biogas	Animal waste	Oct 2007	5,593	Registered
Kampot Cement Waste Heat Power Generation Project	Waste heat/ gas utilisation	Cement production line	Nov 2007	17,107	Registered

Name of CDM project activity	Type of project	Additional information	Approval date	Annual emissions reductions (tCO_2e)	Status
Kamchay Hydroelectric BOT Project	Hydro	New reservoir	Nov 2007	370,496	Under validation
Cambodia Rural Electrification and Transmission Project – 220 kV Interconnection between Cambodia and Vietnam	Energy efficiency	Supply side	Pending	53,616	Work in progress at CDM Methodology Panel

CDM and other emissions reduction projects avoid greenhouse gas emissions reductions; and, importantly, can also improve livelihoods, build capacity and facilitate adaptation to climate change.

For example:

- projects that involve non grid-connected renewable energy generation (such as solar lanterns) avoid emissions from the coal-fired electricity grid and provide independence from a resource that can be unreliable and non-functional in times of extreme flooding.
- cookstove projects create employment, increase profit margins for stove producers and reduce reliance on fuelwood, simultaneously assisting in forest preservation, which was assigned significant importance in the findings of the field research.

Table 18 summarises the potential for emissions reduction projects in Cambodia. Most of the projects that would be suitable in Cambodia are relatively small-scale, which can present problems in terms of economic feasibility. There are costs involved in accrediting emissions reduction projects under the CDM and other programmes, so projects generally need to generate a minimum quantity of emissions reductions in order to cover these costs, as a basic requirement.

Table 18: Summary of emissions reduction project potential in Cambodia[79]

Mitigation option	ER[80] cost range		Abatement potential
Energy efficiency			
Substitution of incandescent lamps with fluorescent lamps	Low		Low
Cooking stoves	Low		Low
Energy savings in buildings	Low		Low
Cogeneration	Low		Medium
Renewable energy			
Mini-hydro power plants	Low	Medium	Low
Solar power	High		Low

Mitigation option	ER[80] cost range		Abatement potential	
Biomass	Low	Medium	Medium	
Transportation				
Public transportation	High		Low	
Fugitive emissions control				
Methane capture from agricultural waste	Medium		Medium	High
Landfill gas	Low		Medium	High

One extension of the CDM concept that has emerged in order to address the problems of economic feasibility of small CDM projects is the "Programmatic" approach, whereby small CDM projects may be grouped together to minimise project costs (such as auditor, consultant and registration expenses) and bureaucratic barriers. Programmatic CDM could be used as a tool to develop small scale projects with an emphasis on projects that involve tangible social benefits as well.

5.4.2 Adaptation

5.4.2a NAPA

As illustrated in Figure 12, overall, there are more adaptation projects in the NAPA relating to drought than flood, which corresponds with the concerns expressed by participants in the field research; however, examination of the NAPA's top 20 priority projects that include at least one of the studied provinces reveals a greater emphasis on flood adaptation (four projects, compared to two projects related to water supply for agriculture – refer to Table 19).

This corresponds with the findings of the V&A Report, which forecast that lowland areas would be likely to experience increases in rainfall and frequency/ intensity of floods. It could reflect a top-down approach adopted in the NAPA, although a field survey[81] was conducted during the formulation of the document which implies that it was at least partially based on needs identified in the field. The fact that only four of the ten projects have been preceded by comparable mechanisms (according to the field research) suggests some disconnect between government plans and on-the-ground realities, or that the projects are yet to become operational. No current information about the status of these projects was located, so the initial priorities of the NAPA may not reflect what actually happened on the ground. Further research would be required within each of the four provinces to explain the discrepancies between the NAPA projects and the concerns identified in the provinces.

Table 19: NAPA projects (from top 20 priority projects) involving studied provinces

Project title	Keywords[82]	Objectives	Provinces	Comparable coping mechanism reported?[83]
Rehabilitation of Multiple-Use Dams	• Water supply	• To improve water management for multiple uses including irrigation, water supply to rural communities, recreational uses and aquatic biodiversity enhancement.	**Kampong Speu,** Takeo	Yes
Development and Rehabilitation of Flood Protection Dikes	• Flood	• To protect settlements and agricultural fields from flood.	**Battambang**, Kampong Cham, Kandal, Kratie, Pursat, Sihanoukville and Svay Rieng	No
Rehabilitation of Upper Mekong and Provincial Waterways	• Flood	• To reduce risks caused by Mekong floods • To improve fishery resources • To improve rural livelihoods by supplying sufficient water for irrigation and domestic uses; and • To improve provincial water transportation.	Provinces along upper Mekong, Koh Kong, **Prey Veng**, Pursat and Svay Rieng	No
Vegetation Planting for Flood and Windstorm Protection	• Flood • Wind	• To reduce flood and windstorm damage to property and crops.	Kampong Thom, Kampot, Kratie, Sihanoukville, Takeo, **Prey Veng, Battambang** and Banteay Meanchey	No
Strengthening of Community Disaster Preparedness and Response Capacity	• Disaster	• To ensure preparedness for and effective response to climate hazards at the community level; and • To reduce climate hazard risks for local communities.	Banteay Meanchey, Kampong Cham, **Kampong Speu**, Kampot, Kandal, **Prey Veng**, Svay Rieng and Takeo	No
Water Gates and Water Culverts Construction	• Flood	• To regulate flood water around the newly rehabilitated road network; and • To minimise road and crop damage caused by flood.	Banteay Meanchey, Kampong Cham, Kandal, Kratie, **Prey Veng**, Siem Reap, Svay Rieng and Takeo	No

Project title	Keywords[82]	Objectives	Provinces	Comparable coping mechanism reported?[83]
Safer Water Supply for Rural Communities	• Sanitation	• To provide safe water in sufficient quantities for rural communities; and • To reduce the risk of contracting water-related diseases.	**Battambang**, Kampong Cham, **Kampong Speu**, Kampong Thom, Kandal, Kratie, **Prey Veng**, Ratanakiri and Takeo	Yes
Development and Improvement of Small-Scale Aquaculture Ponds	• Food and income security	• To ensure food security in the areas where wild fish stocks are insufficient to meet demand; and • To increase the income of people living in these areas.	Kampong Cham, **Kampong Speu**, Kandal, Kratie, Sihanoukville and Svay Rieng	No
Promotion of Household Integrated Farming	• Agricultural production	• To increase agricultural productivity; and • To improve farmers' incomes, food security and livelihoods in the areas affected by flood and drought.	Banteay Meanchey, **Battambang**, **Kampong Speu**, **Prey Veng**, Svay Rieng and Takeo	Yes
Development and Improvement of Community Irrigation Systems	• Water supply	• To provide sufficient water for rice farming; • To reduce the risk of crop failures from water shortage; and • To enhance food security and assist in eliminating poverty among rural people.	Banteay Meanchey, **Battambang**, Kampong Cham, **Kampong Chhnang, Kampong Speu**, Kampong Thom, Kampot, Kandal, Kratie, **Prey Veng**, Pursat, Ratanakiri, Siem Reap, Svay Rieng and Takeo	Yes

5.4.2b Adaptation Fund

The Adaptation Fund was established in 2001 to finance concrete adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol and that are particularly vulnerable to the adverse impacts of climate change.

The Fund is financed from a share (2%) of emissions reductions generated under the CDM, as well as donations. Monetisation of the CERs[84] allocated to finance the Fund started in mid-2009 and LDCs are expected to be assigned priority in accessing funds from this first phase.

The Fund is supervised and managed by the Adaptation Fund Board (AFB), which comprises 16 members and 16 alternates (representing both developed and developing countries) and meets at least twice per year. The GEF provides secretariat services to the Board and the World Bank serves as trustee of the actual Fund on an interim basis. These interim arrangements will be reviewed in 2011.

The operational aspects of the Adaptation Fund, such as project eligibility and how to allocate funds and to whom, are yet to be finalised, but they have been considerably elaborated over the past year.

Eligible parties[85] may submit project proposals directly to the Adaptation Fund Board or through implementing/ executing entities selected by governments and accredited by the Board. These entities are responsible for the overall management of the projects and programmes financed by the Adaptation Fund, as well as the associated financial, monitoring and reporting requirements.

Adaptation "projects" are defined as:

> *A set of activities aimed at addressing the adverse impacts of and risks posed by climate change. They can be implemented at the community, national and transboundary level. Projects concern discrete activities with a collective objective(s) and concrete outcomes and outputs that are more narrowly defined in scope, space and time.*[86]

The definition of an adaptation "programme" is yet to be elaborated, but so far entails:

> *A process, a plan or an approach for addressing climate change impacts which goes broader than the scope of an individual project.*[87]

When assessing potential adaptation projects and programmes, the board will consider:

- Consistency with national sustainable development strategies
- Economic, social and environmental benefits from the projects
- Compliance with national technical standards
- Cost-effectiveness
- Provisions for management, including financial and risk management
- Provisions for monitoring and evaluation and impact assessment
- Avoiding duplication with other funding sources for adaptation for the same project activity
- Moving towards a programmatic approach, where appropriate[88]

Regarding prioritisation of eligible parties, the Board will consider, inter alia:

- Level of vulnerability
- Level of urgency and risks arising from delay
- Securing regional co-benefits to the extent possible

- Maximizing multi-sectoral or cross-sectoral benefits
- Adaptive capacity to the adverse effects of climate change[89]

6. CONCLUSION & RECOMMENDATIONS

While there is consensus that the climate is changing in Cambodia and the impacts have already started to severely affect families and communities, there appears to be a lack of understanding among people about the causes and their relationship to downstream impacts.

Furthermore, coordination among researchers and government reporting is not optimal, and there appears to be limited mechanisms to bank knowledge about the successes and failures of coping mechanisms associated with climate change. Translation of government policies/ plans into real, on-the-ground actions also appears to be lacking.

Moreover, in the four provinces surveyed, there appears to be some disconnect between the concerns and priorities of the people and the focus of adaptation planning and the findings of national climate change impact projections in Cambodia. This could be a reflection of many factors, such as different geographic scopes and timeframes, but it should be further investigated.

Cambodia will only be able to successfully prepare for/ adapt to climate change if a unified approach is adopted, between government bodies, researchers and research institutions, NGOs and civil society. There is an urgent need to take stock of research and actions so far, their level of implementation and their success/ failure, and build on those experiences to accelerate effective adaptation.

Effective adaptation will also be expedited if existing projects related to environmental, energy and poverty alleviation sectors are not branded within their certain fields, but actually assessed for potential climate change adaptation/ mitigation qualities, which could generate funding to upscale and replicate such projects.

Below are some recommendations that address the problems that emerged during the course of this study. Some of the recommendations may fall outside DCA's mandate; however, it is useful to consider their potential relevance to DCA's partners or beneficiaries.

Mitigation & adaptation projects

Support programmatic CDM

Without large scale single point sources of GHG emissions, Cambodia does not have many opportunities for traditional stand alone projects; however, a new initiative, Programmatic CDM may be more relevant. A program of activities would allow small-scale CDM projects to access carbon finance; among these potential projects are initiatives that entail clear poverty alleviation benefits. Troubleshooting programmatic CDM is an advocacy topic that could assist such projects in accessing funding.

Focus on agricultural rather than industrial CDM projects

There is a growing tendency of CDM in Cambodia to focus on industrial projects that, by nature, tend to involve minimal ancillary social benefits. Given the identified urgent need for financial resources to spur adaptation in the agricultural sector, CDM projects in the sector should be assessed to direct revenue to the sector. CDM methodologies relating specifically to agriculture mostly relate to manure management; however, there are also several methodologies relating to biomass waste, such as agricultural residues, which could provide further opportunities if undertaken in a co-ordinated manner.

Become involved in addressing CDM shortcomings

The CDM is plagued by problems relating to its administration, operation and, perhaps of most concern, its success in promoting sustainable development. Opportunities to advocate for improved recognition of sustainable development and poverty alleviation should be recognised and exploited. Such opportunities arise at various UNFCCC meetings, including the annual COP/ MOPs[90] and other forums.

Become involved in the REDD debate

Currently, REDD[91] is the only framework generating forestry credits in Cambodia. It is a very complex issue; however, given the overwhelming importance that research participants placed on forest preservation, it is vital for DCA to stay abreast of the issue and identify any opportunities for advocating for fair distribution of the benefits associated with the mechanism.

Enhance overlaps between mitigation and adaptation

Often, activities that are regarded as focusing on mitigation entail significant adaptation benefits as well, which have not been fully recognised in the past. With the development of the Adaptation Fund and the increasing attention from mitigation to adaptation, the adaptive qualities of mitigation projects could earn recognition.

Furthermore, the emerging trend to direct resources towards adaptation may detract from the importance of continuing mitigation efforts, so advocating for projects that incorporate both concepts ensures emissions the simultaneous achievement of emissions abatement and effective adaptation for people and communities.

Screen development projects for adaptive and mitigative qualities

Many development and conservation projects involve mitigation and adaptation, even if it is not their primary aim. These projects should be screened for these qualities to take advantage of financial opportunities available to scale-up such projects (eg. CDM or the Adapatation Fund); and to replicate the projects (where possible and appropriate), taking advantage of lessons learned and accelerating the implementation of proven mitigation and/ or adaptation activities.

Further research

Explore the disconnect between the literature and the field research

It is important that the discrepancy between the concerns raised in the field research (relating to water shortages, irregular rainfall and drought) and the perceptions of "priority" issues in the government literature is further explored, in order to ensure adaptation funding, resources and efforts align with the adaptation needs of Cambodian people.

Explore adaptation to vector-borne diseases

The field research revealed a general lack of implemented coping mechanism for vector-borne diseases, despite the fact that the NAPA includes four projects dedicated to malaria and dengue fever control. The apparent lack of on-the-ground implementation of coping mechanisms should be explored further.

Explore success stories and failures

Success with coping mechanisms reported in the field research should be further explored to allow future up-scaling or replication, where possible and appropriate. Taking stock of this knowledge will help ensure that adaptation funding can be directed to proven measures, which will expedite the general adaptation process in Cambodia.

Explore the status of the NAPA projects

The status of the NAPA and implementation of its projects should be further explored in order to take stock of the current situation of official adaptation and clarify urgent needs. This may also assist in explaining the apparent discrepancies between the concerns raised in the field research and the focus of priority projects in the provinces studied.

Directly addressing the findings of the Perceptions Study

Promote effective agricultural extension

Many of the problems experienced in the agriculture sector were not directly related to changes in climate or associated impacts; but may be indicative of inappropriate use of pesticides and fertilisers. There were reports of overuse of chemicals actually increasing insect populations, as well as feedback cycles involving depleted soil quality leading to decreased crop yields, requiring increased fertiliser use, which was then linked to further decline in soil quality.

These perceptions need to be further explored; they may reflect a need for training about the functions of different agricultural chemicals and their appropriate use.

Advocate for increased emphasis on water shortage and drought in adaptation

The field research indicated a clear need in the surveyed provinces for improved adaptation measures related to drought and water shortages for agricultural practices; and yet, the 20 top priority NAPA projects that refer to the provinces surveyed focused more on flooding, as opposed to drought/ water shortages. Therefore, it appears that there may be some disconnect between planned adaptation actions and the needs of the four provinces surveyed, which should be explored further. In addition, further study should be conducted to determine if this disconnect is nationwide.

Promote coordination of climate data reporting

During the literature review, a general lack of coordination emerged between different government bodies involved in monitoring and reporting various aspects of climatic change, such as rainfall and temperature statistics and drought and flood reporting. It would be useful to take stock of the statistics that are available, the level at which they are recorded (e.g. commune, district, province), as well as the timeframes involved, and support expansion of monitoring and coordination of reporting.

Consider the context of emissions projection modelling

Projections of Cambodia's GHG emissions detected in the literature review were largely confined to the V&A report[92]. In the report, the authors acknowledge that the models used were generally unsuitable for conditions in Cambodia and corrective factors needed to be applied[93].

While there is always a significant degree of uncertainty involved in GHG emissions projections, it is vital that appropriate models and realistic scenarios are applied, to ensure appropriate adaptation planning and to afford adaptation activities the greatest chance of success.

Revised emissions projections are expected to accompany the Second National Communication (scheduled for release next year); these should be interpreted in the context of the suitability of models and scenarios applied.

Embrace a unified approach

Liaising with other NGOs, civil society, funding bodies and the Cambodia Government and facilitating cooperation between all these groups allows the development of a cohesive and equitable vision for climate change action in Cambodia.

Tracking advocacy and financing opportunities

Monitor the Adaptation Fund

The recent commencement of monetisation of the Adaptation Fund and elaboration of institutional and operational arrangements of the Fund may indicate that financing of adaptation projects is imminent. The Fund should be monitored to ensure opportunities are promptly harnesses, especially considering Cambodia, as an LDC, may benefit from priority funding.

Harness advocacy opportunities associated with the release of the Second National Communication

Cambodia's Second National Communication, expected to be released in 2010, may generate significant publicity about climate change matters in Cambodia. Its launch would provide an ideal platform for raising the issues identified in this study (and any further exploration of the issues), as well as other problems that may have become evident in the interim.

Monitor and attend regional climate change workshops and meetings

Official UNFCCC meetings and other climate change-related forums are frequently conducted throughout Southeast Asia and provide ideal platforms for advocacy regarding the issues identified in this study (and any further exploration of the issues), as well as other problems that may have become evident.

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APPENDIX 1: SUMMARY OF LITERATURE REVIEW OF EVENTS THAT MAY BE ASSOCIATED WITH CLIMATE CHANGE IN CAMBODIA

Event	Date	Impacts	Source
Drought	1994	• Loss of nearly 70% of the country rice harvest. • Most severely affected areas: eastern Prey Veng and Svay Rieng, central Kompong Thom, southern Kandal, Takeo, and Kompong Speu, and northwest Battambang.	Indochina Digest, 12/2/94, "Drought Raises Fear of Famine", http://www.mekong.net/cambodia/123194ns.htm.
Flood	1996	• 1.3 million people affected (over half requiring emergency aid). • Six provinces along the river affected. • More than 600,000 ha of crops damaged or destroyed. • 50,000 homes damaged or destroyed. • Considered worst flood in more than 30 years.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009. Torrente, E., Zhang, J. and Le-Huu, T., 2008, *CBDRM and Poverty Reduction*, Sustainable Development and Water Resources Section, United Nations Economic and Social Commission for Asia and the Pacific, Partnerships for Disaster Reduction-South East Asia Phase 4.
Floods	1999	• 37, 527 people affected. • 17,732 ha rice destroyed. • 491 houses destroyed.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. Peou, S., 1999, "Cambodia Country Report 1999", Second ADRC International Meeting, 5-8 December 1999, Kobe, Japan, http://www.adrc.asia/countryreport/KHM/KHMeng99/Cambodia99.htm, accessed September 2009.
Floods	2000	• 3,448,629 people affected. • 317,975 houses damaged. • 7,068 houses destroyed.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. McCarthy, J., Canziani, O., Leary, N., Dokken, D. and White, K. (eds), 2001, *Climate*

		• 347 deaths. • 401,379 ha of rice growing areas destroyed[94]. • US$157 million in damage. • Affected 22 out of 24 provinces. • Considered "worst" flooding in 70 years.	*Change 2001: Impacts, Adaptation, and Vulnerability*, Cambridge University Press. Cambridge. Tin, P., Boer, R. and O'Brien, N. (eds), *2001b, Vulnerability and Adaptation Assessment of Climate Change in Cambodia*, Ministry of Environment, Phnom Penh. National Committee for Disaster Management (NCDM), n.d. (cited in Helmers, K. and Jegillos, S., 2004, *Linkages between flood & drought disasters & Cambodian rural livelihoods & food security*, Federation of Red Cross and Red Crescent Societies and the Cambodian Red Cross Society, Phnom Penh).
Floods	2001	• 2,121, 952 people affected. • 945,665 people experienced food shortages. • 2,251 houses destroyed. • 62 deaths.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. Helmers, K. and Jegillos, S., 2004, *Linkages between flood & drought disasters & Cambodian rural livelihoods & food security*, Federation of Red Cross and Red Crescent Societies and the Cambodian Red Cross Society, Phnom Penh. Khun, S., 2002, "Country Report 2002: Disaster Management in Cambodia", http://www.adrc.asia/countryreport/KHM/KHMeng02/Cambodia_CR.htm, accessed August 2009.
Floods	2002	• 89 communes, 38-41 districts in 6-7 provinces around Tonlé Sap Lake affected. • 1,439,964 people affected. • 102,205 people evacuated. • 29 deaths. • 477,472 people experienced food shortages. • 1,082 houses destroyed. • 14,356 houses affected. • 129 schools affected. • 7 health centres affected. • 45,003 ha of rice affected.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009. Khun, S., 2002, "Country Report 2002: Disaster Management in Cambodia", http://www.adrc.asia/countryreport/KHM/KHMeng02/Cambodia_CR.htm, accessed August 2009.

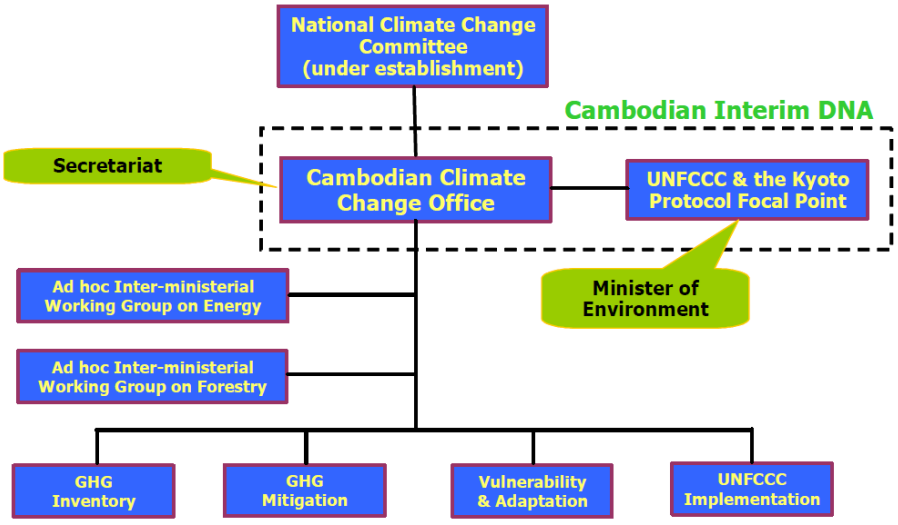
		• 35km of Road No.6 between Siem Reap and Banteay Meanchey flooded. • US$ 12.45 -19 million in damage.	
Floods	2000-2002	• 438 casualties. • US $205 million in damage.	NCDM, 2002 (cited in Ministry of Environment (MoE), 2006, *National Adaptation Programme of Action to Climate Change (NAPA)*, Ministry of Environment, Phnom Penh).
Typhoon	2001	• 743 houses, six schools and two temples destroyed. • 1 death • 11 injured. • Sedimentation in the Mekong River and Bassac River. • Damage to many national and rural roads and bridges.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009.
Drought	2002-2004	• Longest in 21 years. • 2,017,340 people in up to 14 provinces affected. • 154,069 families experienced food shortages. • US$9-21.5 million in damage. • 62,702-134,926 ha rice damaged. • Worst affected provinces: Kampong Speu, Prey Veng, Takeo, Kandal and Odor Meanchey.	World Health Organisation (WHO), 2007, "Climate Change Country Profile: Cambodia", http://www.wpro.who.int/sites/climate/working_docs.htm, accessed August 2009. Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009World Food Program (WFP), n.d., "History of Shocks", http://www.foodsecurityatlas.org/khm/country/vulnerability/history-of-shocks, accessed September 2009. Khun, S., 2002, "Country Report 2002: Disaster Management in Cambodia", http://www.adrc.asia/countryreport/KHM/KHMeng02/Cambodia_CR.htm, accessed August 2009. Mao, H., 2005, Cambodia Country Paper for the Third Annual Mekong Flood Forum, 3rd Annual Flood Forum, Vientiane, Lao PDR, 7-8 April 2005.
Floods	2005	• Affected 4 provinces: Stung Treng, Kratie, Kampong Cham and Kandal.	"Cambodia Country Report on Flood Information in Cambodia", *4th Annual Mekong Flood Forum, Siem Reap, Cambodia*, 18-19 May 2006, http://www.mrcmekong.org/download/free_download/AFF-

		• 790 people evacuated in Kratie and Kampong Cham. • 20 deaths. • "a number of" houses damaged or destroyed. • 6.7% of cultivated areas destroyed	4/session1/Cambodia_country_report.pdf, accessed September 2009.
Drought	2009	• Affected around 42,414 ha of rice. • 517 ha of rice crops destroyed. • Affected 13,706 ha of rice paddy in Battambang, 12,379 ha in Pursat, 8,527 ha in Prey Veng, 5,528 ha in Kandal, 2,502 ha in Takeo, 172 ha in Kampong Thom.	"Cambodia offers farmers fund to fight against drought", *Xinhua*, 20 August 2009, http://english.peopledaily.com.cn/90001/90777/90852/6734304.html, accessed October 2009.

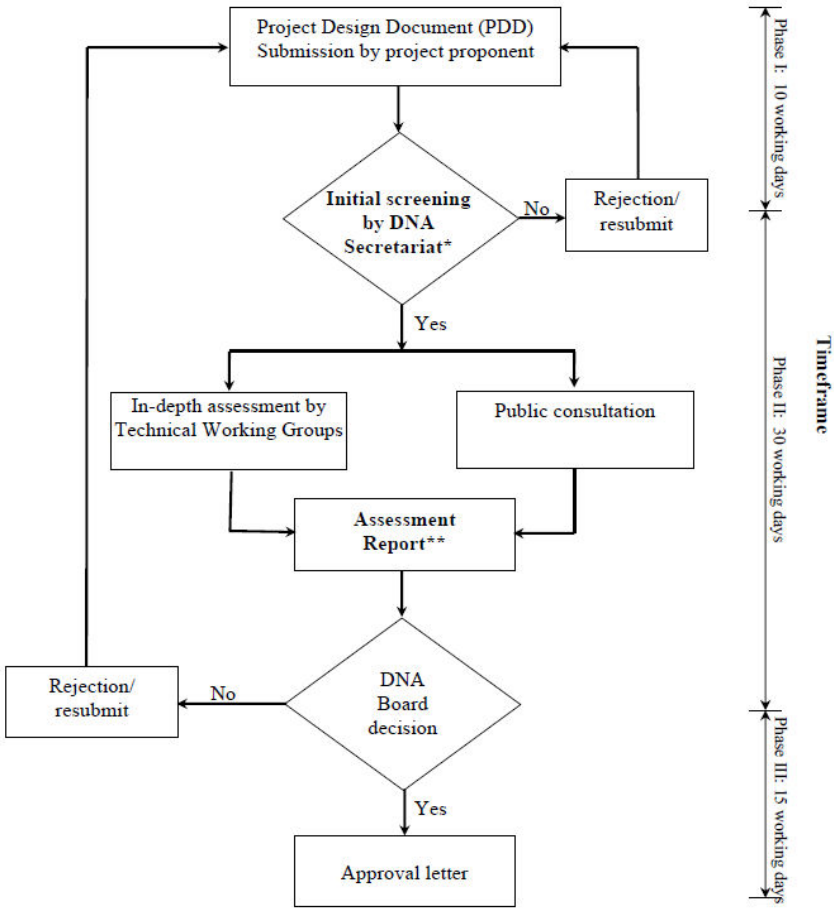
APPENDIX 2: FREQUENCY OF FLOODS AND DROUGHTS AND TOTAL RICE AREA AFFECTED (1993-2000)[95]

No	Province	Years of flood over a decade	Average (ha)	Years of drought over 9 years	Average (ha)
1	Prey Veng	10	42,270	9	23,275
2	Battambang	10	22,304	9	45,917
3	Takeo	9	21,223	9	5,587
4	Banteay Meanchey	9	16,675	5	17,519
5	Kampong Thom	10	15,255	9	7,996
6	Kampong Cham	8	14,773	8	9,139
7	Pursat	9	10,782	9	6,893
8	Siem Reap	9	9,581	9	7,729
9	Svay Rieng	9	9,471	9	4,442
10	Kandal	9	8,474	9	2,757
11	Kampong Speu	9	6,485	8	6,899
12	Kampong Chhnang	9	4,860	9	6,622
13	Kratie	8	4,614	8	1,113
14	Kampot	7	3,667	8	5,575
15	Stung Treng	7	2,087	5	2,667
16	Phnom Penh	8	1,534	5	495
17	Ratanak Kiri	7	1,197	5	733
18	Preah Vihear	7	1,037	6	1,512
19	Mondul Kiri	7	1,026	2	407
20	Sihanoukville	9	865	2	949
21	Oddar Meanchey	1	807	0	0
22	Koh Kong	5	190	3	810
23	Kep	1	4	0	0
24	Pailin	0	0	0	0

APPENDIX 3: ADMINISTRATIVE FRAMEWORK OF CDM IN CAMBODIA[96]



APPENDIX 4: GOVERNMENT APPROVAL PROCESS FOR CDM PROJECTS IN CAMBODIA[97]

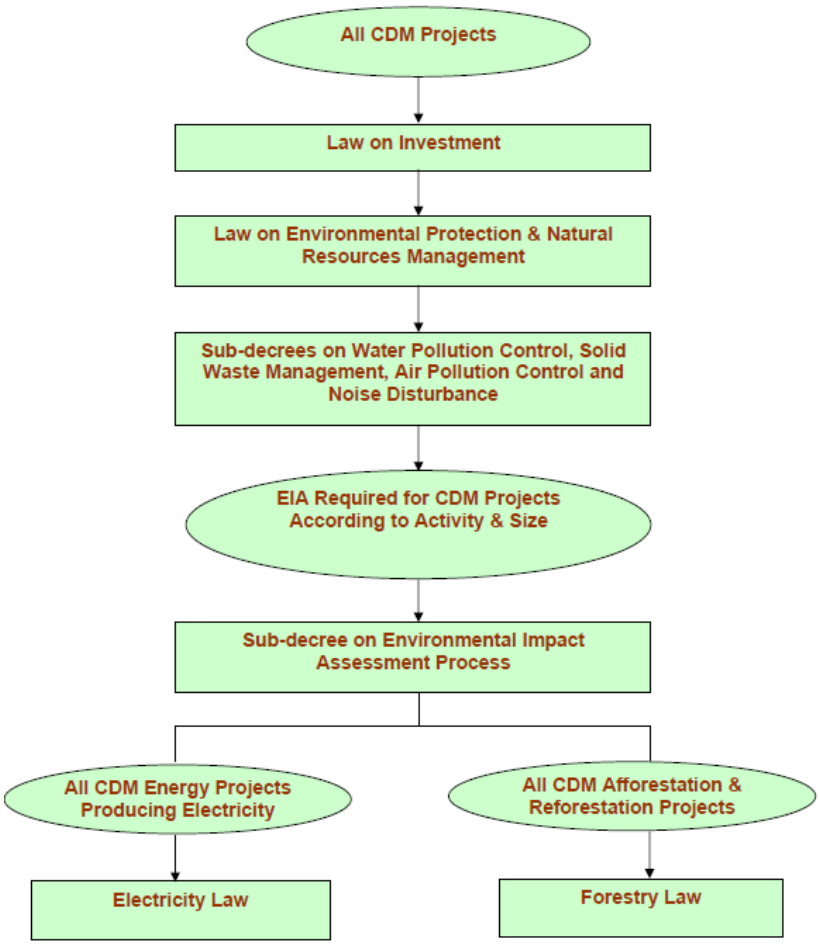


Note:

* All documentation will be reviewed for completeness: the PDD document shall be complete and submitted with the required information as requested in the Application Form (Appendix A)

** Including project technical assessment report by Working Groups and a summary of the positions of the main stakeholders groups.

APPENDIX 5: SUMMARY OF KEY LEGISLATION APPLICABLE TO CDM PROJECTS IN CAMBODIA[98]



[1] http://www.discoveryindochina.com/cam/map_provinces.html

[2] Enteric fermentation, which occurs in the digestive systems of ruminant animals (animals that have a special stomach, known as a rumen, and include cows, sheep, and water buffalo), results in the release of CH_4.

[3] Rice cultivation releases CH_4 through anaerobic decomposition of organic matter in waterlogged soils.

[4] Agricultural soils emit N_2O when the natural nitrification and denitrification process are influenced by practices such as use of synthetic and organic fertilizers, production of nitrogen-fixing crops, cultivation of high organic content soils, and the application of livestock manure to croplands and pasture.

[5] Global Warming Potential (GWP) compares the ability of GHGs to trap heat in the atmosphere, compared to CO_2. The GWP of CO_2 is therefore 1.

[6] Ministry of Environment, 2002, *Cambodia's Initial National Communication, Ministry of Environment*, Phnom Penh.

[7] Ibid.

[8] NAPA Team, 2005, *Vulnerability and Adaptation to Climate Hazards and to Climate Change: A Survey of Rural Cambodian Households*, Ministry of Environment, Phnom Penh.

[9] Rinbo, E., 2009, "Cambodia: Mainstreaming Flood and Drought Risk Mitigation in East Mekong Delta", *The Expert Group Meeting on Innovative Strategies towards Flood Resilient Cities in Asia-Pacific*, 21-23 July 2009, Bangkok; Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[10] Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009.

[11] 1996-1998 were El Nino/ La Nina years, which are characterised by extreme weather that is unrelated to climate change; therefore, these years were excluded from the table.

[12] For example, NAPA Team, 2005, *Vulnerability and Adaptation to Climate Hazards and to Climate Change: A Survey of Rural Cambodian Households*, Ministry of Environment, Phnom Penh.

[13] Helmers, K. and Jegillos, S., 2004, *Linkages between flood & drought disasters & Cambodian rural livelihoods & food security*, Federation of Red Cross and Red Crescent Societies and the Cambodian Red Cross Society, Phnom Penh; Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009; Torrente *et al.*, u, 2008; Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[14] Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009; Helmers, K. and Jegillos, S., 2004, *Linkages between flood & drought disasters & Cambodian rural livelihoods & food security*, Federation of Red Cross and Red Crescent Societies and the Cambodian Red Cross Society, Phnom Penh.

[15] Yusuf, A. and Francisco, H., 2009, *Climate Change Vulnerability Mapping for Southeast Asia*, Economy and Environment Program for Southeast Asia (EEPSEA), Singapore.

[16] Ibid.

[17] Cambodia Development Resource Institute (CDRI), 2009, "Cambodia Outlook Brief", http://www.cdri.org.kh/webdata/download/ocbrief09/ocb3e.pdf, accessed October 2009.

[18] Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[19] Ibid.

[20] Nesbitt, 1996 (cited in Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh).

[21] Cambodia Development Resource Institute (CDRI), 2009, "Cambodia Outlook Brief", http://www.cdri.org.kh/webdata/download/ocbrief09/ocb3e.pdf, accessed October 2009.

[22] Ibid.

[23] See, for example, Nerlander, L., 2009, Climate Change and Health, Commission on Climate Change and Development, http://www.ccdcommission.org/Filer/commissioners/Health.pdf, accessed October 2009.

[24] Cited in Pinkaew, T., 2007, "Changing climate leads to increase in malaria in Cambodia", Oxfam America website, http://www.oxfamamerica.org/articles/changing-climate-leads-to-increase-in-malaria-in-cambodia, accessed August 2009.

[25] Ibid.

[26] Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[27] Based on data from 1996-1999 (in ibid).

[28] Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[29] For example: Pinkaew, T., 2007, "Changing climate leads to increase in malaria in Cambodia", Oxfam America website, http://www.oxfamamerica.org/articles/changing-climate-leads-to-increase-in-malaria-in-cambodia, accessed August 2009; Gold, J., 2009, "Resistant malaria a concern, WHO says", Phnom Penh Post, 25 September, http://www.phnompenhpost.com/index.php/2009092528569/National-news/resistant-malaria-a-concern-who-says.html, accessed August October 2009.

[30] For example: National Center for Parasitology, Entomology and Malaria Control, n.d., http://cnm.gov.kh/?VBD_Watch:Page_2, accessed August 2009; Jacobson, A., 2004, *Act Now: for all of the Asia Pacific to get malaria treatment that works*, Access to Essential Medicines Campaign - MSF Australia, Glebe, Australia; Department of Planning and Health Information, Ministry of Health, the Reproductive Health Association of Cambodia, and Population Reference Bureau, n.d, "Fewer Malaria Cases in Cambodia", http://www.prb.org/Articles/2002/FewerMalariaCasesinCambodia.aspx, accessed August 2009.

[31] Continuously increasing global population; economic development primarily regionally oriented; per capita economic growth and technological change are fragmented and slow (Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh).

[32] Same global population as Scenario 1, peaking mid-century and declining thereafter; rapid change in economic structures towards service and information economy; reduction in material intensity; introduction of clean and resource-efficient technology (Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh).

[33] Ibid.

[34] Ibid.

[35] Ministry of Environment (MoE), 2006, *National Adaptation Programme of Action to Climate Change (NAPA)*, Ministry of Environment, Phnom Penh.

[36] Importantly, the V&A Report also notes that a single climatic variable – rainfall – is applied to estimate yield anomalies, and may not accurately represent the true impact of climate change. The report recommends that future studies adopt a "deterministic" approach, use of crop growth inputs such as fertilizer, pesticide and other environmental factors.

[37] Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[38] Patz and Balbus, 1996 (cited in ibid).

[39] Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[40] Patz and Balbus, 1996 (cited in ibid).

[41] 'Sensitivity' is not clearly defined in the report; however, it is assumed that it refers to the degree of exposure to the risk of malaria.

[42] Based on data from 1982-2002 (Ministry of Environment (MoE), 2006, *National Adaptation Programme of Action to Climate Change (NAPA)*, Ministry of Environment, Phnom Penh).

[43] Ibid.

[44] Yusuf, A. and Francisco, H., 2009, *Climate Change Vulnerability Mapping for Southeast Asia*, Economy and Environment Program for Southeast Asia (EEPSEA), Singapore.

[45] The report applied the IPCC's (2001) definitions for the constituents of the equation:

Vulnerability: The degree to which a system is susceptible to, or unable to cope with the adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Exposure: The nature and degree to which a system is exposed to significant climatic variations.

Sensitivity: The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli.

Adaptive capacity: The ability of a system to adjust to climate change (including climate variability and extremes), to moderate the potential damage from it, to take advantage of its opportunities, or to cope with its consequences.

[46] Yusuf, A. and Francisco, H., 2009, *Climate Change Vulnerability Mapping for Southeast Asia*, Economy and Environment Program for Southeast Asia (EEPSEA), Singapore.

[47] NAPA Team, 2005, *Vulnerability and Adaptation to Climate Hazards and to Climate Change: A Survey of Rural Cambodian Households*, Ministry of Environment, Phnom Penh.

[48] Ministry of Environment (MoE), 2005, *Analysis of Policies to Address Climate Change Impacts in Cambodia*, Ministry of Environment, Phnom Penh.

[49] Ibid.

[50] Based on ibid.

[51] Ibid.

[52] A mechanism under the Kyoto Protocol that allows developed countries to invest in emissions reduction projects in developing countries. Only countries that have ratified the Kyoto Protocol may participate. The emissions reductions generated are called Certified Emissions Reductions (CERs) and are traded between countries that are seeking to achieve emissions targets under the Kyoto Protocol.

[53] Official body representing a country's government that is responsible for approving CDM projects and general management of the mechanism in the country.

[54] Ministry of Environment (MoE), 2005, *Analysis of Policies to Address Climate Change Impacts in Cambodia*, Ministry of Environment, Phnom Penh.

[55] MOWRAM, 2003 (cited in ibid).

[56] Ministry of Environment (MoE), 2005, *Analysis of Policies to Address Climate Change Impacts in Cambodia*, Ministry of Environment, Phnom Penh.

[57] A country that is **not** listed in Annex 1 of the UNFCCC and therefore not assigned emissions targets. Non-Annex I countries are developing countries.

[58] Field research report in Annex I.

[59] Field questionnaire was excluded because there was less focus on free discussion.

[60] Based on level of discussion generated, content of discussion, level of consensus among groups and level of attribution to climate change.

[61] Vice-Chief of Provincial Department of Agriculture, Forestry and Fishery in Prey Veng.

[62] Chief of Water Use Community in Thmey village, Sdao Kong commune, Prey Veng.

[63] Chief of Water Use Community in Thmey village, Sdao Kong commune, Prey Veng province.

[64] Mr Phea Ea, Vice Chief of Weather Forecasting Office.

[65] Based on level of discussion generated, content of discussion, level of consensus among groups and level of attribution to climate change.

[66] Project Staff (Poverty Reduction), CEDAC.

[67] Mr Lor Bunnath, LWF Project Manager, Mean Nork Village, Samaki Meancheay district, Kampong Chhnang Province.

[68] Based on level of discussion generated in FGDs and KIs and the proportion of people who identified the mechanisms in the field questionnaire.

[69] For implemented mechanisms.

[70] Helmers, K. and Jegillos, S., 2004, *Linkages between flood & drought disasters & Cambodian rural livelihoods & food security*, Federation of Red Cross and Red Crescent Societies and the Cambodian Red Cross Society, Phnom Penh; Asian Disaster Reduction Center (ADRC), 2001, "Country Report 2003: Cambodia", http://www.adrc.asia/countryreport/KHM/2003/page1.html, accessed October 2009; Torrente *et al*., u, 2008; Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[71] See Appendix 2

[72] Vice-chief of Provincial Department of Agriculture, Forestry and Fishery in Prey Veng.

[73] Ministry of Environment (MoE), 2005, *Analysis of Policies to Address Climate Change Impacts in Cambodia*, Ministry of Environment, Phnom Penh.

[74] Head of health centre, Sraey Tacheay Village, Kampong Chhnang Province.

[75] Vice-Chief of Provincial Department of Agriculture, Forestry and Fishery in Prey Veng.

[76] Aer Phiseth, Head of Provincial Water Resource Department and Chea Ratha, Head of District Agricultural Office in Korng Pisey.

[77] NAPA Team, 2005, *Vulnerability and Adaptation to Climate Hazards and to Climate Change: A Survey of Rural Cambodian Households*, Ministry of Environment, Phnom Penh.

[78] Iyadomi, K., 2009, *CDM Country Fact Sheet: Cambodia*, Institute for Global Environmental Strategies.

[79] Hanh, D., Michaelowa, A. and de Jong, F., 2006, *From GHGs Abatement Potential to Viable CDM Projects – The Cases of Cambodia, Lao PDR and Vietnam*, Hamburg Institute of Environmental Economics, Hamburg.

[80] "Emissions Reduction"—credit representing 1 tonne of CO_2 abatement.

[81] NAPA Team, 2005, *Vulnerability and Adaptation to Climate Hazards and to Climate Change: A Survey of Rural Cambodian Households*, Ministry of Environment, Phnom Penh.

[82] As a proxy for the climate hazard category assumed in the NAPA – projects were only classified by sector, not by climate hazard.

[83] In field research.

[84] Certified Emissions Reductions – emissions reduction credits generated under the CDM.

[85] *Eligible Parties to receive funding from the Adaptation Fund are understood as developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change including low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems* (Adaptation Fund Board, 2009).

[86] Adaptation Fund Board, 2009, "Draft Provisional Operational Policies and Guidelines for Parties to Access Resources from the Adaptation Fund", *Seventh Meeting of the Adaptation Fund Board*, Bonn, September 14-16, 2009.

[87] Ibid.

[88] Ibid.

[89] Ibid.

[90] Conference of the parties to the UNFCCC, serving as the meeting of the parties to the Kyoto Protocol – an annual meeting of all parties to the UNFCCC and Kyoto Protocol, where issues related to the Convention and Protocol are discussed.

[91] Reduce Emissions from Deforestation and Degradation

[92] Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh.

[93] *From validation of this study, it was indicated that the two GCM models used in this analysis (CCSR and CSIRO) were not very suitable for use in Cambodia because the two models were developed for use Japan and Australia which are very different geographical region. The deviation of GCM models from the observed rainfall data was very significant. The deviation of monthly wet season rainfall could reach 794 mm, especially during the rainy season. Therefore, correction factors were develop and used in the subsequent analysis.* (Tin, P., Boer, R. and O'Brien, N. (eds), 2001b, *Vulnerability and Adaptation Assessment to Climate Change in Cambodia*, Ministry of Environment, Phnom Penh).

[94] In some cases the crop may be flooded for a short period and then recovers to produce a good yield while in the statistics the result is a failed crop (UNDP & GEF & MOE, 2001).

[95] Ministry of Environment (MoE), 2005, *Analysis of Policies to Address Climate Change Impacts in Cambodia*, Ministry of Environment, Phnom Penh.

[96] Koun, E. M. and Chea, C.T., 2007, "Health Impacts of Climate Variability and Change in Cambodia", *Workshop on Climate Change and Health in South-East and East Asian Countries*, 2-5 July 2007, Kuala Lumpur, Malaysia.

[97] Ministry of Environment (MoE), n.d., *Cambodian Designated National Authority Clean Development Mechanism Assessment Procedures*, Ministry of Environment, Phnom Penh.

[98] Hanh, D., Michaelowa, A. and de Jong, F., 2006, *From GHGs Abatement Potential to Viable CDM Projects – The Cases of Cambodia, Lao PDR and Vietnam*, Hamburg Institute of Environmental Economics, Hamburg.