Coastal Adaptation and Resilience Planning Component

Assessment of Community Vulnerability and Risks from Climate Change in the Coastal Zone of Cambodia

Cambodia Climate Change Alliance (CCCA)

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In Koh Kong Province

Noy Leng, village chief; Chut Teth, commune chief, Peam Krasaob; Ty Vich, commune secretary, Peam Krasaob Khoem SuKem, commune chief, Tuol Kokir; My Thorn, commune councillor Peam Krasaob; Khoem Saneth, commune councillor, Tuol Kokir; Num Duong, commune councillor, Tuol Kokir; Neang Kun, commuen councillor, Peam Krasaob; Yem Yan, commune councillor, Peam Krasaob; Seak Sabun, community member, Peam Krasaob; Ouch Touch, chief of provincial cabinet; Pen Vanna, deputy district governor, Mondol Seima; Houng Cham Roeum, PDA; Lung Khoem Tha, vice chief, DLMUC; Seng Saem, Chief, DWRAM; Mom Phalla, Deputy Director, DOE; Meas Sytha, vice chief, Forestry; Pay Savin, Chief, Fishery.

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Executive Summary

Cambodia's coastal zone is threatened by severe impacts of climate change such as storms, storm surges, sea level rise and seawater intrusion, and has as such been identified as a focal point in Cambodia's work in adapting to climate change. This report is an assessment of vulnerability and risk to livelihoods in CARP's target communities in relation to current climatic conditions and projected trends; with a view to introduce alternative or modified livelihoods.

Five Communes in two districts as target communities

- Tuek Thla, Tuek L'ak and Sameakki Communes, Prey Nob District, Sihanoukville Province
- Peam Krasaob and Tuol Kokir Communes, Mondol Seima District , Koh Kong Province

Their selection was based on the fact that both areas border the shoreline and largely consist of low-lying land, and consequently are highly vulnerable to sea level rise, storm surges, saltwater intrusion and tropical storms. The *overwhelming* source of livelihoods for all three target communes of Prey Nob is crop production – mostly paddy. All other sources together contribute 25% or less. The *main source* of livelihood for the Peam Krasaob Commune is fisheries. Tourism, however, is gaining increasing importance (up to 25% of income at Peam Krasaaob Community – 10% from tourist boats and 15% from selling operations). In Tuol Kokir, the *main source* of income is crop production (50% of average househod income from crop production, 30% from livestock and fishing, 10% from wages).

Main climate change predictions

- A sea level rise of 18 to 56 cm by the 2090s.
- An increase in rainfall along the coast by 2 to 6% by 2050. And a consequential increase in frequency and intensity of flooding events due to more frequent episodes of heavy rainfall.
- An increase in mean annual temperatures by 0.3 to 0.6 °C by 2025, by 0.7 to 2.7 °C by the 2060s and by 1.4 to 4.3 °C by the 2090s. And thereby increased risk of periodic droughts. In addition, a substantial increase in the number of 'hot' days and nights.

Sea Level Rise (SLR) combined with a decline in mangrove, and an increase in the frequency and intensity of storms and storm surges, has already led to some coastal inundations. A consequence is the salinization of the land surface as well as the groundwater, impacting the fertility of farming areas as well as freshwater ecosystems.

This poses a threat to food security and livelihoods because most agriculture in the coastal zone is concentrated on these flood-prone low-lying coastal areas. The infrastructure in the coastal zone also comes under pressure, which can lead to an increased vulnerability over time and lost income from tourism.

Increasing rainfall particularly at the coast. Storms occur almost every year from mid October and through December. However, with climate change causing more variable weather, there may be an increase in the intensity and frequency of flooding events.

Flooding, heavy rainfall and storms destroy property and productive assets, such as crops and livestock. Flooding will often lead to poor water supply and unsanitary/unhygienic conditions, causing serious health issues and serious disease outbreaks. An increased frequency of storms will also affect cultivation, fisheries and coastal erosion.

Increasing temperatures increase the likelihood of droughts and hot days/hot nights. Droughts or heat waves will ultimately cause problems regarding water scarcity. All such issues have a detrimental effect on the overall health of people, crops and livestock. An increase in temperature or occurrences in heat waves will also reduce the ability of people to work due to heat stress. Though only a minor concern in coastal areas today, this scenario may escalate if the weather gets more irregular, in which case the coastal area will be particularly vulnerable.

Climate experiences in the target communities

The communities in Peam Krasaob and Tuol Kokir have already experienced environmental changes overtime - some of these are:

- Increase in coastal storms
- Drought in the rainy season
- Seawater intrusion
- Decrease in marine life
- Well water/ground water no longer drinkable

Some of the environmental changes experienced by the community in Prey Nob are:

- Extended wet season
- Intensified storms during the wet season
- Livestock health problems due to intensified heat
- Ecosystems contribute less to food security
- Decrease in soil fertility

The communities in all target areas are taking steps in order to cope with some of the altered climate conditions. However, many of the coping strategies are in response to the changes being experienced currently and expected in the short term. And even then, these are probably inadequate in the face of these forces that are at play here.

Vulnerability and Risk Assessments

This vulnerability and risk assessments for Prey Nob, Peam Krasaob and Tuol Kokir focus on four potential risk scenarios, namely the loss of crops in the wet season, the loss of crops in

the dry season, loss of livestock and loss of fishing opportunities. Moreover, the assessment focuses on the current sources of income. This is assessed in four risk categories based on both likelihood and consequence of expected climate changes. On the basis of careful deliberation, the vulnerability and risk assessment is categorised in four categories: Low; Medium; High; and Extreme. Only the most severe cases are highlighted below:

Peam Krasaob: The risk scenario in terms of loss of fishing opportunities is assessed to be in the High category towards the year 2100. Peam Krasaob mostly consists of water and mangrove forests and fisheries is a very important source of income for the people. Climate Change (and particularly SLR) is likely to cause significant losses of the habitats (the mangrove forests in particular) that provide shelter and food for fish. Such developments are likely to negatively alter the distribution and productivity of the fishing, and thus impact the livelihoods of the people in Peam Krasaob. However, there is also a possibility that the mangrove are able to either survive in their current position or in fact move inland.

This depends on the rate of SLR and whether there are ample sediment supplies. There is some uncertainty, however, whether this scenario will take place. As such, the likelihood of the losing fishing opportunities is not as great as the consequences would be. Peam Krasoab is, therefore, considered in the high risk category. There is also the risk that sea water inundation, if not contained by protective dykes, will make all normal cultivation activities impossible; while homesteads may also have to be moved to neighbouring communes. The rationale for keeping the commune as an administrative unit may thus become unclear in this scenario.

Tuol Kokir: The risk scenario of loss of crops in the wet season is assessed to be in the Extreme category towards the year 2100. In Tuol Kokir the most important source of income is rice (over half of household income is from crops). Climate change is likely to cause loss of farm land, deteriorating soil and water quality, and increase the probability of flooding. Thus, the loss of crops (rice) will have severe consequences for Tuol Kokir. The likelihood of this happening is assessed as high.

Prey Nob: The possibility of loss of crop (rice) in the wet season is assessed as extreme going towards 2100. As in Tuol Kokir, climate change will cause the loss of farming land and cause the degradation of soil and water quality. Flooding will also become more likely. In Prey Nob, crops remain the single most important source of income for households. The loss of crops (rice) might thus impact very severely in Prey Nob overall.

Although the concerned communities have made commendable[1] efforts to counter the effects of climate change and variability, the current adaptive capacity to future climate change in the coastal areas is relatively low. The medium to longer term adaptive capacity is seen as inadequate. Assitance from outside of the communites, from local as well as national authorites, are clearly indicated in order to enable the communties to adequately cope with the predicted climate changes.

The raising and extension of existing protective dyke systems as well as consideration of drainage and pumping requirements especailly for Prey Nob area, but also for the dykes for the Koh Kong areas, were identifed by all interviewed stakeholders as the main adaption

[1] CARP "Coping Strategies"report, June 2012, refers.

measure. A technical and financial feasibility study by MoWRAM or others may therfore be indicated.

The feasibility of engaging in this activity will not be further considered in this report because it is already in hand via other parts of the wider Coastal Component. It is, however, necessary to note that the issue poses a serious threat to the sustainability of all demonstration activities and to the very livelihood of especailly the Prey Nob area. The inadequacy of dyke systems combined with expected sea level rise and the sinking of dyke systems would be devastating for the area (table 1, page 16).

Unless effective solutions are found in this context, it is difficult to imagine that the demonstration activities identified below would become sustainable, if the predictions of climate change materialise. All commune councils targeted eccho this concern, and potential beneficiaries of demonstration activites may well show less interest, if these overriding dyke system considerations are not seen to become addressed. This general concern is thus seen as more serious than has been acknowledged to date.

Proposed Demonstration Activities Regarding Livelihood Adaption

All the potential changes, as far as possible, subscribe to the 'no-regret' criteria stipulated by the Component Document; i.e. that the changes will be effective and profitable even if the predicted climate changes do not fully occur. This is because the climate change predictions are associated with degrees of uncertainty.

The potential changes are specific to the targeted localities; that is: the three communes of Tuek Thla, Tuek L'ak, and Sameakki at Prey Nob District, Sihanoukville Province; and the two communes of Peam Krasaob and Tuol Kokir, Mondol Seima District, Koh Kong Province. An amount of US$ 700,000 for overall adaptation is budgeted for such activities under CARP. Economic justification of these activities will be addressed in the next report under CARP activity 2.6. The proposed demonstration activites are as follows:

1. Integrated Farming Training Programme for (a) agricultural/fisheries extension staff and (b) households/families in multi-scale climate change adaptation strategies and integrated farming (integration of crops, livestock, fish, water) at 4 target communes. Preceded by Agro Ecological Systems analysis (Participatory Rural Appraisal (PRA) methodology in use by MAFF), if required.

2. Community Forestry projects in cooperation with the Forestry Administration, where possibilities exist at Tuol Kokir. This might include livestock grazing rights for livestock in forest areas as well as tree nurseries. The relation of community forestry to climate change adaptation is that tree planting is likely to be one of the measures for protecting homesteads, stabilising dykes, production of fuel wood and fruits as well as income generation, where suitable land may be present (as in Tuol Kokir).

3. Community Fisheries project at Peam Krasaob in cooperation with the Fisheries Administration; especially in terms of strengthening regulatory measures and their enforcement. The relation of community fisheries to climate change adaptation is that general fishing developments and its regulatory measures are likely to be required to adjust the livelihood of fisning communites (see further in chapter 6).

4. Reinforcement of community dyke maintenance, drainage and irrigation systems management in cooperation with MoWRAM – for Prey Nob and Tuol Kokir.

5. Promotion and increased availability of shorter duration seeds for crops; particularly for wet-season paddy, thus, possibly enabling harvest before onset of heavy flooding and sea water surges at all five communes. Such varieties will need to be tested (at no cost to farmers) in specific localities, where they are likely to be effective.

6. Promotion of increased livestock keeping at five communes - by using a revolving scheme for improved breeds – tested successfully in Cambodia, Laos and elsewhere. This is in response to increased flooding problems as livestock are moveable.

7. Possibly promotion of in-field water conservation and on-farm rain harvesting methods as a separate demonstration activity – to be decided

The very short project period (CARP ends 1st Quarter 2014) poses a challenge because it will allow one main crop season (2013) *only* for implementation. Such a short implementation period is unusual for development projects, where 3-5 year periods are the norm.

The proposed demonstration activities will still, however, be able to start operations and be implemented as intended in the five target communes. But more time would have been desirable for better consolidation and harvesting of results – as well as for expansion of the created capacity to other areas.

Abbreviations and Acronyms

ADB	Asian Development Bank
ACLEDA	Association of Cambodian Local Economic Development Agencies
AFD	The Agence Française de Développement
AIT	Asian Institute of Technology
RRCAP	AIT- UNEP Regional Resource Centre for Asia and the Pacific
CARP	Coastal Adaptation and Resilience Planning Component
CARDI	Cambodian Agricultural Research and Development Institute
CCCA	Cambodia Climate Change Alliance
CDP	Commune Development Plan
CFO	Community-based Fisheries Organisation
EU	European Union
FiA	Fisheries Administration
GEF	Global Environment Facility
HH	Household
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
IUU	Illegal, Unreported and Unregulated
LT	Long Term
MCS	Monitoring, Control and Surveillance
MoE	Ministry of Environment
MoWRAM	Ministry of Water Resources and Meterology
MT	Medium Term
NAPA	National Adaptation Program of Actions to Climate Change
NCCC	National Climate Change Committee
NGO	Non-Governmental Organization
PDA	Provincial Directorates of Agriculture

PPCR	Pilot Program for Climate Resilience
PRA	Participatory Rural Appraisal
RGC	Royal Government of Cambodia
SHV	Sihanoukville
SLPP	Smallholder Livestock Production Programme
SLR	Sea Level Rise
ST	Short Term
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development

Currency Exhange rates

1 US$ = Riels 4,100

CONTENT

1. Introduction

The Royal Government of Cambodia (RGC) has identified the coastal zone as a focal point in Cambodia's work to adapt to existing and coming impacts of climate change. Cambodia's coastal zone is threatened by severe impacts of climate change such as storms, surges, sea level rise and seawater intrusion.

This report is an assessment of vulnerability and risk to livelihoods in CARP's target communities in relation to current climatic conditions and projected trends; with a view to introduce alternative or modified livelihoods. The assessment has been formulated as CARP output 2.4.

The objective of the CARP is to build coastal zone adaptation capacity at national and provincial level, and to develop coastal adaptation plans through a practical learning-by-doing - capacity building exercise involving all relevant central and de-central stakeholders. The developed coastal adaptation plans will then be translated into practical demonstration adaptation measures to be implemented in vulnerable communities in selected agriculture or mangrove areas.[2] To do this one of the first steps is this assessment, which has been preceded by "Assessment of Coping Strategies" and "Review of the vulnerability of existing agricultural practises".

The report is structured as follows: after introducing the target areas in Chapter 2, follows an overview of the main climate change prediction for the coastal zone of Cambodia in Chapter 4. Chapter 5 essentially provides the reports main vulnerability assessments; while Chapter 6 outlines proposed demonstration activities for adapting to climate change at the target communities. Some of these will be subjected to further economic assessments under activity 2.6.

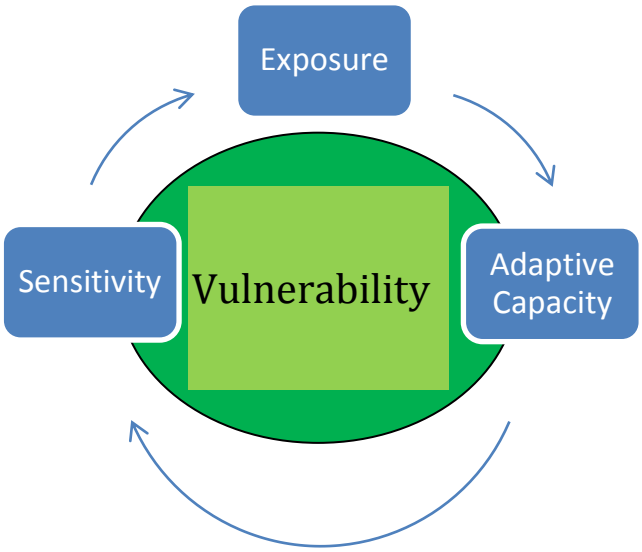
[2] Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, p. 34

2. Methodology and Data

"A serious weakness of vulnerability assessments is that they generally focus only on potential threats (e.g., exposures, hazards, stresses, etc.) that may affect livelihoods and well-being rather than consider what people can do and are already doing to safeguard or improve their livelihoods. The focus on potential negative impacts of exposure and sensitivity to rising temperatures and other extreme events (e.g., cyclones, floods) tends to be disempowering for individuals, households, and communities that are unable to directly influence these drivers of change. Focusing on impacts is also disempowering because it overlooks the intrinsic adaptive capacity and demonstrated ability of affected populations to adjust positively to significant change"[3].

This vulnerability assessment avoids the above mentioned 'serious' weakness by focusing on *adaptive capacity* and, in this context, considers the constraining and enabling factors for individuals, households or communities to cope with various types of change. This includes consideration of possible responses that households or communities may be able to initiate using the resources at their disposal as well as those; which this project can make available. This also includes building on coping strategies that target households are already undertaking (ref. Assesment of Coping Strategies in the Coastal Zone of Cambodia, CARP June 2012).

Figure 2.1: Assessment Framework[4]



[3] Roth, Brown, Grünbühel, Williams, MacLeod, van Wensveen, and Hochman, ACIAR 2012. An integration framework for social research and farming systems modeling to co-develop farmer-verified adaptation strategies in the context of climate change.

[4] Adapted from "Yusuf and Francisco, 2009: "Hotspots: Vulnerability mapping in Southeast Asia".

In short: Sensitivity and exposure to climate change may condition the type of desirable response. The coping strategy that can be applied is, however, limited by the adaptive capacity of the concerned households and communities.

Risk is in this context defined in terms of impact on livelihood prospects, given the identified vulnerability (sensitivity + exposure + adaptive capacity).

Data

The assessment is based on existing literature references and data – as well as on consultations with and data collected from respective communities as follows:

Data and information on climate change: This builds on specific literature and database references to Cambodian conditions as quoted in Chapter 4.

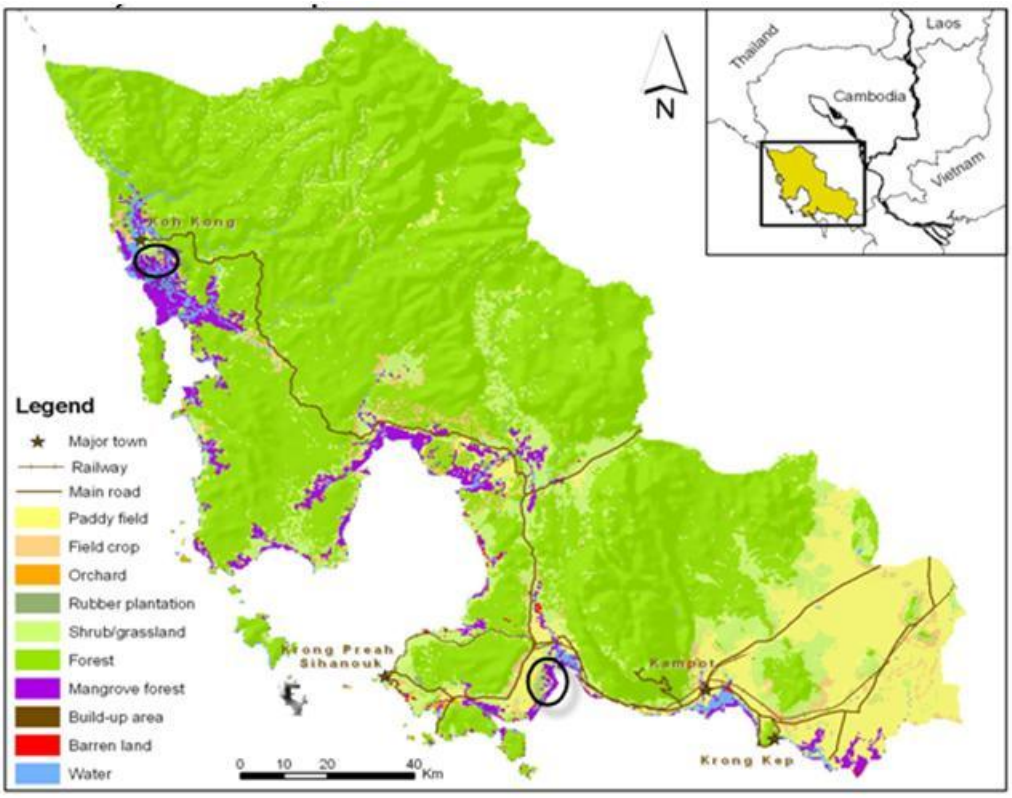
Data and information on socio-economic and livelihood conditions at the target communities builds on specific coastal zone references as well as own consultations and data collection at the concerned communities. The former includes previous participatory appraisal action research activities conducted at the communities by the preceding: (a) CARP assessment of community coping strategies, June 2012, and (b) the study "Climate Change Adaptation: Finding the appropriate response by the AIT-UNEP RRCAP, February 2011, which was conducted in the project area.

These two sets of information and data are then simply combined and analysed in terms of vulnerability and risk following the concept illustrated in Figure 1.

3. The Coastal Zone

Cambodia's coastal zone consists of four provinces (Kampot, Koh Kong, Sihanoukville and Kep). The total area covered by these provinces is approximately 17,237 km^2. The coastal shoreline is 435 km, and runs along the Gulf of Thailand. The coastline has one deep seaport, located at Sihanoukville, which is one of the main economic centres of Cambodia. The climate of the coastal zone is defined as tropic monsoon with an annual rainfall between 2,000 and 4,000 mm. This amount of rainfall is higher than other areas of Cambodia.[5]

FIGURE 3.1: Land Uses in the Coastal Zone. Circles indicate target areas.



The coastal zone has access to substantial sources of freshwater, from rivers streams, rivers and lakes that run in the area. Despite these sources of freshwater, the lack thereof is still a problem in the area. During the rainy season, rivers, streams and lakes flood due to the amount of rain, resulting in destruction of crops in low lying areas. In the dry season the downstream rivers get mixed with the salty seawater, making the water unsuitable for irrigation purposes[6]. Observations indicate that the salt seawater can reach up to 10 km inland along rivers and canals.

5 MoWRAM weather statistics
6 Cambodia Climate Change Alliance, "Coastal Adaptation and Recilience Planning Component", 2010, p. 16

3.1 Target Communities

The following locations have been chosen as target communities:

- **Tuek Thla, Tuek L'ak and Sameakki Communes, Prey Nob District, Sihanoukville Province**
- **Peam Krasaob and Tuol Kokir Communes, Mondol Seima District, Koh Kong Province**

These five communes in two districts have been decided on in the CARP7 document. As stated in the CARP, "Prey Nob and Mondol Seima districts were selected as pilot districts during consultations between the MoE, provincial and district authorities from the coast, the CCA and the national and international consultants. Their selection was based on the fact that both areas border the shoreline and largely consist of low-lying land, and consequently are highly vulnerable to SLR, storm surges, saltwater intrusion and tropical storms. Beneath is a brief presentation of the target communities:

Prey Nob District, Sihanoukville Province

Prey Nob district consists of 18,444 households with 93,141 people. This district is located in a particularly low-lying area with a total of 10,000 ha dedicated to rice production, which is protected by a dyke system. This dyke system was rehabilitated over a four-year period through funds from French Development Agency (AFD). An agreement between MoWRAM and the Prey Nob Water Users allocates responsibility for dyke maintenance. The Team observes, however, that MoWRAM seems to have been unable to adequately maintain the sea dyke system as the sea now floods parts of Prey Nob annually. This may also be caused by insufficient dimensions (rise, length) of the same dyke system. The number of people and households *of the Prey Nob target communes* are:

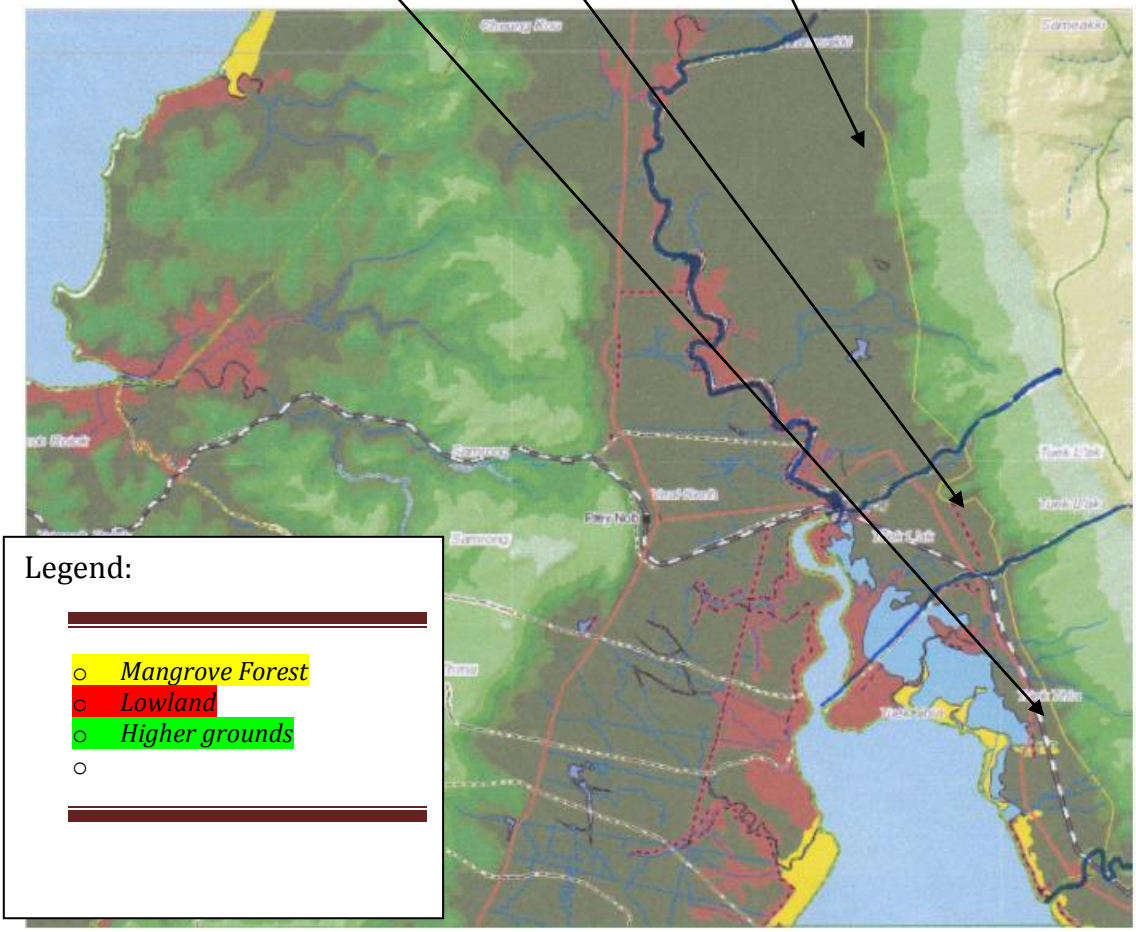
Table 3.1: Population and Households Prey Nob[8]

District	Commune	Total Population	Total HH
Prey Nob	Tuek Thla	5,123	1,133
	Tuek L'ak	4,111	861
	Sameakki	3,991	959
Total		13,225	2,953

A map showing the location of the three communes is in Figure 3.

7 Cambodia Climate Change Alliance, "Coastal Adaptation and Recilience Planning Component", 2010, Apendix G p. 115
8 Source: Provincial Department of Planning 2011

FIGURE 3.2: Map of Tuek Thla, Tuek L'ak and Sameakki Communes



The target commune areas are all located to the east of the Kampong Smach River and adjacent to the Bokor Mountain and National Park. A large part of the formal commune area is apparently situated within the Bokor National Park. However, the Commune Councils do not appear to have any jurisdiction over these national park areas (MoE maintain jurisdiction over these areas directly). Only a few households (about 50) have non-timber rights in adjacent forest areas.

The main areas under Commune Council jurisdiction are paddy lands. However, the three communes are not recognised as part of the Prey Nob Polders. Although their paddy lands are subject to the same risks of SLR, sea water intrusion and underground seepage and storm surges. In addition, especially Sameakki Commune is subject to flooding risks from rivers and streams.

Mondol Seima District , Koh Kong Province

Almost 95%[9] of villagers living in Peam Krasaob undertake fishing; while 64% of households have fishing as their main occupation. Following the efforts by the government to stop mangrove destruction in the sanctuary, many of the local people changed occupations to chicken and duck raising, harvesting crabs and snails, fishing, small-scale business, hunting, small speed boat operation, repairing boat and fishing gear, thatch weaving, fish processing, and repairing houses."

Because Peam Krasaob almost only consists of fishermen, an additional commune in Mondol Seima District has been chosen, to ensure that farmers are also being represented. This commune is Toul Kokir. The numbers are in Table 3.2:

Table 3.2: Population and households of *target communes* at Mondol Seima

District	Commune	Total Population	Total HH
Mondol Seima	Peam Krasaob	1,318	277
	Tuol Kokir	1,199	241
Total		2,517	518

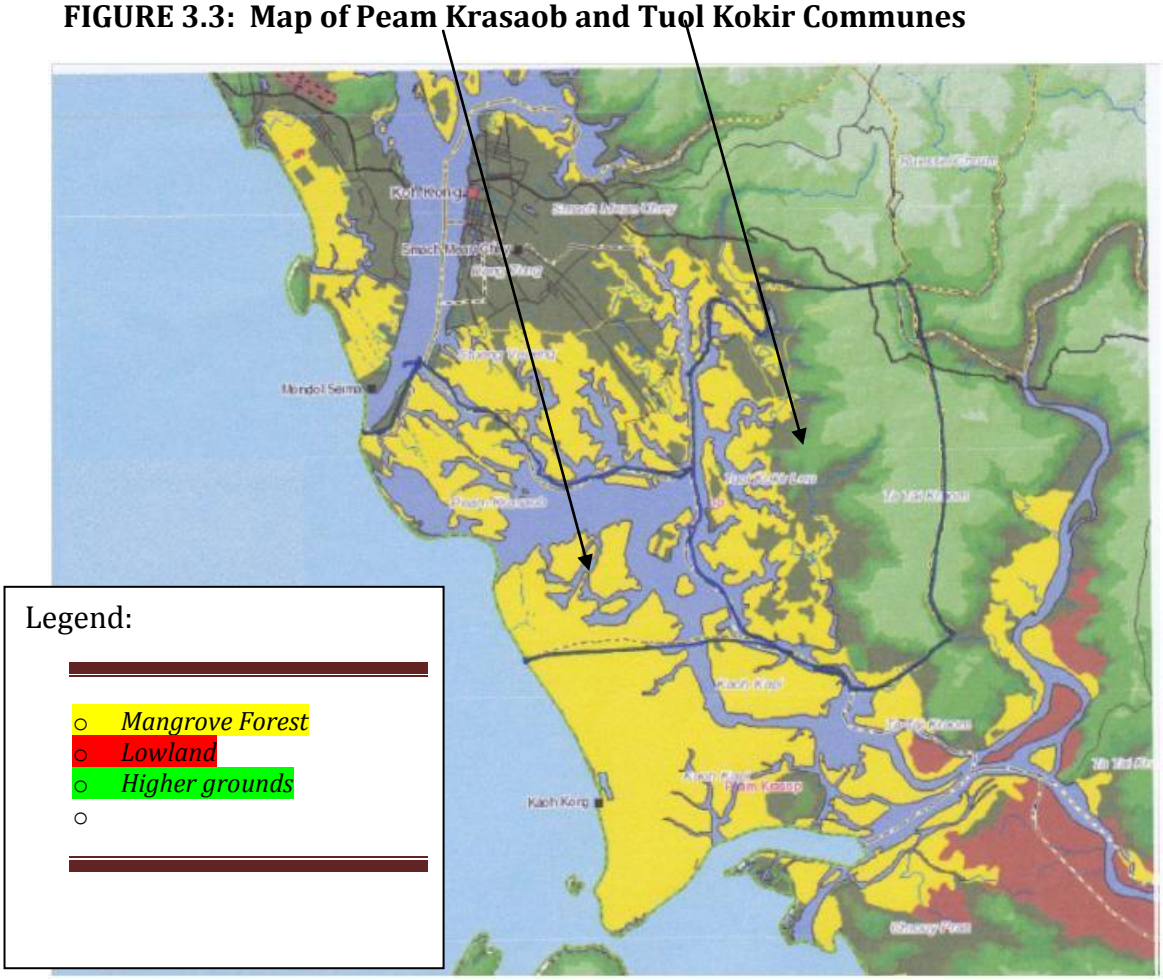
Source: Commune data base 2012.

The physical layout of the two communes is shown in Figure 3.3. The commune of Peam Krasaob is almost entirely made up of waterways and mangroves. The main village is actually located in the neighbouring commune of Stueng Veng. It was moved to there a few years ago (because its previous location near the open sea was inundated and for a large part heavily eroded into the sea (including the pagoda). The memory of this cataclysmic event is still very strong with the inhabitants, and concerns for a similar future event are present. Peam Krasaob commune is otherwise completely located within the Peam Krasaob Wildlife Sanctuary. Over 90% of the inhabitants are fishermen, however, an increasing share (currently estimated as 25%) of household income is obtained from eco-tourism.

Tuol Kokir Commune is located to the East of the Peam Krasaob estuary. The commune also contains large mangrove areas as well as paddy and upland areas. It also contains part of neighbouring national park and forest reserve areas but these areas are under jurisdiction of the Ministry Environment and the Forestry Administration respectively. .

[9] Citation from Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, p. 23 - 24

FIGURE 3.3: Map of Peam Krasaob and Tuol Kokir Communes



3.2 Livelihood Profiles of Target Communes

3.2.1 Level of Income

According to the survey on household income, the average gross daily income of a household is 9,915 Riel in Prey Nob and 18,310 Riels in Peam Krasaob. Average gross annual income of a household in the three communes of Prey Nob district is US$871 per year. The average gross income of household in the two communes of Mondol Seima District is US$1,608 (CARP Assessment of Coping Strategies, data sheets).

The main source of cash income in Prey Nob is from actual sales of livestock, paddy, fishing and poultry. Livestock – although not often sold or traded – are clearly an important store of value, providing some form of security to households in times of need. The main sources of cash income in Peam Krasaob is from actual sales of fisheries products, tourist services, wet season paddy, and labour wages.

Table 3.3: Average Gross Income[10] in Prey Nob & Mondol Seima

Target Area	Commune	Gross Income per HH Wet Season (Riel/Daily)	Gross Income per HH Dry Season (Riel/ Daily)	Average Gross Income per HH (Riel/daily)
Prey Nob	Sameakki	4,370	15,460	9,915
	Tuek L'ak			
	Tuek Thla			
Mondol Seima	Peam Krasaob	12,708	23,620	18,310
	Tuol Kokir			

Source: Datasheets of "Assessment of Coping Strategies in the Coastal Zone of Cambodia".

3.2.2 Main Sources of Income

The main sources of income for their livelihoods are estimated by the Commune Councillors themselves during a mini-workshop in April 2012 as follows:

Table 3.4 Main Income Sources for Prey Nob target Communes[11]

	Prey Nob Generally	Tuek Thla	Tuek L'ak	Sameakki
Crops	75%	80%	77%	75%
Livestock	5%	5%	5%	7%
Fisheries	6%	7%	5%	5%
Wage (private and government)	5%	1%	10%	5%
Remittances	3%	0%	0%	1%
Other income (small business, garment, palm oil factories)	6%	7%	3%	7%

Source: Mini-workshop with Commune Councillors, April 2012.

[10] Please note this as Gross Income. Net income by subtracting production expenses are lower.

[11] Note: This is different from main occupations listed in Commune Profiles 2012; where, among other, Tuek Thla only has 51% with agriculture, but 47% of households with fiishning as the main occupation (see Annex 3 for data). However, since most households are expected to have multiple occupations, the numbers given in Tabel 3.3 is assessed as the more relevant in this context.

It is clear that the *overwhelming* source of livelihoods for the three target communes of Prey Nob is crop production – mostly paddy. All other sources together contribute 25% or less but are not thereby considered insignificant.

It is also clear that crop production is the main area of *sensitivity* to climate change. And, as will be evident from chapter 4, *exposure* to such climate change effects, mainly in terms for floods, sea water intrusion and salinity, are already being felt at the three communes as well as in the Prey Nob area generally.

Table 3.5 Main Sources of Income for Mondol Seima Target Communes[12]

	Mondol Seima	Peam Krasaob Community	Tuol Kokir
Crops	0%	4%	55%
Livestock	0%	0%	20%
Fisheries	76%	60%	10%
Wage (private and government)	3%	8%	10%
Remittances	0%	3%	3%
Tourist boat	10%	10%	-
Other income (small business, garment and palm oil factories)	11%	15%	2%

Source: Mini-workshop with Commune Councillors, April 2012

It is clear that the *main source* of livelihoods for the Peam Krasaob Commune is fisheries. Tourism is gaining increasing importance (up to 25% of income at Peam Krasaob Community – 10% from tourist boats and 15% from selling operations).

It is also clear that both fisheries and tourism is *sensitive* to climate change. And, as will be evident from chapter 4, *exposure* to such climate change effects, mainly in terms of storms and floods, are already being felt at Peam Krasaob.

The sources of livelhoods is more *diverse* in Tuol Kokir with over 50% of average household income from crop production, 30% from livestock and fishing and 10% from wages. It was evident from visiting Tuol Kokir that income from outside the commune, including seasonal employment in Thailand, is a factor.

Being more diversifed, Tuol Kokir households are comparatively less *sensitive* to climate change, but still somewhat *exposed* particularly in regard to crop production and fisheries – as is highlighted in Chapter 4.

[12] For data on main occupations see Annex 3. The same consideration applies to this table as mentioned under the previous footnote.

3.2.3 Livelihood Profiles for Income Groups

The conditions of the poor households in the target areas differ depending on the location, for example, in terms of proximity to towns. The Poverty Survey of Ministry of Planning divide poor households into two types; (i) those close to urban areas and (ii) those in remote areas. In general, in areas close to urban areas, the population is more densely concentrated, in comparison to more remote areas.In more densely populated ares, almost all householdsare facing a sanitation problem, as there is little space for toilets. .

In addition, poor households differ according to their occupation and number of family members involved in earning income. The following are characteristics of poor households:

1. They do not have own cultivated land or less than one hectar
2. Low income
3. Most family members do not have regular income
4. The number of livestock that they raise is small
5. They may have lost family income, face food shortages, sold properties, or borrowed money from other people within the last 12 months.

3.2.4 Poor household distribution

The number and percentage of poor households category 1 & poor category 2 in each commune is shown in the table below.

Table 3.6: Poor households in Prey Nob & Mondol Seima

No.	District	Commune	Poor 1	Percentage	Poor 2	Percentage	Not poor	Percentage	Total HH
1	Mondol Seima	Peam Krasaob	55	18%	103	33%	115	49%	277
		Tuol Kokir	52	18%	68	23%	127	59%	241
2	Prey Nob	Sameakki	162	17%	162	17%	635	66%	959
		Tuek L'ak	103	12%	127	15%	631	73%	861
		Tuek Thla	112	10%	218	19%	803	71%	1133

Source: Provincial Planning Departments, Sihanoukville and Koh Kong Province, 2011

The condition of poor households category 1. The official survey has four types for poor households category 1:

1. Poor households that have no land and live on illegal land like roadside, river banks or public land;
2. Poor households that have no land but live on other people's land to look after land or farm for other people;
3. Poor households that have no land but live with their relatives, e.g. son or daughter that live with their parents, aunt or uncle, or the parents that live with their son or daughter etc.;

4. Poor households that have their own house and land. In general poor households in type 4 are located quite far from the main road and scattered, only foot paths lead to their houses.

The condition of poor households category 2: Most of them have their own house and land, and most of their houses are located no less than 100 meters from the main road.

The percentage of households that have land holdings of less than 1 ha are 37% in Tuek Thla, 55% in Tuek L'ak and 30% in Sameakki commune. The households with no land is about 24% in Tuek Thla, 10% in Tuek L'ak and 14% in Sameakki commune. These households were classified as poor category 1.

About 54% of households in Tuol Kokir, with land holding of less than 1 ha and 20 % with no land holding are classified as poor category 2. In Peam Krasaob commune there is only 30 ha of cultivated land for paddy, vegetable and crop.

4. Climate Change in Cambodia

Although not as highly exposed to the effects s of climate change as other countries in the region, e.g. Vietnam and the Philippines, Cambodia is rated as one of the most vulnerable countries in the world to climate change (9th rank World Risk Index 2011 Vulnerability ranking catastrophes and natural disasters, 6th rank Maplecroft Climate Change Vulnerability Index 2012)[13]. Cambodia's vulnerability is based on a poor level of infrastructure, a very low level of capacity in adapting to climate change effects, and that such a big part of the population are occupied as farmers in remote areas.

4.1 The Coastal Zone

One of the most vulnerable areas in Cambodia to climate change is the coastal zone. Climate change can encompass seasonal variability as well as inter-annual variability. These are sometimes manifested in extreme weather occurrences, such as storms, cyclones, flooding, heat waves, etc. Below, only changes in average conditions are highlighted. The main climate change predictions are:[14]

1. A Sea Level Rise (SLR) of 18 to 56 cm by the 2090s. This will specifically hit the coastal area.
2. An increase in rainfall along the coast by 2 to 6% by 2050 – lowland areas are likely to experience a greater increase in rainfall than in highlands. And a consequential increase in frequency and intensity of flooding events due to more frequent episodes of heavy rainfall.
3. An increase in mean annual temperatures by 0.3 to 0.6 °C by 2025, by 0.7 to 2.7 °C by the 2060s and by 1.4 to 4.3 °C by the 2090s. This is likely to increase evapo-transpiration and thereby increase the risk of periodic droughts. A substantial increase in the number of 'hot' days and nights;

Sea Level Rise

The coastal zone is subject to an expected rise in sea level of 0.18 to 0.56 m by the 2090s.[15] This is exacerbated by tidal variation, which can be up to 0.7 m per day; while waves of 4-5 m height are known at sea during storms.[16]

This combined with a decline in mangrove forests, and an increase in the frequency and intensity of storms and storm surges, has led to more coastal inundation.[17] This coastal inundation has dramatic effects for the communities along the coastal line. One consequence is the salinization of the surface and the

13 2/2-2012, http://www.businessinsider.com/climate-change-vulnerability-2011-10
14 CCCA Coastal Adaptation and Resilience Planning component document, Feb. 2011, page 17..
15 http://www.thegef.org/gef/sites/thegef.org/files/documents/document/2-7-11%20-%20Webposting.pdf
16 UN-Habitat 2012: Sihanoukville Vulnerability Assessment.
17Working Paper, Capacity Implicationsis categorised in four categories;
http://www.sida.se/Global/Countries

groundwater. The salinization has a severe impact on the fertility of the areas used for farming, and on the freshwater based ecosystems.

This poses a threat to food security and livelihoods because most agriculture in the coastal zone is concentrated on these flood-prone low-lying coastal areas. The infrastructure in the coastal zone also comes under pressure, which can lead to an increased vulnerability over time and loss in income from tourism.[18]

Increase in rainfall

Storms occur almost every year from mid October and through December. However, with climate change causing more variable weather, there may be an increase in the intensity and frequency of flooding events.

Flooding, heavy rainfall and storms destroy property and productive assets, such as crops and livestock. Flooding will often lead to poor water supply and unsanitary/unhygienic conditions, causing serious health issues and potential disease outbreaks. An increased frequency of storms will also affect cultivation, fisheries and coastal erosion.

Increase in Temperature

The coastal zone is subject to an increase in mean annual temperatures by 0.3 to 0.6 °C by 2025, by 0.7 to 2.7 °C by the 2060s and by 1.4 to 4.3 °C by the 2090s; which likely will increase the likelihood of droughts. It is also predicted that there will be an increase in hot days and nights.

Droughts or heat waves will ultimately cause problems regarding feeding/watering livestock[19], watering crops and drinking water scarcity. All such issues have a detrimental effect on the overall health of people. An increase in temperature or occurrences in heat waves will also reduce the ability of people to work due to heat stress. Alhtough drought may be a minor concern today (unlike in the rest of the country), this scenario may escalate if the weather gets more irregular, in which case the area will be particularly vulnerable (due to lack of experience).

Sinking of Polder Areas and Dyke systems of Prey Nob

Monitoring data from MoWRAM (personal communication) indicate that the dykes of Prey Nob are sinking by about 2 cm per year at present. Although this may not, strictly speaking, be a climate change phenomenon, it must be noted here because of its potential very serious consequences in combination with especially the predicted sea level rise. In just 20 years this could imply that the dykes will be 50 cm lower (40 cm from sinking and 10 cm from sea level rise).

18 17/2-2012, http://weadapt.org/knowledge-base/vulnerability/Cambodia

19 Drought will affect all living organisms. However, the great advantages of livestock over crops in this context are: (1) that livestock are moveable, (2) that drinking water quantities required are minimal compared to e.g. a hectare of crops, (3) fodder can be preserved to overcome drought periods.

The Polder Committee considers that the dykes are already now about 50 cm too low – as is witnessed by regular see water intrusions over about 500 hectares.

However, because most of the climate change predictions are both long term and very uncertain, households and communities have difficulties in properly relating to them. This difficulty is sought alleviated by a break-down of these expectations into more limited time horizons as follows:

1. **Short Term (ST):** Covering the present, and predictions up to year 2020.
2. **Medium Tem (MT):** Covering prediction for 2020-2039.
3. **Long Term (LT):** Covering prediction for 2040-59.
4. **Very Long Term:** Covering predictions for 2060-2100.

It is expected that people can relatively easily relate to the ST prediction. MT predictions are more difficult for many individual households; but communities and commune, district and provincial authorities as well as more alert households should be able to relate to such prediction. The longer term predictions are for the more far-sighted (especially younger) households and mentioned authorities.

These periodic predictions are illustrated in Table 4.1. These are the quantitative predictions; which are expected to be acerbated by accompanying increase of climatic variability; e.g. in terms of seasonal storms, floods and droughts. NAPA thus expects an increase in frequency and intensity of flooding events due to more frequent episodes of heavy rainfall. Lowland areas are likely to experience a greater increase in rainfall than in highlands. Note the clear trend of less rain during the dry season and more rain during the wet season.

Sensitivity and Exposure

As already mentioned (chapter 3), it is clear that crop production is the main area of *sensitivity* to climate change for Prey Nob. *Exposure* to such climate change effects, mainly in terms for floods, sea water intrusion and salinity, is already being felt at the three communes as well as in the Prey Nob area generally. This seen in combination with the current dyke sinking trend may well be a threat to the livelihood of the whole area in waiting.

It is also clear that probably both fisheries and tourim at Peam Krasaob are *sensitive* to climate change. And *exposure* to such climate change effects, mainly in terms of storms and floods are already being felt at Peam Krasaob.

Being more diversifed, Tuol Korki households are comparativly less *sensitive* to climate change, but still *exposed* particularly as regards crop production and fisheries.

Table 4.1: Prediction of Climate Change at the Coast

LIKELY SCENARIO FOR COASTAL CLIMATE CHANGE IN CAMBODIA[20]

Hazard	Impact	Current - 2019	2020-2039	2040-2059	2060-2100	2080-2100 (90%)[21]
Sea Level Rise	• Coastal erosion • Loss of cultivable land • Salinity of water supply	5 cm	10 cm	18 cm	32 cm	56 cm
Average Temperature Change (Degrees C)	• Heat / Drought • Heat stress in humans , plants & livestock • Increase of pests and diseases	0.2[22]	1 (0.8-1.2)	1.6[23] (1.4-1.9)	2.9 (2.2 -3.9)	4.1 (3.7-4.6)

[20] Main Source: http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisRegion=Asia&ThisCcode=KHM. All data are cumulative from the baseline; e.g. expected SLR is 36-56 cm by 2100 (not during 2080-2100).

[21] "90%" indicate the higher levels of model predictions.

[22] Mean annual temperature has increased at a rate of around 0.18°C per decade since 1950. (Source: UNDP Climate Change Country Profile for Cambodia).

[23] Increase in rainfall along the coast by 2 to 6% by 2050. This prediction is based on the global warming scenarios SRESA2, SRESB1 and General Circulation Models (GCM) CCSR and CSIRO (INC, 2002).

Hazard	Impact	Current - 2019	2020-2039	2040-2059	2060-2100	2080-2100 (90%)[21]
Change in Rainfall in dry season(mm) (October-April)[24]	• **Drought**	**-**	**-4.8 (-7.4--2.7)**	**-3.2 (-10.8-+10.5)**	**-2.5 (-10.4-+16.7)**	**14.5 (-1.9-+50.1)**
Change in rainfall in wet season (mm) (May-October) [25]	• **Flooding**	**-**	**0.3 (-10.9-+9.4)**	**8.8 (-4.2-+19.4)**	**14.3 (+3.2-+25.7)**	**49.7 (+27.5-+63.0)**
Polder Sinking[26] (cm) Prey Nob only	• **Damage to crops** • **Damage to homes**	**12**	**52**	**72**	**?**	**?**

[24] However, mean rainfall over Cambodia does not show any consistent increase or decrease since 1960. (Source: UNDP Climate Change Country Profile for Cambodia).

[25] However, mean rainfall over Cambodia does not show any consistent increase or decrease since 1960. (Source: UNDP Climate Change Country Profile for Cambodia).

[26] The dyke sinking tendency is probably more clearly present and felt that most of the 'real' climate change phenomenons.

4.2 Coping strategies in Koh Kong and Sihanoukville

The Adaptation Knowledge Platform conducted research in 2010 on the coping strategies in the two target districts (Prey Nob and Mondol Seima). A summary of the research from The Adaptation Knowledge Platform is presented as follows[27]:

The communities in Peam Krasaob and Tuol Kokir have already experienced environmental changes overtime - some of these are:

- Increase in coastal storms
- Drought in the rainy season
- Seawater intrusion
- Decrease in marine life
- Well water/ground water no longer drinkable

Among other things these changes have had the consequences of larger expenditures for drinking water for the villagers, with the result of less money available for expanding livelihoods. Livelihoods have moved to from farming to marine collection, increasing the pressure on the aquatic natural resources. The pressure on marine life has also resulted in increased expenses for fishing gear.

4.2.1 For Peam Krasaob Commune

For Peam Krasaob the villagers' perception on the change in the eco-system is that they have experienced a decline in marine life. The villagers mention as a cause that the law prohibiting fishing from "outsiders" is not being enforced, causing an unsustainable pressure on marine life. Furthermore sand dredging is also mentioned as a cause.

The villagers feel an improvement has occurred in the enforcement of protecting the mangrove forests. However the negative effect of this is that they cannot hunt monkeys, thus losing a source of food security. Because the village of Peam Krasaob was relocated from an island to the main land, the villagers now have the possibility of backyard farming, hereby enabling them to grow fruits and vegetables. However the absence of freshwater limits the productivity of this backyard farming.

A very positive change for the villagers is the expansion of eco-tourism. Due to an increased awareness of the possibilities in tourism, the villagers have organized

[27] Source: http://www.climateadapt.asia/resources/publication/view/60

themselves in a way so that tourism now is an alternative source of income near the villages. Instead of as before, when the villagers had to migrate in order to find alternative sources of income.

The CARP report, "Coping Strategies in the Coastal Zone of Cambodia", June 2012, emphasize the steps the local community councils in Peam Krasaob Commune and Tuol Kokir have taken in their respective coping efforts. For Peam Krasaob this is highlighted in the following.

Drought: Of actions taken prior to droughts the community council has the following focus areas. (1) To ensure water sources for the community by building basins to store drinking water for the community. (2) Prepare medicine for the community both in relations to humans and animals, (3) preparing water sources and (4) to ensure preparedness in the case of forest fire.

The community committee is fully aware of the risk for sickness among animals during a drought, and have methods for ensuring that if an animal gets sick, then it is burned immediately in order to prevent the disease to spread.

The community committee has a budget to be used in the case of a drought. For this budget the community committee have applied for funding from the district authorities. The budget includes buying medicine and buying trees to plant.

According to the community committee these actions, have resulted in the planting of 160 Ha of trees, less than 50 % of animals dies during a drought and one community well has been built.

Seawater intrusion/flooding*:* The community committee has had a 5 km saltwater protection dyke built, based on community funding and contribution in kind from villagers. Furthermore the community committee is informing households to build small hills for the animals to seek shelter. Boats are also being prepared to have the villagers´ belongings on them. The community committee are also informing villagers about the importance of cleaning their houses during and after seawater flooding has occurred. The community councils further support financially villagers in repairing houses, which have been damaged.

Storms and lightning: The community committee has limited coping strategies for storms and lightning. In 2011, 38 houses and 14,000 m^2 of mangrove forests were destroyed, 2 fishing boats sank and forest fires occurred in about 30 places.

The community committee inform villagers to listen to radio and TV, in order for them to keep updated. When a storm hits the community, villagers are informed to move to a shelter place, which has been established. According to the community committee as a result of this information-sharing, none of the fishermen goes out fishing at the sea. 90 % of households are listening to radio or TV to keep updated. 10 % of the households have bought lightning protection devices.

4.2.2 Toul Kokir Commune

In Tuol Kokir commune due to its location further inland than Peam Krasaob, the villagers in Tachat Village experiences a severe decline in their access to fresh water. This decline has a number of consequences:

The life in the fresh water sources has according to the villagers dramatically decreased, due to that the fresh water-marine water cycles is no longer regular ("Assessment of Coping Strategies", CARP June 2012, page 18). The water cycle now has shortened fresh water period as a result of more frequent droughts. The villagers perceive the decrease in fresh water as a consequence of deforestation in the area near the lake and fresh water stream. These tendencies were confirmed by the field visit to Tol Kokir, April 2012.

For Tachat Village the mangrove forest has been subjected to mass deforestation due to concession to companies. The villagers have however themselves also taken part in deforestation of the mangrove forests, as part of producing charcoal. Furthermore the villagers use the slash and burn technique on order to create land for agriculture.

In terms of coping strategies, the CARP report, "Coping Strategies in the coastal zone of Cambodia" from June 2012 emphasizes what steps the local community council in Toul Kokir has taken in their coping efforts. This is highlighted in the following.

Drought: In the case of drought the community committee rehabilitate the channel system, and to protect the drinking water sources. Furthermore the committee makes sure that fences are being built around the ponds.

Seawater intrusion: In severe cases villagers are being evacuated to a shelter place, which has been established. The committee ensures both prior, during and after that the seawater dyke protection system is working, if any damages have been done, the community committee ensures that the system is repaired. The seawater dyke that the community has built is 600 meters long and 1 meter high.

Storms and lightning: A priority for the community committee is to get the villagers to stay updated on the storm by TV and radio, and to have them ready to evacuate to the shelter place. Furthermore the committee has raised awareness on the importance not to cut down the trees around the villages, as it protects the households against the storm. In the case of lightning some of the villagers have bought lightning protection gear.

Severe rainfall: The community committee defines severe rainfall as a period of 2 months continuously rain. For the villagers it damages the agricultural production by increasing pest attacks on the crops. The agriculture officer of the district is an important capacity for the community. The community committee contacts the officer as soon as they identify a problem with pest on the crops.

According to the community committee, the focus on pest on the crops and mechanisms in place to fight it, have ensured that 70% of the crops were prevented from being destroyed by pest.

4.2.3 Sihanoukville – Prey Nob & Ou Oknha Heng Communes

According to the research from The Adaptation Knowledge Platform, the communes of Prey Nob and Ou Oknha Heng have (as in Koh Kong) experienced a number of environmental changes overtime, some of these are:

- Extended wet season
- Intensified storms during the wet season
- Livestock health problems due to intensified heat
- Ecosystem contribute less to food security
- Decrease in soil fertility

As consequences of these impacts, farmers have been forced to increase pesticides, herbicides and chemical fertilizers. Another change is that farmers have been forced to change to other natural resources for extraction. The pressure on marine fish continues to cross unsustainable rates. The lake has also started to come under a continued pressure from a growing number of livelihoods replacing their losses from fishing in the lake. Villagers also mention that as a consequence there exists less solidarity in the commune due to increased competition for resources.

4.2.4 Prey Nob Commune

The village Boek Krang in Prey Nob Commune have a number of different coping strategies in place. In the case of flooding, which happens 2 to 3 times per year, the villagers open the gates to the dykes that have been established in order to lower the level of the flooding. This however has a negative impact on the water volume for agriculture. The villagers are aware of the health risks involved with a flooding. Thus after a flooding has occurred the villager make sure of cleaning the surroundings immediately after the flooding.

None of the above-mentioned strategies are by the villagers seen as sustainable coping strategies, and they still encounter a loss when flooding occurs.

Storms: As in Peam Krasaob, information is given to villagers to stay updated by radio and TV, and not to go out fishing on the sea. Prior to a storm if the communities has been notified, some place wood sticks in the rice field to support the rice from breaking. The Tuek Thla Commune ensures help to villagers, who have had their houses damaged during a storm.

Seawater intrusion: In the case of seawater intrusion the coping strategies are similar to those of Peam Krasaob. Building dykes to protect against the seawater is a central strategy in the communities, but also to prepare boats for evacuation of villagers and their belongings.

4.2.5 Conclusions on Coping Strategies

"*A general problem with the coping strategies in both communities (provinces) is that they seem to lack a long-term perspective. The strategies seem more to be about trying to keep a status quo instead of trying to improve the livelihoods on a long-term basis. None of the coping strategies seems to come up with a solution on how the communities on a long-term basis can engage in a sustainable way of living in the ecosystem surrounding them. This is a problem because status quo seems to be getting worse. Furthermore some of the coping strategies due to their short-term perspective put further pressure on the ecosystem, thus worsening the situation for the long-term. Thus an emphasis should be given in any awareness-raising activities to stress the interconnection between coping strategies to climate change and other development issues.*

In relation to the CARP and its objective it should be regarded as a problem, that a general structure to support the coping strategies at an individual and community level is not in place for the communities. Before developing a technical capacity in the target communities, it is this report's recommendation that a clear emphasis should be given to develop the organizational capacity at the community level. Such a structure needs in a transparent way to ensure a better communication and technology transfer between the RGC, other development service providers and the villagers in the target communities" (CARP 2012).

4.2.6 Adaptive Capacity

From the above on coping strategies, the earlier assesments of *sensitivity* and *exposure* to climate change at the target communes are confirmed.

It is also made clear from the above and its conclusions that:

- There *is* some and even considerable *adaptive capacity* and resilience displayed by the concerned communities in their attempts to cope with experienced climate change. Their motivation for doing whatever possible is clearly evident, commendable and a clear sign of the perceived threats to their livelihoods.
- It is also clear, however, that these coping strategies are in response to the changes being experienced currently and expected in the short term and even then probably inadequate in the face of the forces that are at play here.
- And for the medium to longer term the adaptive capacity of the concerned communites is therefore also clearly inadequate. Assistance from outside of the communites, from local as well as national authorites, are clearly necessary in order to enable the communities to adequately cope with the predicted climate changes.

This is further expanded in Chapter 5.

5 Vulnerability and Risk Asessements

This vulnerability and risk assessments for Prey Nob, Peam Krasaob and Tuol Kokir focus on four potential risk scenarios, namely the loss of crops in the wet season, the loss of crops in the dry season, loss of livestock and loss of fishing opportunities. Moreover, it is important to note that the assessment focuses on the current sources of income.

Throughout risk categories are: L = low; M = medium; H = High; and E = Extreme. Please note that each of these risk categories is defined as: Likelihood x Consequence = Risk Category. This means, for example, that even if there is a high likelihood of the loss of crops in Peam Krasaob, the consequence of losing them may be low (crops constitute only 0-4% of income at Peam Krasaob) – thus resulting in only a medium category. The results of the assessment are presented in the following, and the main matrices are annexed.

5.1 Summary of Vulnerability and Risk Matrix results

5.1.1 Peam Krasaob

Table 5.1 shows the four risk scenarios for Peam Krasaob and which risk category they belong to according to the period. The rating scores are given on the basis of careful deliberation on the likelihood of the risk scenario happening and the consequences of said risk scenario in each period.[28] (Ref. sources of income, section 3.2.1).

Crops in the wet season: The risk scenario concerning the loss of crops in the wet season is assessed to be in the medium risk category by the year 2100. Although, SLR and increased rainfall will have an effect on cultivatable land and flooding, respectively, crops (rice) play only a very small part as a source of income for the community members. In fact, there exists only very few hectares of cultivable land at Peam Krasaob. Therefore, despite there is a high likelihood that crops (in the wet season) will be lost due to climate change, the consequences of this may not be very critical.

Crops in the dry season: The risk scenario of loss of crops in the dry season is assessed to be in the low category. As stated in the aforementioned, there exists only very few hectares of cultivatable land. Therefore, there would be less serious repercussions for households in Peam Krasaob.

Livestock: The risk scenario of loss of livestock is assessed to be in the low category. In Peam Krasaob livestock do not play any significant role in terms of a source of income. Considering this, both likelihood and the consequence of the loss of livestock would not be severe.

[28] Table 5.1 has been constructed on the basis of Annex 4.1: Vulnerability and Risk Assessment Matrix for Peam Krasaob.

Table 5.1, Risk Assessment, Peam Krasaob

Component	Risk Scenario	Risk Category in relation to Period[29]				
		Current -2019[30]	2020-2039[31]	2040-2059[32]	2060-2100[33]	2080-2100 (90%)[34]
Crops	Destruction/loss of crops in wet season	L	L	L	M	M
	Destruction/loss of crops in dry season	L	L	L	L	L
Livestock	Loss of livestock	L	L	L	L	L
Fisheries	Change of aquatic ecosystems	M	M	H	H	H

Fisheries: The risk scenario in terms of loss of fishing opportunities is assessed to be in the High category in the very long term.Rising temperatures (sea and air), ocean acidification, SLR and higher amounts of rainfall are predicted to cause significant losses of the mangrove forests, sea grass and other habitats that provide shelter and food for coastal fish. These developments will negatively alter the distribution and productivity of fish, and thus the livelihoods of the people in Peam Krasaob, considering that Almost 95%[35] of villagers living in Peam Krasaob undertake fishing; while 64% of households have fishing as their main occupation

The risk scenario in terms of loss of fishing opportunities is assessed to be in the High category towards the year 2100. Peam Krasaob mostly consists of water and mangrove forests and fisheries is a very important source of income for the people. Climate Change (and particularly SLR) is likely to cause significant losses of the habitats (the mangrove forests in particular) that provide shelter and food for fish. Such developments are likely to negatively alter the distribution and productivity of the fishing, and thus impact the livelihoods of the people in Peam

[29] Quantities (in cm, degrees and mm) are cumulative, not per period.
[30] SLR: 5 cm, Average temperature change: 0.2^{c}, Average rain increase: -11 mm
[31] SLR: 10 cm, Average temperature change: 1^{c}, Average rain increase: -2 mm
[32] SLR: 18 cm, Average temperature change: 1.6^{c}, Average rain increase: 1.7 mm
[33] SLR: 36 cm, Average temperature change: 3.4^{c}, Average rain increase: 4.6 mm
[34] SLR: 56 cm, Average temperature change: 4.1^{c}, Average rain increase: 29 mm
[35] Citation from Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, p. 23 - 24

Krasaob. However, there is also a possibility that the mangrove are able to either survive in their current position or in fact move inland.

This depends on the rate of SLR and whether there are ample sediment supplies. There is some uncertainty, however, whether this scenario will take place. As such, the likelihood of the losing fishing opportunities is not as great as the consequences would be. Peam Krasoab is, therefore, considered in the high risk category.

Generally: There is currently an unsustainable pressure on the marine life at Peam Krasaob. Not only are the inhabitants threatened by altered climate patterns, but their main source of income, fisheries, is also in danger – in part due to over fishing (and climate change). However, the movement of the Peam Krasaob village inland perhaps presents an opportunity of added income possibilities from backyard farming. Worth noting is that villagers in Peam Krasaob have organized themselves to embrace eco-tourism, which is becoming an attractive alternative source of income. Tourist boats are responsible for 10% of households' income in Peam Krasaob and selling operations for 15%. However, with climate change also threatening the point of tourist interest (predominantly, the mangrove forest), the long term sustainability of this is also vulnerable.

There is also the risk that sea water inundation, unless contained by protective dykes, will make all normal cultivation activities impossible; while homesteads may also have to be moved to neighbouring communes. The rationale for keeping the commune as an administrative unit may thus become unclear.

5.1.2 Tuol Kokir

Table 5.2 shows the four risk scenarios for Tuol Kokir and which risk category they belong to according to the period. For each period, a risk scenario is assessed (on the basis of the likelihood and consequence) and as such given a risk category.[36]

[36] Table 5.2 has been constructed on the basis of Annex 4.2: Vulnerability and Risk Assessment Matrix for Tuol Kokir.

Table 5.2: Risk Assessment, Tuol Kokir

Component	Risk Scenario	Risk Category in relation to Period[37]				
		Current -2019[38]	2020-2039[39]	2040-2059[40]	2060-2100[41]	2080-2100 (90%)[42]
Crops	Destruction/loss of crops in wet season	M	M	H	H	E
	Destruction/loss of crops in dry season	L	L	M	M	M
Livestock	Loss of livestock	L	M	M	M	M
Fisheries	Change of aquatic ecosystems	L	M	M	M	M

Crops in the wet season: The risk scenario of loss of crops in the wet season is assessed to be in the Extreme category in the very long term. In Tuol Kokir the most important source of income is rice (more than half of the households' income is derived from crops). SLR would cause the inundation of farming land. SLR would also affect the quality of both soil and groundwater, in terms of the salinization of both. Rainfall is also predicted to increase in the future. More frequent and heavier rainfall will increase the probability of flooding, which in turn will damage crops. Thus, the loss of crops (rice) will have severe consequences for Tuol Kokir. The likelihood of this happening is also high.

Crops in the dry season: The risk scenario of the loss of crops in the dry season is assessed to be in the medium category in the very long term. In this risk scenario, SLR would also damage cultivable land. Rising temperatures and an increased possibility of droughts would escalate the need for irrigation. However, considering it is mainly supplementary crops that are grown in the dry season (i.e. vegetables); the consequences of the loss of these would not be dire, despite the high likelihood of this risk scenario actually happening.

[37] Quantities (in cm, degrees and mm) are cumulative, not per period.

[38] SLR: 5 cm, Average temperature change: 0.2^{c}, Average rain increase: -11 mm

[39] SLR: 10 cm, Average temperature change: 1^{c}, Average rain increase: -2 mm

[40] SLR: 18 cm, Average temperature change: 1.6^{c}, Average rain increase: 1.7 mm

[41] SLR: 36 cm, Average temperature change: 3.4^{c}, Average rain increase: 4.6 mm

[42] SLR: 56 cm, Average temperature change: 4.1^{c}, Average rain increase: 29 mm

Livestock: The risk scenario of the loss of livestock is assessed to be in the medium risk category in the very long term. More frequent and heavier rainfall will increase the likelihood of flooding. SLR will degrade the quality of soil and water, which will have a detrimental effect on the overall health of the livestock. Rising temperatures and heat waves increase the threat of livestock suffering from heat stress. The consequences of losing livestock would be very severe to the livelihoods of Tuol Kokir, as livestock are not only an important source of income (livestock provide one fifth of the source of income) but also important in the overall agricultural cycle as a workforce. The likelihood of this risk scenario happening, however, is not as large, therefore a medium risk category.

Fisheries: This risk scenario concerning fisheries is assessed to be in the medium category in the very long term. Rising temperatures (sea and air), ocean acidification, SLR and higher amounts of rainfall are predicted to cause significant losses of the mangrove forests, sea grass and habitats that provide shelter and food for coastal fish. However, considering that fishing in Tuol Kokir is only a supplement to the main source of income, crops, the consequences, however likely, will not be severe.

5.2.3 Prey Nob

Table 5.3 shows the four risk scenarios for Prey Nob and which risk category they belong to according to the period. For each period, a risk scenario is assessed (on the basis of the likelihood and consequence) and as such given a risk category.[43]

[43] Table 5.3 has been constructed on the basis of Annex 4.3: Vulnerability and Risk Assessment Matrix for Prey Nob.

Table 5.3: Risk Assessment, Prey Nob

Component	Risk Scenario	Risk Category in relation to Period[44]				
		Current -2019[45]	2020-2039[46]	2040-2059[47]	2060-2100[48]	2080-2100 (90%)[49]
Crops	Destruction/loss of crops in wet season	M	M	H	H	E
	Destruction/loss of crops in dry season	L	M	M	M	M
Livestock	Loss of livestock	L	L	M	M	M
Fisheries	Change of aquatic ecosystems	L	M	M	M	M

Crops in the wet season: The possibility of loss of crop (rice) in the wet season is assessed to be in the extreme risk category towards the year 2100. Particularly two climate change scenarios are predicted to have a direct influence on this. First of all, SLR would cause the inundation of farming land. SLR would also affect the quality of both soil and groundwater, in terms of the salinization of both. Either way, SLR will damage cultivatable land in Prey Nob. In addition, land subsidence may pose an even higher threat.

Rainfall is also predicted to increase in the future. More frequent and heavier rainfall will increase the probability of flooding, which in turn will damage crops. In Prey Nob, crops remain the single most important source of income for households (three quarters of the households' income stem from crops). Thus, the loss of crops (rice) will have severe consequences for Prey Nob, just as there is a high likelihood that this risk scenario could happen.

Crops in the dry season: The risk scenario of losing crops in the dry season is assessed to be in the medium risk category towards year 2100.In this risk

[44] Quantities (in cm, degrees and mm) are cumulative, not per period.

[45] SLR: 5 cm, Average temperature change: 0.2^{c}, Average rain increase: -11 mm

[46] SLR: 10 cm, Average temperature change: 1^{c}, Average rain increase: -2 mm

[47] SLR: 18 cm, Average temperature change: 1.6^{c}, Average rain increase: 1.7 mm

[48] SLR: 36 cm, Average temperature change: 3.4^{c}, Average rain increase: 4.6 mm

[49] SLR: 56 cm, Average temperature change: 4.1^{c}, Average rain increase: 29 mm

scenario, SLR would also damage cultivatable land. Rising temperatures and an increased possibility of droughts would escalate the need for irrigation. However, considering that it is mainly supplementary crops that are grown in the dry season (i.e. vegetables); the consequences of the loss of these would not be dire, despite the big likelihood of this risk scenario actually happening. This is therefore a medium risk category[50].

Livestock: The risk scenario of loss of livestock is assessed to be in the medium risk category towards the year 2100. More frequent and heavier rainfall will increase the likelihood of flooding; while more droughts in the dry season can put pressure on feeding ruminant livestock. This can probably be managed through appropriate fodder conservation measures. SLR will degrade the quality of soil and water, which will have a detrimental effect on the overall health of the livestock. Rising temperatures and heat waves increase the threat of livestock suffering from heat stress. The consequences of losing livestock would be quite severe to the livelihoods of the communes in Prey Nob, as livestock are not only used for household consumption but also in the overall agricultural cycle as a workforce. The likelihood of this risk scenario happening, however, is not as large, wherefore a medium risk category.

Fisheries: This risk scenario is assessed to be in the medium category towards the year 2100. Rising temperatures (sea and air), ocean acidification, SLR and higher amounts of rainfall are predicted to cause significant losses of the mangrove forests, sea grass and habitats that provide shelter and food for coastal fish. However, considering that fishing in Prey Nob is only a supplement to the main source of income, crops, the consequences, however likely, will not be severe.

5.2 Vulnerability and Adaptive Capacity

There are several coping mechanisms in place in all target areas, such as trees being planted to protect against storms and ponds/basins for storage of drinking water. Also worth mentioning is the information dissemination of the importance of cleaning housing and surrounding areas after flooding and information on TV and radio concerning storms.

As mentioned in the CARP Assessment of Coping Strategies report from June 2012 (as summarised in Chapter 4), a general problem with the coping strategies in the communities is that they lack long-term perspective. The strategies have too much emphasis on trying to keep the status quo, and not enough emphasis on improving the livelihoods on a more long-term basis. The coping mechanisms do not seem to come up with a solution on how the communities can engage in a

[50] The possibilites for growing an additional crop on a large scale is currently limited, and not likley to be substantially improved in the short term. This is mainly due to a shortage of water for irrigation. However, furher research, and shortening of the growing season for the main crop, may open for such possibilites.

sustainable way of living in the ecosystem surrounding them, on a long term basis.

Adaptive capacity refers to a given systems ability to change the way it works, the ability to manage (and reduce) the exposure and/or vulnerability to climate change. Thus, it implies that the system is not only to cope with the consequences of climate change but also to take advantage of the opportunities it presents. Although the concerned communities have made commendable efforts to counter the effects of climate change, the current capacity to adapt to future climate change in the coastal areas is relatively low.

The specific understanding of climate changes relevant to livelihoods efforts and how such climate changes should be incorporated into adaptive strategies is often quite limited. Perhaps this is due to uncertainty on how climate change will in fact manifest itself at the local level. Predictions on how the climate will develop are uncertain, and relating to various climate change scenarios is quite difficult. Better and more localized predictions would be an improvement and make communities more able to adopt relevant measures in this context.

It is, therefore, clear that for the medium to longer term the adaptive capacity of the concerend communites is inadequate. Assistance from outside of the communites, from local as well as national authorites, are clearly indicated in order to enable the communties to adequately cope with the predicted climate changes. Proposals for such assistance is made in Chapter 6.

6. Introduction to Adapted Livelihoods

Both mitigation and adaptation are essential in reducing the risks of climate change. Climate change affects poor people's strategies to secure elements of a basic living standard, including the opportunity to:

- earn an income and meet material needs;
- maintain health and a basic education;
- speak up for oneself and have rights;
- maintain a sense of social and cultural affiliation.

Each specific context demands a different set of measures. Therefore, sustainable adaptation measures must be place specific, and there are no one-size-fits-all solutions that will contribute to both vulnerability reduction and poverty reduction.

This report follows a three-step approach[51] to identifying specific measures, taking people's strategies to secure needs as a starting point:

1. Step 1: How do people secure or fail to secure needs?
2. Step 2: What is the influence of climate variability and change on how people secure or fail to secure needs?
3. Step 3: What new measures or alterations to existing interventions are necessary in order to implement sustainable adaptation?

Step 1 has largely been addressed in chapter 3, step 2 largely in chapters 4-5. In this chapter 6, come the proposals of how to implement sustainable interventions and adaptations as follows:

Section 6.1 contains a long list and descriptions of potential interventions, which might be considered for implementation. These are simultaneous screened and assessed, and some of them are proposed for further evaluation, consultation and / economic assessment.

Section 6.2 contains the selected short listing of interventions, which are candidates for further evaluation. The economic evaluation is the subject of the second report of this consultancy. This is formulated in the component document as Activity 2.6: "Analysis of economic and social cost and benefits of options for modified agricultural practises and fuel wood production that are less vulnerable to impacts of climate variability and climate change".

[51] Source: GECHS Report 2007: Climate Change Adaptation and Poverty Reduction: Key interactions and critical measures. Report prepared for the Norwegian Agency for Development Cooperation (Norad).

6.1 Options for Demonstration Activities

6.1.1 General

These potential changes are divided into two main groups: (I) Off-Farm and (II) On-Farm. Off-Farm changes are changes that will affect agricultural production practises on the farms, but the changes themselves start from outside the individual farms or even outside the concerned village communities. On-Farm changes are on the concerned farm or inside its households. *Some of these potential changes may later be developed into demonstration activities under CARP.*

All the potential changes, as far as possible, subscribe to the 'no-regret' criteria stipulated by the Component Document; i.e. that the changes will be effective and profitable even if the predicted climate changes do not fully occur. This is because the climate change predictions are associated with degrees of uncertainty.

The potential changes are specific to the targeted localities; that is: the three communes of Tuek Thla, Tuek L'ak, and Sameakki at Prey Nob District, Sihanoukville Province; and the two communes of Peam Krasaob and Tuol Kokir, Mondol Seima District, Koh Kong Province. A major characteristic of all these communes are their lowland character for their cultivated areas, near to the sea, and also adjacent to extensive mangrove areas, national parks and forest reserves.

An amount of US$ 700,000 is budgeted for all types of demonstration activities under CARP. However, supplementary sources may become available; e.g. from PPCR and/ or the Climate Change Trust Fund, if sufficiently justified.

The below definition of potential demonstration activities for CARP builds on direct consultations with concerned communities and officials as well as on the CARP draft reports on "Coping strategies" and "Vulnerability of Coastal Cultivation Systems".

6.1.2 Potential Off-Farm Changes

1. **Raising and extension of existing protective dyke systems as well as consideration of drainage and pumping requirements for the polder areas. A technical and financial feasibility study by MoWRAM or others may be indicated.**

    - *The feasibility of engaging in this activity will not be further considered in this report because it is already in hand via other parts of the wider Coastal*

Component. It is, however, necessary to note that the issue poses a serious threat to the sustainability of all demonstration activities. And unless effective solutions are found in this context, it is difficult to imagine that the demonstration activities identified below would become sustainable, if the predictions of climate change materialise. This threat is especially present for the Prey Nob areas, but also the two targeted commune councils at Koh Kong is keenly aware to the threats posed by the sea, and has expressed concerns regarding the inadequacy of the present dyke systems.

2. Planting of mangrove forest and protective trees for dyke systems

This activity is also already defined in the plans and budgets for the coastal component (GEF part). It will not, therefore, be subjected to further assessments in this report.

3. Development of Eco- and/or Agro-tourism.

It was observed during field investigations that Eco-tourism into the large mangrove areas currently contributes an estimated 25% of average community income for Peam Krasaob commune, Koh Kong. This contribution from tourism mainly occurs as transport fees and sales of food, drinks and other items to tourists. Overnight stays are not usually involved. This contribution to household income is a recent development initiated during the time of the Danida-funded Coastal Zone Management Project 1997-2007, and should be counted as a major sustainable achievement of that project. *(It is resilient to the particular effect of expected Sea Level Rise only if this can be countered via the protective dyke systems).*

The Sihanoukville (SHV) provincial administration has expressed interest in opening a similar venture (or 'tourism corridor') into the Prey Nob areas. It is clear that the SHV area receives substantially more tourists than does Koh Kong (The potential for such a venture in terms of possible customers should therefore be present. It may not, however, be clear at present how to capture this potential tourist market. Nor is it clear if the type of tourist frequenting SHV could be motivated for eco-or agro-tourism into the Prey Nob areas.

<u>Proposal:</u> An action plan for a pilot into eco- and/or agro- tourism for the three target communes (or even other Prey Nob polders) could be developed and costed <u>by a separate consultancy.</u> <u>The potential</u> for increased income (judging from the Peam Krasaob experience) is: 25% of present average household (hh) income from tourism: $ 200 /HH x 3000 HHx 0.25 = $ 0.15 million / year – in the three Prey Nob target communes only.

4. **Integrated Farming Training Programme for (a) agricultural /fisheries extension staff and (b) households / families in multi-scale climate change adaptation strategies and integrated farming (integration of crops, livestock, fish, water). Preceded by Agro-Systems analysis (PRA methodology in use by MAFF), if required.**

A concept along these lines is currently practised under the first Cambodia NAPA implementation project funded by GEF, UNDP and IFAD. It has now run since 2009 and reached about 6000 farmers in Preah Vihear and Kratie provinces. Apparently very successful (documentation).[52] Adaptation of this concept is also well in line with the CARP component document, which emphasise that links between the mentioned project and CARP will be established, among other, to exchange technology and knowledge on climate change adaptation.

The farmer field school concept has, furthermore, been practised in Cambodia and elsewhere (particularly in Vietnam and Bangladesh) with high degrees of successful impact (documentation in Annex 3) on increasing rural incomes as well as on diminishing unwanted environmental and human health impact through the often associated propagation of Integrated Pest Management (IPM) technologies.

The concept finally offers the possibility of developing tailor-made solutions to suit individual households as well as individual communities and communes – if the farmer field schools concept is integrated with a preceding agro-ecological systems analysis for each commune. A working model for agro-ecological systems analysis is currently used by the Department of Agricultural Extension. The model integrates crop, plantation, livestock and fisheries, water and other income sources into the integrated agricultural (or livelihoods) concept, and allows individual households as well as their larger communities to develop comprehensive solutions that are tailor-made to their specific needs and preferences[53].

By providing the space for comprehensive solutions, all concerns of particular households (e.g. not only related to climate change) can be accommodated; while likely unsuccessful sub-optimisation though peace-meal solutions to particular constraints are avoided.

[52] Possible yield increases of over 100 % has been indicated. However, monitoring data from the project will not become available before Novermber 2012.

[53] For example, different age-groups would have different preferences and opportunities.

<u>Proposal for Economic Assessment:</u> Establishment of farmer/fisher training programme in integrated farming / livelihoods in four (or five ?)[54] target communes by following the above described concept. Implementation in the following steps:

i. *Adaptation of model and curricular to coastal conditions (3 months)*
ii. *Conduct of Agro-Systems Analysis in 4 communes (3 months) – can be in parallel with (1).*
iii. *Implementation of Training of Trainers programme (of all presently concerned extension agents both in government, NGO and private sector, if relevant). (3 months)*
iv. *Implementation of Farmers / Fishers training programme using the Farmer Field Schools concept – <u>at least for one year</u>, longer if possible. This could include visits to areas with similar problems (e.g. in Vietnam), if affordable.*
v. *Establishment of a sustainable continuation basis for re-fresher training and possibly other types of extension support along above lines (but less intensive) – to continue after project closure.*
vi. *Monitoring and documentation of the impact and experiences through steps i-v.*

Full costing and impact expectation on above in next report.

5. Digging of a fresh-water reservoir for household water supply and dry-season irrigation of 90 ha (particular for Tuol Kokir Commune – but possibly already included in Component plans ?).

This is already part of the Component budget (GEF part) . It is not, therefore, pursued furher here.

6. Development of salt-tolerant paddy varieties and possibly other crop varieties as well.

CARDI has recently collected some few traditional paddy varieties with some salt tolerance (tolerance for some salt in irrigation water – not in the soil) at the coast. It is the intention to develop further on these varieties – in cooperation with IRRI, Manila, which is also working on isolating salt-tolerant varieties. However, the IRRI developments may still be some years away from concrete outputs. Japanese plant breeders are also working on such developments.

[54] Peam Krasoab may be sufficiently covered by the proposed activities under Fisheries Community (2.12) – to be decided.

The process of developing improved salt-tolerant varieties of paddy could be as follows: (1) screening of traditional varieties for selection; (ii) Cross-breeding with other varieties; (iii) cooperation with IRRI, Manila, insert promising salt-tolerant genes. However, CARDI has only very limited Government funds for such developments. This process may therefore take 7-10 years. If project funds of say $ 100.000 – 150.000 for the necessary resources could be made available, the process could possibly be shortened to 5 years.

CARDI (ref. personal communication) has no current knowledge of salt tolerance for other corps in Cambodia. The process for developing such would in any case be: (i) breeding; (ii) crossing; (iii) testing – preceded by a feasibility study on the possibilities for developing such varieties.

Proposal: The implementation of this activity will go much beyond the component period, thereby making it difficult to complete the intended plant breeding programme. It is therefore suggested to leave these potential developments to others with longer time horizons.

7. Occupational Change Support Programme; possibly including vocational training, when effective. This "change" is not strictly a change to agricultural practises – except in the sense of scaling down to part-time farming/fishing - or NO farming /fishing at all.

Cambodia is in the middle of a massive transformation of large parts of the population from rural areas to urban living. This is a 'normal' occurrence in the context of the longer term development of the country. All countries known goes through this kind of process at one time or another. Climate change predictions have similar horizons (long term).

It therefore stands to reason, that not all rural people will continue to earn the major part of their livelihood from rural occupations. Instead, especially the younger generations will want to move to urban occupations or living in search of better opportunities; while the elder generations would not have such opportunities nor may they want to pursue such ends, even if they could. A programme to aid this on-going macro-process could, in a way, be termed as the ultimate agricultural climate change response because the concerned people would be moving to livelihoods less vulnerable to climate change.

But is it feasible for a short-term project like CARP (ends 1 quarter 2014 – less than 2 years) to engage in such an assistance programme, and if so, what could its content be ?

The CARP component document mentions training in, for example, hairdressing and/or mechanic repairs, as distinct activities thought appropriate for CARP. However, training alone in e.g. the mentioned activities may well go beyond the

CARP project period, thereby posing the threat of leaving possible participants stranded long before they may be ready to engage in their professions. Such a support programme, probably, needs to continue for more than 5 or preferably more than 10 years, in order to show sustainable impact.

The content of such a programme could, besides all sort of relevant training, include advisory, material and financial support for small enterprises, scholarships or similar educational promotion activities, coordination of apprenticeships, and possibly many other activities.

Proposal: It is proposed to not engage in this programme activity mainly because the CARP time horizon is much too short to achieve much demonstration effect.

8. Development of new and/or support to existing micro-credit schemes for respective commune member's investments in *sustainable* agricultural, fisheries, livestock, processing, marketing or other enterprises. Criteria for climate change adaptation to be developed in this context

A major binding constraint for small enterprises, including agriculture and fishing, is the relative high cost of doing business in Cambodia – compared to the neighbouring countries, in particular Thailand and Vietnam. A main part of that 'high cost' is caused by financing costs (interest), which often reach 2-3.5 % per month for micro-loans of the kind typically available for rural households. Financing costs can thus sometimes reach the cumulative equivalent of 40-50% per annum. It is very difficult to imagine sustainable enterprises under such conditions.

Such financing costs invariably impact on all types of expenses (capital investments as well as operating cost). And thus permeates all kinds of production processes (e.g. fishing, agriculture, processing, transport, storage, social events). Such high financing costs *alone* thereby makes it very difficult for most enterprises to compete and become viable. There is thus a clear case for promotion of lower interest rates in micro-finance.

However, long volumes are written about the difficulties of during just that: lowering interest rates. Untold sums of precious capital have been lost by most donor agencies trying to do this. Currently, it is an area or field of development most shy away from. The main difficulties centre around the sharing of risks, the cost of operating small loans, the fungibility[55] of capital (not always used as proposed), and the often intransparency of such credit operations. Operations into such credit ventures require particular expertise as well as mutual trust.

[55] "Fungibility" is a term often used in banking and credit. It means that money has multiple use, may relativley easilily be substituted for other valuables, and this use and misuse is often difficult to control.

It is not, therefore, recommended for the CARP to directly engage into such a venture. However, partnering with a reputable Cambodian credit institutions (e.g. like ACLEDA Bank) might be a possibility, if such an institution would be interested (by no means certain). It could be explored, but it will likely not be an easy undertaking for CARP.

<u>Proposal:</u> it is proposed to leave this for later consideration. Meanwhile possible consultations along these lines could be undertaken.

9. Development of community-based storm/floods insurance schemes for crops, livestock and possibly others items (e.g. houses, boats), if feasible.

Most western countries, and some developing countries, have insurance schemes covering against losses suffered from storms and floods. However, as far as is known, such schemes do not currently operate at the national level in Cambodia – although some explorations were made a few years ago under USAID or ADB funding. It might instead be possible to develop local schemes; for example for the Prey Nob Polder Areas – managed locally by the polder community organisation.

The latter type of insurance scheme was very common in some western countries in the earlier part of the last century – mostly managed and financed by local communities, and bestowed reduced risks from calamities on local communities.

However, a quick calculation of likely costs involved to not look encouraging: Currently possibly damage from sea water intrusions *alone* may amount to a risk level of 500 ha per year (but expected to increase annually). Loss of such crops would amount to about $ 176 /ha (ref. Prey Nob crop budget 2012) or $ 88,000 per year in expected pay-out form such a scheme for this risk factor alone. In addition, the administration of the scheme could cost, say $ 12.000 – in total $ 100,000 in scheme expenses .

This would require scheme income of a similar order – for example a levy of $ 10 per ha for the 10,000 ha of the Prey Nob polder areas. This level of insurance levy is almost equal to current average seed expenses / ha (USD 13). And this is only counting one risk factor: Sea Water intrusion. Possibly such a scheme could not become financially viable under the given circumstances at Prey Nob – especially not since such risks are expected to increase over time.

Proposal: it is proposed to leave this kind of insurance scheme alone for the time being. It could receive further study, once the dyke system has been rehabilitated or reconstructed.

10. Small-scale local (possibly mobile) weather forecasting of storms and other weather events; e.g. based on piloting of equipment and systems under the first NAPA climate change adaptation project under GEF-UNDP-IFAD funding.

We do not have sufficient information about possible technical solutions at this time. However, possibly an 11 m mast unit (costing about $ 15,000 installed) could suffice for local storm warnings for the fisheries community at Peam Krasaob**.** In addition, the management, maintenance and design of an appropriate user-interface for interpretation of the data streams might be required. The Peam Krasaob Community management structure cold be put in charge of the operation and assisted by the provincial department of MoWRAM.

But the Peam Krasaob community reportedly currently get such information from across the nearby Thai border. It therefore also needs to be examined whether such a local weather station would substantially improve storm warnings for the local fishermen. For Prey Nob presumably such information could be made available from the SHV Port Authority, but it is not presently known whether this is in fact possible.

Proposal: Further investigations as outlined above.

11. Community Forestry projects in cooperation with the Forestry Administration, where possibilities exist. May include livestock grazing rights for livestock in forest areas.

We do not currently have sufficient information on this possible demonstration activity. Consultations with the Forest Department at Koh Kong province revealed, however, that a community forestry project has recently been established at Tuol Kokir commune (now lacks funds), and that another associated activity could be one or more forestry nurseries for the target *and* possibly other communes.

Proposal: Further consultations on this with the Forestry Administration, MAFF, and its provincial department at Koh Kong.

12. Community Fisheries project at Peam Krasaob in cooperation with the Fisheries Administration; especially in terms of strengthening regulatory measures and their enforcement[56].

"There is a high incidence of Illegal, Unreported and Unregulated (IUU) fishing, the impact of which on Cambodian fish stocks is unknown, and results in the potential benefits of marine fisheries currently not being captured by Cambodians. Habitat degradation is a major concern, due to dynamite/ cyanide fishing, illegal trawling in nursery areas, mangrove destruction (for firewood, shrimp culture), siltation, and urban/ industrial pollution. Conflicts between fishermen are common over access rights and gear interactions. Monitoring, control and surveillance are considered ineffective. Efforts to control/ reduce fishing effort and to find alternative livelihoods for fishers are well recognized, but present a huge challenge to RGC". (ref RGC 2010).

"There has been a commendable promotion of co-management/ Community-based Fisheries Organisations (CFOs) in recent years, although many need greater financial and technical support for effective operation. A Royal Decree and Sub-Decree on Community Fisheries Management was promulgated in 2005. To reduce illegal fishing, the law allows serious penalties to be applied to those who break the law including government officers. To investigate, prevent and counteract illegal activities and compile documents for submission to courts, the officers of the fisheries administration are considered as judicial fisheries police. There is, however, a concern in regard to the efficacy of enforcing the law. Human, financial and material resources allocated for planning/management appear not to be commensurate with the socio-economic value of sector" (ref EU Programme doc).

The Purpose of this proposed demonstration activity could therefore be: Strengthening of the community fisheries capacity at Peam Krasaob to fully engage in the decision making processes leading to sustainable fisheries through improved management, and to deliver quality services to its members.

The current proposal is founded on the following factual obeservations:

1. The Peam Krasoap Cummunity has clearly identified this type of activity as of high priority for them – on par with dyke maintenance. Clearly in order to maintain and improve the productivity of their resource base. This ws confirmed by a mini-workshop with the Commune Councillors, April 2012 (Result documented in Annex 3).
2. The national Strategic Framework for Fisheries 2010-19 emphasise the Community Fisheries concept as one of its priorities (RGC 2010, page 19).

[56] FiA has currently 21 registered Coastal Fisheries Communities. Nor sure if Peam Krasoab is one of those but enquiries has been made, (Fia is yet ro respond). if not, official registration with FiA as a Community Fisheries Organisation should be sought - as is required by the RGC sub-decree on CF management.

3. A number of donor agencies have agreed and are actively funding Community Fisheries (CF) activities in Cambodia. These agencies include Danida, EU, among others.[57]
4. There were no less than 469 CFis in the country in 2010, but only 324 were officially registered (303 inland, 21 coastal)[58] with MAFF, as is required by the RGC sub-decree on CF management.

We understand from comments received that this type of natural resource management activity was previously tried under the Danida Coastal Resources Project 1997-2007, with limited success. However, a critical success factor is that the Commune Council be allowed to assume full responsibility by the national park authorithy. This may not have been possible during that period, since the Commune Councils in many respects were still under formation at that time.

The livelihood potential of this proposed demonstration activity is increased fisning opportunities for the households of Peam Krasoap commune because of enforcement of regulations, estabishment of fish santuaries and refuges, - as well as incresed incoem from eco-tourisme etc. The Economic Assessment report quantifies this as a potential combined income benefit of USD 320 per household per year from after year 5.

This could be achieved through:

1. Stressing the need for a fully responsible management unit for the Peam Krasaop fishing estuary and to mobilise resources in line with specification of a community area management plan, if such do not already exist.

2. Bringing fishing effort into line with the reproductive capacity of the stocks, through support for the development of ecosystem-specific management plans with full engagement of fishers and other concerned stakeholders, in tandem with efforts to develop and expand stock enhancement methods such as mangrove protection and rehabilitation, demarcation of conservation areas and management of fish refuges.

3. Strengthening of fisheries monitoring, control and surveillance through capacity development of community fisheries members to undertake MCS and enforcement, together with expanded extension services to supplement and support services provided by FiA from District and Cantonment levels.

Activities could include (most of these activities are suggested by Peam Krasaob Commune Councillors):

1. Demarcation of community fishing zones in shallow water areas

[57] Ref. Annual Work Plan 2012 for Fisheries Strategic Framework.

[58] Strategic Planning Framework for Fisheries 2010-19, Vol. II, Background Information (RGC 2010)

2. Set up teams to protect community fishing zones
3. Plant mangrove trees
4. Create tourist fishing zones
5. Training and extension activities, including in aquaculture techniques like fish, crab, shell, frog and shrimp farming
6. Procurement of equipment required for improving monitoring, control and surveillance of the fisheries
7. Promotion of processing and marketing
8. Management supports

Proposal: Development and costing of a Demonstration Activity Plan for Peam Krasaob as outlined above in collaboration with the Peam Krasaob Commune Council, community members and FiA of Koh Kong.

13. Reinforcement of community dyke maintenance, drainage and irrigation systems management in cooperation with MoWRAM – for Prey Nob and Tuol Kokir.

The concerned Community Councillors have themselves suggested most of the following in this category, which also includes suggestions from mentioned draft CARP reports:

1. Build and rehabilitate sea water protection dykes
2. Build protective dykes for village homesteads
3. Repair water gates (sluice gate)
4. Repair (or deepen) other infrastructures (roads, canals, drains, reservoirs)
5. Develop proper water management plans
6. Construct water weirs for agriculture and livestock farming
7. Soil quality surveys for agriculture
8. Dig ponds for aquaculture
9. Integrate these action plans into government/ commune investment programmes
10. Management supports; including systematic monitoring of salinity and land subsidence

Proposal: Development and costing of a Demonstration Activity Plan for Prey Nob and Tuol Kokir as outlined above in collaboration with the Polder Management, Commune Council, community members, district authorities and MoWRAM provincial departments.

14. **Development of cooperative produce marketing, processing and / or input purchasing - or the same in cooperation with private commercial enterprises.**

    This potential demonstration activity would required several years of active presence by the project. It is therefore not seen as a feasible option as present.

6.1.3 Potential On-Farm Changes

The above off-farm changes would enable several on-farm changes; particularly could above off-farm activity 4 (integrated farming) enable all of the on-farm changes listed below, where relevant.

15. **Promotion of Integrated Pest Management (IPM) – a well established method of controlling multiple pests (in particular insect attacks) in crop production by using eco-friendly methods. This is particularly in response to the climate change of increased temperature, which is likely to increase such pest attacks.**

This activity is normally an integrated part (or even the main part) of undertakings involving Farmer Field Schools – like under activity 4. It can also be developed as an independent package – not necessarily connected to activity 4. This is not, however, recommended as it is much better to go for the more comprehensive approach – particularly in this context of finding appropriate adaptive measures to climate change.

Proposal: it is proposed to include IPM as an integrated part of demo activity 4

16. **Promotion and increased availability of shorter duration seeds for crops; particularly for wet-season paddy possibly enabling harvest before onset of heavy flooding and sea water surges. Such varieties will need to be tested (at no cost to farmers) in specific localities, where they are likely be effective.**

While this activity may well be part of off-farm activity 4, it can also, or even at the same time, be undertaken as a stand-alone demonstration activity. This is because of its nature of experimental trial or adaptive research; which is likely to require the participation of a research organisation experienced in this type of activity (e.g. Cambodia Agricultural Research and Development Institute (CARDI)).

The Provincial Directorates of Agriculture (PDA), and the Commune Councils, could and should participate and be given a role in this context. However, neither the PDA's nor the Commune Councils probably currently have sufficient

capacity to lead this kind of demonstration activity. But the activity may be able, over the CARP period, to install such a capacity at the PDA's.

The first NAPA project has entered into a contract with CARDI for similar activities. That contract also cover other areas of agricultural adaptive research

Proposal: Development and negotiation of a contract with CARDI for the above. This may also include other activities, if relevant.

17. On-farm water conservation method, and rain harvesting This in response to underground seepage of salt water into the water table – thereby to some extent possibly reinforcing the fresh groundwater table.

Future pressures from climate change may intensify water shortages, such as those already experienced by the target communities, i.e. fresh water scarcity. Rainwater harvesting can improve water supplies (e.g., in terms of own consumption) or increased crop production.

Rainwater harvesting locally collects and stores rainfall through various technologies. In the format envisaged, in situ rainwater harvesting system, rainwater harvesting technologies include soil and water management strategies that improve rainfall infiltration in the soil and decrease surface runoff. Thus, rainwater is efficiently put to use and soil erosion is countered. Examples of such systems are terracing, pitting and conservation tillage practices. Due to rainwater harvesting soil water is recharged to primarily better crop growth and increase farm productivity. Yet, the water can also be used for other purposes.[59]

This activity could also include promotion of improved and more efficient on-farm irrigation practises, for example, drip irrigation in vegetable and fruit production.

Proposal: *This activity can be included under the curicular of demo activity 4. In addtion, it could become a demonstration activity in its own right. To be decided.*

18. Promotion of increased livestock keeping - possibly by using a revolving scheme for improved breeds – tested successfully in Cambodia, Laos and elsewhere. This is in response to increased flooding problems as livestock are moveable. And although livestock also need water and fodder in the dry season the quantities of water involved are much less

[59] Ref. UNEP/Stockholm Environment Institute "Rainwater Harvesting: A Lifeline for Human Well-Being". 2009

than for e.g. a ha of paddy; while fodder conservation makes it possible to manage dry periods.

The major problem categories that plague livestock production in Cambodia are (a) diseases, (b) poor nutrition and (c) the low genetic potential of the local breeds. Disease could be minimised by vaccination, quarantine and management measures. Improved nutrition is both a management and a fodder availability problem. With the increase of population, the availability of wild fodder or feed is getting scarce. The farmers also lack the knowledge and the capital to improve the situation. Similarly, there is little incentive to improving the genetic potential

It is considered, however, that a revolving livestock scheme for improved breeds can address the above mentioned constraints. It will, in addition, increase the capital, income and nutrition base of the involved households, and thereby improve their livelihood prospects. The scheme can function as follows:

1. A few progressive farmers in each commune are selected to receive (as a grant with obligations) individual female animal(s) of an improved breed. The selected breeds must have a proven record of adequate productivity under Cambodian conditions. This could be a cow, pig, or small flock of ducks or hens, depending on local preferences and circumstances.

2. A pre-condition is that the first female[60] (and possibly more) offspring of these improved animals is passed (again as a grant with obligations) to a second selection of farmers in the same commune or village. Another pre-condition is that the farmers in question agree to receive advice and to follow certain guidelines on the husbandry of these animals. Contracts to the above effect are entered into between the concerned farmers and the CARP, plus possibly the Commune Councils, if this is appropriate. Subsequently 'passing' the gift' in this way can, in principle, continue into eternity, or at least until all interested households have received their improved breed.

3. Extension and disease control support must be made available through the Village Animal Health Workers as well as from the Animal Health and Production Department at provincial levels. The appropriate training of these can be incorporated into off-Farm activity 2.4

4. A farmer or community based organisation at each participating village should be established to take responsibility for all appropriate measures in this context, and provide a basis for recording and selection process, without which the introduction of improved breeds simply may dissipate into the unknown.

[60] Or the equivalent in cash.

The implementation of this demonstration activity could be outsourced to an NGO or similar organisation with experience of operating such schemes or at least with experience in promoting animal production. The commune councils need to be party to such contractutal arrangmeents, but do not themselves have sufficient experience and capacity to act as managers of this demonstration activity.

This demonstration activity would thus provide starting stock to farmers, as well as appropriate vaccination, feed pots, worming, and performance recording organisation in farmer groups. This will be accompanied with regular coaching in livestock management, nutrition, recording, pasture improvement, fodder conservation, etc. The incentive for recording, breeding selection and improved management could be provided by organising rural fairs in which prizes will be given to the owner of the best bull/best cow. Prize money (or in kind) may be donated by the private sector as promotional action (CP feed, Pharma, vaccines…).

It will give farmers a tool to actually produce livestock, and at the same time, deal with one of the major constraints, which is farmer's lack of capital to invest. This is to be done without actually making straightforward donations, which diminish ownership and motivation.

The concept is based on the experience of the EU-supported Livestock Farmer Support Project in Laos, Smallholder Livestock Production Programme (SLPP) in Cambodia 2005-10 and similar projects elsewhere. The former Coastal Zone Project 1997-2007 also used this concept. This experience has proven that the system of "passing the gift" (used by Heifer International for many years) is an effective way to introduce good livestock management practices. It is now also part of a major new EU-funded livestock sub-sector programme for Cambodia due to start beginning of 2013.

<u>Proposal:</u> It is proposed to develop and cost an implementation plan for a 'rotating livestock scheme' as described above. In doing that emphasis will be on: (1) getting the scheme started and complete the first rotation round before CARP closure beginning 2014, and (2) establish sustainable farmer organisations and support mechanisms also before CARP closure in 2014 – thereby securing that the rounds of rotation can continue on the basis of the livestock donated in the first round.

19. Promotion of mari-culture (e.g. crab ponds, shrimp fields, fattening cages, etc). This is in response to increased salinity as these marine cultures live in or tolerate salt water.

The concerned Community Councillors have themselves suggested the following in this category:

1. Provide fish seedlings and techniques for mari-cultures
2. Provide mari-culture techniques like fish, crab and shell farming
3. Digging of ponds (e.g. crab ponds)

Promotion of mari-culture is probably mostly relevant for Peam Krasaob and Tuol Kokir communes at Koh Kong. Here such activities can become part of off-farm activities 12 and 4 respectively.

Proposal: It is proposed that this potential demonstration activity becomes part of the community fisheries activity for Peam Krasaob and the integrated farming activity for Tuol Kokir.

20. **Fuel wood production of *Lucana sp*. However, these species require well-drained and non-acidic soils in order to thrive properly.[61] This would, therefore, only be a potential where higher grounds would be available.**

Proposal: To be considered in connection with the potential support to the already established community forestry project at Tuol Kokir Commune (Activity 11). Perhaps other species for fuel wood production could be found relevant for promotion in this context.

6.2 Short-listed Demonstration Activities

These short-listed activities are proposed for economic analysis under activity 2.6 as follows:

1. Integrated Farming Training Programme for (a) agricultural /fisheries extension staff and (b) households / families in multi-scale climate change adaptation strategies and integrated farming (integration of crops, livestock, fish, water) at 4 target communes. Preceded by Agro-Systems analysis (PRA methodology in use by MAFF), if required.

2. Community Forestry projects in cooperation with the Forestry Administration, where possibilities exist at Tuol Kokir. May include livestock grazing rights for livestock in forest areas. This is closely linked to the climate change agenda via its potential for promotion of appropriate tree species for shelter, food and fuel.

3. Community Fisheries project at Peam Krasaob in cooperation with the Fisheries Administration; especially in terms of strengthening regulatory measures and their enforcement[62].

[61] "Farming wood fuel for sustainable energy In rural areas in Cambodia" Sam Bona Leuk Dana, Small And Medium Enterprise Cambodia, 2005.

[62] FiA has currently 21 registered Coastal Fisheries Communities. If not, official registration with FiA as a Community Fisheries Organisation should be sought - as is required by the RGC sub-decree on CF management.

4. Reinforcement of community dyke maintenance, drainage and irrigation systems management in cooperation with MOWRAM – for Prey Nob and Tuol Kokir.

5. Promotion and increased availability of shorter duration seeds for crops; particularly for wet-season paddy possibly enabling harvest before onset of heavy flooding and sea water surges at all five communes. May include vegetables and supplementary crops. Such varieties will need to be tested (at no cost to farmers) in specific localities, where they are likely be effective.

6. Promotion of increased livestock keeping at five communes - by using a revolving scheme for improved breeds – tested successfully in Cambodia, Laos and elsewhere. This is in response to increased flooding problems as livestock are moveable. The influence of potentiallya more drought conditions also needs to be considered.

7. Promotion of in-field water conservation and on-farm water harvesting methods, if decided.

These seven proposed demonstration activites for CARP are generally characterised as:

- Containing most of the climate change counter measures suggested by the target communes and concerned offficials. However, the implementation arrangements proposed are still to be discussed with these and other stakeholders. (But notably do not contain rehabilitation of dyke systems, which are a clear priority for the target communes).
- Expected *a priory* (before calculations) to yield considerable social, environmental, economic and general livelihoods benefits; while at the same time being adaptive to the climate change predictions. However, detailed economic calculations are still to be made as part of activity 2.6.
- Posing relatively low implementation risks generally and for the concerned households in particular – because the implementation modalities proposed are well and successfully tried in similar circumstances.
- Are expected to have realistic resource requirement (although activity costing are still to come under Activity 2.6).

- Are expected to be implementable by the concerned and mentioned institutions and partners – with the capacity building measures defined in the proposals, where relevant.

The very short project period (CARP ends 1 Quarter 2014), however, poses a challenge because it will allow one main crop season (2013) *only* for implementation. Such a short implementation period is unusual for any kind of development effort, where 3-5 year periods are the norm.

The proposed demonstration activities, however, will still be able to start operations and be implemented as intended in the five target communes. But more time would have been desirable for follow-up, consolidation, application of lessons learnt and harvesting of results – as well as for expansion of the created capacity to other areas.

This observation would have been relevant for any kind of demonstration activity, not just for the above six, which are selected as to be not particularly vulnerable to the short time horizon.

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ANNEXES

Annex 1: TOR, Team Programme, People Met

Annex 2: Climate Change Prediction

Annex 3: Socio-Economic Data

Annex 4: Vulnerability and Risk Assessment Matrixes

Annex 1: TOR, Team Programme, People Met

Annex 1.1 Terms of Reference

Terms of reference – Livelihood Specialist

Vulnerability and risk assessment of community livelihoods in target districts

Analysis of economic and social costs and benefits of options for modified agricultural practices and fuel wood production

The coastal zone plays an increasing role in Cambodia's development, and continues to provide important environmental services. Human activities in Cambodia's coastal zone include recreation, industry, agriculture, fishery and transport. These activities may have direct or indirect effects on changing the coast. Recreation and tourism is an important sector among others. The beaches and islands attract an increasing number of tourists. Agriculture activities in the coastal zone are also quite significant. For example, approximately 45% of the population in Koh Kong-Sihanoukville and 80% in Kampot are engaged in agricultural activities. These activities are concentrated mainly in low-lying coastal zones due to the fertility of the land.

The coastal zones of Cambodia are threatened by several natural hazards, such as storm surges, high tide, beach erosion and seawater intrusion. Successions and combinations of droughts and floods have already resulted in a significant number of fatalities and considerable economic losses. Losses arising from floods have been further exacerbated by deforestation. Nationally, floods have accounted for 70% of rice production losses between 1998 and 2002, while droughts accounted for 20% of losses. Due to the impact of climate change, sea level rise (SLR) may affect the 435-km long coastline and the frequency and intensity of floods may increase and cause severe damage to, amongst other things, rice harvests. Low-lying areas, including settlements, beach resorts, seaports, coastal fisheries, and mangroves forests, may be threatened by rises in sea levels.

The National Adaptation Programme of Action to climate change (NAPA, 2006) identified the agriculture, water resources, coastal zone, and human health sectors as requiring immediate and urgent attention in order to address climate-induced problems. This component on "Coastal Adaptation and Resilience Planning" (hereafter referred to as "the coastal component") forms an integral part of the Cambodia Climate Change Alliance (CCCA). The development objective for the CCCA programme is "*climate change activities in Cambodia are nationally owned, led and aligned with Cambodia's development priorities, and are effectively coordinated and implemented*".

Brief Component Description

The immediate objective of this component is 'increased resilience of coastal communities and ecosystems to climate change through adaptation planning, demonstrated targeted local interventions and provision of practical learning experience in adaptation planning to the NCCC/CCD.'

There are 2 Outcomes of this component:

- Outcome 1: Improved climate change knowledge integrated into land use and coastal development plans.
- Outcome 2: Increased resilience of coastal communities and coastal ecosystem buffers to climate change and improved livelihoods.

Assignment

The following assignment relates to outputs under Outcome 2. Activities to be performed for the present assignment are indicated and shortly described below:

Vulnerability and risk assessment of community livelihoods in target districts – output expected end of June 2012 (activity 2.3 and identified sub-activities)

1. Access current data on climatic conditions and projected trends

2. Access or construct likely scenarios for the 2 districts for:

    a. 2.0: Very Short Term; e.g. 2012-2015.
    b. 2.1: Short Term (ST); e.g. 2015-2020
    c. 2.2: Medium Term (MT); e.g. 2020-2040
    d. 2.3: Long Term (LT); e.g. 2040-75
    e. 2.4: Very Long Term; e.g. 2075-2025

3. Evaluate most likely Scenarios.

4. Access /collect and group info/stats on community livelihoods in the two districts – preferably using a methodology similar to the Cambodia Socio-Economic Survey 2004 (example in attachment 1) – possibly supplemented by 'poverty' profiles and coping strategy illustration (examples in attachments 2-3).

5. Combine and integrate results of above points (2-3) and (4) into a vulnerability and risk matrix - (matrix to be developed).

6. Highlight / summarise the matrix results.

7. Introduction to alternative livelihoods – based on above.

Analysis of economic and social costs and benefits of options for modified agricultural practices and fuel wood production – output expected end of June 2012 (activity 2.6 and sub-activities)

1. Collect, procure and assemble relevant data on costs and benefits of above.
2. Calculate and analyse economic data on above – probably using the Gross Margin methodology – (possibly combined with cost/benefit ratios). Methodology may depend on data available.
3. Possibly elaborate results from (2) into financial and economic internal rates of return (IRR), if relevant and if data allows.
4. Consider intangible social costs and benefits, if any.
5. Summarise strategically and relate to the results of Activity 2.3.

Outputs

The output should be in the form of two separate reports, and extensive input to two other outputs.

2.3 Vulnerability and risk assessment of community livelihoods in target districts – output expected end of June 2012

2.5 Analysis of economic and social costs and benefits of options for modified agricultural practices and fuel wood production – output expected end of June 2012

And extensive inputs to the outputs:

2.7 Development of a detailed implementation plan for community adaptation demonstrations (end of October 2012)

2.10 Establishment of a monitoring and evaluation format for assessing benefits of demonstration activities (end of October 2012).

Qualifications

- Master degree in international development and livelihood improvement
- A minimum of 15 years working experience mainly focused on sector programming, value chains, livelihood improvement and capacity development
-
- Experience in public participation development process in relation to livelihood development

- Experience from livelihood programmes
- Strong analytical skills
- Previous experience from Cambodia is an advantage

Contact person

Contact person for the consultant will be Senior Technical Adviser Mr. Jens Erik Lyngby.

Duration

The consultancy will be for a part-time 2 months work, with a starting date of around mid April 2012 until end October 2012. Deadline for reporting will be end of June for the first two outputs and for inputs to the two remaining outputs end of October 2012.

Annex 3.2 Livelihoods Team Programme

Date	Time	Activity
		Inception Period **April 17 – May 4 2012**
2012		**Week 16**
April 16 **Monday**	Noon Afternoon	• Literature review and other preparations
April 17 **Tuesday**	Morning Afternoon	• International travel Denmark-Cambodia • *Arrival Phnom Penh*
April 18 **Wednday**	Morning Afternoon	• Internal Meeting with Local Livelihoods Consultant • Planning and arrangements for field tour to coastal provinces • Consultations and doc review[63] (*continuous*)
April 19-20 **Thursday / Friday**	Morning Afternoon	• Other meetings with MoE, and MAFF, Other Consultations, data collection and doc review (*continuous*)
April 21-22		*Week-end*
2012		**Week 17**
April 23 **Monday**	Morning Afternoon	• At Prey Nub area Mini-workshop with commune councillors at Prey Nub District office Visits to three commune sites
April 24-25 **Tuesday / Wednesd.**	Morning Afternoon	**Meeting** s Travel to Koh Kong Meeting with provincial departments Mini-workshop with commune councillors

[63] Consultations and reviews will be continuous throughout the assignment, and new meetings will continue to be added to the work plan.

Date	Time	Activity
		Inception Period **April 17 – May 4 2012**
April 26 **Thursday**	Morning Afternoon	• Meeting at Peam Krasop Site vists to Peam Krasoap and Tol Kokir
April 27 **Friday**		• **Meeting with provincial departments at Koh Kong** • Consultations and Reviews
April 28-29		*Week-end* *Travel to Phnom Penh*
2012		**Week 18**
April 30 **Monday**	Morning Afternoon	• More consultations and data collection in Phnom Penh
May 1-2 **Tuesday / Wednday**	Morning Afternoon	• Combined Review of field tour, consultations etc • Draft process and methodology to produce expected outputs due by end of June 2012.
May 3 **Thursday**	Morning Afternoon	Debriefing, discussions and presentation of work process for May-June 2012.
May 4 **Friday**	Morning Afternoon	Departure and international travel Cambodia-Denmark

Date	Time	Activity
		Data Collection Phase **May 4 – June 10, 2012**
2012	**May 7-11**	**Week 19**
Activity 2.3		Remaining data gaps are to be filled by SS during the week 7 - 11 May 2012.
Activity 2.6		Remaining listings, data collections and data procurements are to be done by SS during the two weeks 7 - 11 May and 21-25 May 2012.
May 12-13		*Week-end*

Date	Time	Activity
		Data Collection Phase **May 4 – June 10, 2012**
2012		**Week 20**
May 14-20		Mainly public holidays in Cambodi*ia*
2012	**21-25 May**	**Week 21**
Activity 2.3		Sub-Activity (2) and (3): *Construct and evaluate likely projections for climate change,* are to be accomplished by SS during the week 21 - 25 May[64] 2012.
Activity 2.6		Remaining listings, data collections and data procurements are to be done by SS during the week 21-25 May 2012. Field data collection tour to the coast
May 26-27		*Week-end*
2012	**May 28-1 June**	**Week 22**
Activity 2.3		Sub-Activity (5): *Draft Vulnerability and Risk Matrix,* is to be accomplished by SS during the week 28-May - 1 June 2012.
Activity 2.6		Sub-Activity (2.b); *Assembly of data into formats* is to be accomplished by SS during the week 28 May- 1 June 2012,
June 2-3		*Week end*
2012	June 4-8	**Week 23**
Activity 2.3		Sub-activity (7.1) "*listing of alternative livelihoods'*, should be done by SS during the week 4-8 June 2012.
Activity 2.6		*First calculations* (re. sub-activity 3) by SS during the week 4-8 June 2012.
June 9-10		Week-end
2012	June 11-15	**Week 24**
June 11		International Travel of International Experts

[64] The preceding week is mostly public holidays in Cambodia.

Date	Time	Activity
		Assessment Phase **(June 10-30 2012)**
2012		**Week 23**
June 7-8		Reviews and report drafting preparations
2012		**Week 24**
June 10 **Sunday**		• International travel Denmark-Cambodia
June 11 **Monday**	Morning Afternoon	• *Arrival Phnom Penh* Literature review and other preparations • Internal Meetings
June 12 **Tuesday**	Morning Afternoon	• Meeting UNDP-DEF / IFAD project unit at MAFF 14.00 *Reviews, data collection, consultations (continous)*
June 13 **Wednday**	Morning Afternoon	• Meeting at MOWRAM 15.00 • Further Consultations and doc review[65] (*continuous*)
June 14-15 **Thursday / Friday**	Morning Afternoon	• Consultation on weather stations data collection and doc review Briefing at Project Office, MoE.14.30 • *Assess and finalise data collections*
June 16-17		*Week-end*
2012		**Week 25**
June 18 **Monday**	Morning Afternoon	• Finalise and summarise vulnerability and risk matrix results
June 19 **Tuesday**	Morning Afternoon	• Screening, evaluation and short-listing of high-potential candidates for alternatives livelihoods

[65] Consultations and reviews will be continuous throughout the assignment. New meetings will thus continue to be added to the work plan.

Date	Time	Activity
		Assessment Phase **(June 10-30 2012)**
June 20-21 **Wedneday** **Thursday**	Morning Afternoon	• .drafting of output 2.3: "Vulnerability and Risk Assessment Report" • **Presentation of draft Report 2.3.** (June 21, 10 am. at MoE)
June 22 **Friday**	Morning Afternoon	• AK accompanies Survey Team to Preah Sihanouk Province for collection of data (until June 25) • Final assembly of economic analysis
June 23-24		*Week-end*
2012		**Week 26**
June 25 **Monday**	Morning Afternoon	• Assessment and elaboration of economic calculations. • Assessment of intangible social costs & benefits
June 26-27 **Tuesday-Wednesd.**	Morning Afternoon	• Summarise strategically – and first drafting of Output 2.6: Cost & Benefits Report
June 28 **Thursday**	Morning Afternoon	• **Submission of Report 2.6** • Action Plans for July- September 2012.
June 29 **Friday**	Morning Afternoon	• **Debriefing meeting at MoE** • Departure and international travel Cambodia-Denmark
2012		**Week 27**
July 2-6		***Preparation of the two FINAL Draft Reports***

Annex 1.3 Persons Met

Name	Title, Organization
Dr Vann Monyneath	National Coordinator, Ministry of Environment
Mr. Meas Rithy	Deputy National Coordinator, Ministry of Environment
Mr Sreng Sophal	Project Administrator, Ministry of Environment
Dr. Heng Chan Thoeun	Deputy Director, Ministry of Environment
Mr Pieter Ypma	Senior Manager, CAVAC Innovation in Agriculture
Dr. Philip Charlesworth	IDE, Cambodia
Dr. Sovichi Kao	Deputy Director General, Fisheries Administration
Ms Hap Navy	Head Socio-Economist, Fisheries Administration
Ms Mao Mony Ratana	Senior Programme Officer, Danida
Mr. Prak Visal	Deputy Director, Sihanoukville Province
Mr. Phay Phan	Deputy Governor, Sihanoukville Province
Dr. Mak Soeun	Director, Department of Agricultural Extension, MAFF
Mr Srey Vuthy	Deputy Director, Planning, MAFF
Mr Pelle Gatke	Technical Adviser, Fisheries Action Coalition Team (FACT)
Mr Chan Danith	Coordinator, Secretariat of the TWG-Fisheries
Mr Julian Abrams	Consultant, NCDD, Ministry of Interior / UNDP
Mr. Kong Chanthan	Chief of Office, NCDD, Ministry of Interior
Mr Liam Fee	Development Adviser, UN HABITAT
Mr Kosal Sar	National Sepcialist, LGCC, NCDD, UNCDF
Mr Meach Yady	Chief, Agricultural Marketing, MAFF
Ms Meas Sotheavy	Deputy Director, Planning and Statistics, MAFF
Dr Tue Kell Nielsen	Water Resources Management Adviser, CARP
Mr. Tuy Samran	Project Manager, EC-FAO Food Security Project
Mr. Soy Seung	Programme Assistant, FAO
Mr. Jeevanan Duraisamy	Climate Change Officer, FAO
Mr. Victor Jona	Deputy Director General, MIME
Mr. Meas Bunley	National Communication Officer, NAPA / UNDP
HE Veng Sakhon	Secretary of State, MOWRAM
Dr. Kesothea Nou	Researcher, Cambodia Development Resources Institute
Ms Kalyan Keo	Programme Manager, UNDP
Mr Pinreak Suos	National Advisor, NAPA Follow-Up Project, UNDP
Dr. Philippe Leperre	Senior Livestock Consultant, Laos
Dr. Dara Rat Moni Ung	Adviser, NAPA Follow-Up Project, UNDP and IFAD
Jens Erik Lyngby	Senior Adviser, CARP
Dr. Mamara	Director, Carmbodia Agricultural Research Institute

List of participants attended sharing information on Community Livelihood for Climate Change Adaptation from 22-28 Apr 012 at Preah Sihanouk and Koh Kong Provinces

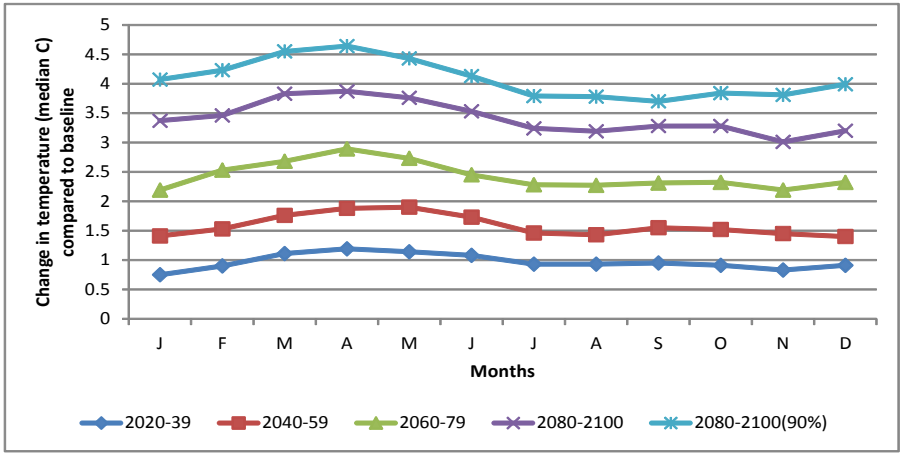
N	Name	Position	Institution
1	Sao Buryvattanak	Deputy district governor of PreyNob	PreyNob District
2	PHoeun Nam	commune chief	Toethla
3	Hak San	commune chief	ToekLaOrk
4	Prak SaRoem	commune chief	Sammaky
5	Keut Yin	Vice Commune Chief	Sammaky
6	Ing Chan	Commune Council	Sammaky
7	Yim Boy	Poldar community Chief	Poldar community
8	Nou Ramy	Director	PUC
9	Meas Sarath	Chief P4	PUC
10	Thim Puthy	Commune Secretary	Toethla
11	Soem El	Commune Council	Toethla
12	Choun SunHeng	Vice Commune Chief	ToekLaOrk
13	Ven Num	Commune Council	ToekLaOrk
14	Oun Am	Environmental Unit	PreyNob District
15	Meas Rithy	Deputy	CCA Costal Zone Project/LDCF
16	Sreng Sophal	Project Admin	CCA Costal Zone Project/LDCF
17	Jens Lauring Knudsen	In. consultant	CCA Costal Zone Project/LDCF
18	Phay Phan	Deputy Provincial Governor	Preah Sihanouk province
19	Kuy Hak	Deputy Director of DAFF	Preah Sihanouk province
20	Hun Phy	Deputy Director of DLMUC	Preah Sihanouk province

21	Heng SorphanRith	Deputy Director of DWRAM	Preah Sihanouk province
22	Chim Kalyanny	Deputy Director of DoE	Preah Sihanouk province
23	Prak Visal	Deputy Provincial Cabinet	Preah Sihanouk province
24	Noy Leng	Village Chief	Village I
25	My Thorn	Commune Council	Peam Krasoap,KK
26	Chut Teth	Commune Chief	Peam Krasoap,KK
27	Khoem SuKem	Commune Chief	TuolKorki, KK
28	Khoem Saneth	Commune Council	TuolKorki, KK
29	Num Duong	Commune Council	TuolKorki, KK
30	Neang Kun	Commune Council	Peam Krasoap,KK
31	Yem Yan	Commune Council	Peam Krasoap,KK
32	Seak SaBun	Community	Peam Krasoap,KK
33	Pen Vanna	Deputy district governor	MondulSeyma, district, KK
34	Ty Vich	Commune Secretary	Peam Krasoap,KK
35	Ouch Touch	Chief of provincial cabinet	KK
36	Houng ChamRoeun	DAFF staff	KK
37	Lung KhoemTha	Vice Chief of DLMUC	KK
38	Seng SaEm	Chief office of DWRAM	KK
39	Mom Phalla	Deputy Director od DoE	KK
40	Meas Sytha	Vice Chief Forestry contentment	KK
41	Pay Savin	Chief of Triage, Fishery	KK

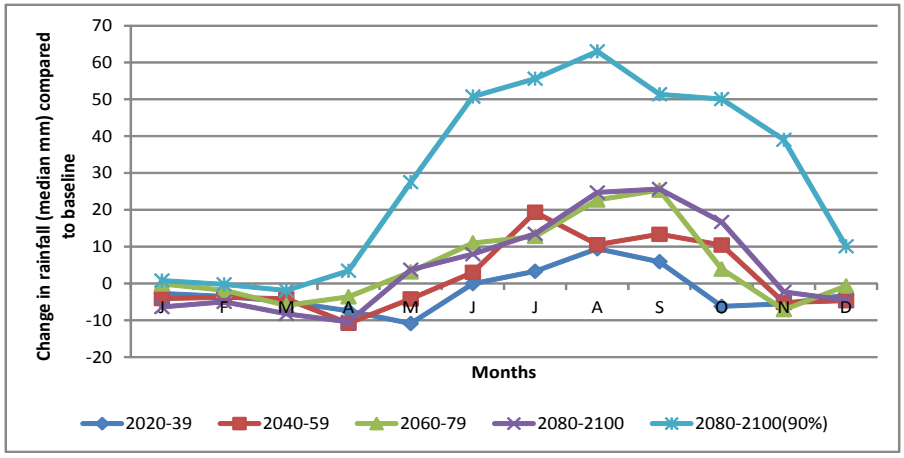
Annex 2: Climate Change Predictions

Increase in temperature and increase in rainfall

	2020-39	2040-59	2060-79	2080-2100	2080-2100(90%)
J	0.75	1.41	2.19	3.37	4.07
F	0.9	1.53	2.53	3.46	4.23
M	1.11	1.76	2.68	3.83	4.55
A	1.19	1.88	2.89	3.87	4.64
M	1.14	1.9	2.73	3.76	4.43
J	1.08	1.73	2.45	3.53	4.13
J	0.93	1.46	2.28	3.24	3.79
A	0.93	1.43	2.27	3.19	3.78
S	0.95	1.55	2.31	3.28	3.7
O	0.91	1.52	2.32	3.28	3.84
N	0.83	1.45	2.19	3.01	3.81
D	0.91	1.4	2.32	3.2	3.99
Sum	11.63	19.02	29.16	41.02	48.96
Average	0.97	1.59	2.43	3.42	4.08



	2020-39	2040-59	2060-79	2080-2100	2080-2100(90%)
J	-2.69	-4.08	-0.11	-6.4	0.8
F	-3.48	-3.73	-1.82	-4.99	-0.23
M	-4.9	-4.2	-5.96	-8.22	-1.91
A	-7.41	-10.81	-3.61	-10.41	3.47
M	-10.86	-4.2	3.15	3.75	27.53
J	-0.03	3.04	11.02	7.97	50.78
J	3.34	19.36	12.79	13.49	55.63
A	9.44	10.54	22.69	24.71	63.04
S	5.92	13.36	25.33	25.67	51.39
O	-6.2	10.45	3.92	16.71	50.1
N	-5.49	-5.18	-7.09	-2.27	39.05
D	-3.1	-4.69	-0.69	-4.52	10.1
Sum:	-25.46	19.86	59.62	55.49	349.75
Average	-2.12	1.66	4.97	4.62	29.15



Annex 3: Socio-Economic Data

3.1 Prey Nup Mini-Workshop

For Toek Thla, Thoek Laork and Sammaki Communes information was gathered regarding the most serious climate impact, sources of household income, recommendations for changed agricultural practices and recommendations on demonstration activities at a mini-workshop on Monday 23rd April 8-12: Prey Nob District Rep, Toek Thla, Thoek Laork and Sammaki Commune Council Memebers, Poldar Community at Prey Nob District Office Hall

The results were as follows:**Question No.1 – Most serious climate impact**

	Prey Nob Generally	Toek Thla	Toek Laork	Sammaki
Short-term (now)	- Insects destroy rice fields - Sea water level rises up every year. - Flood caused by surface runoff. - Draught (not serious) - Storms	- Storms destroy houses and rice fields frequently in October until December. - Sea water level rises up and destroys rice fields and crops.	- Sea water level rises up. - Storms destroy rice fields (just in time the rice is reap) - Insects destroy rice fields - Draught occurs during rainy season - Increase temperature	- Storms destroy crop, fruit tree and other agriculture - Storms destroy houses (roofs were removed, houses collapsed) within 5 to 15 days long in October until December (every year). - Sea water intrusion into rice field. - Poor soil fertility (productivities decrease) - Lakes are shallow because of siltation
Medium-term (in 2020)	- Sea water level rises up every year. - Draught (not serious) - Storms	- Increase temperature abnormally (very hot) - Local people face a lot of difficulties like storms, draught, sea water rising,	- Sea water intrusion into rice field. - Lakes are shallow because of siltation which will result insufficient	- Awareness raising - Agricultural planning, - Construct sea water and fresh water protection dams - Construct

		etc.	water sources. - Increase temperature - Increase population - Insufficient lands for agriculture - Lack of water for usage	fresh water reservoirs - Introduce new rice varieties to fit with the seasons
Long-term (2020-2050)	- Sea water level rises up - Serious floods and take long time.	- The impacts will get worse if there is no protection measures to be carried out.	N/A	N/A
Very long term (2050-)	- Sea water level rises up and destroy dams and other constructions - Draught		N/A	N/A

Question No.2 – Sources of household income

	Prey Nob Generally	Toek Thla	Toek Laork	Sammaki
Crops	75%	80%	77%	75%
Livestock	5%	5%	5%	7%
Fisheries	6%	7%	5%	5%
Wage (private and government)	5%	1%	10%	5%
Remittances	3%	0%	0%	1%
Other income (small business, garment and palm oil factories)	6%	7%	3%	7%

Question No.3 – Recommendations for changed agricultural practices

	Prey Nob Generally	Toek Thla	Toek Laork	Sammaki
1	Agricultural sector - Rehabilitate dams - Rehabilitate reservoirs - Promote insect/pest prevention substance - Change agricultural practices - Change rice varieties - Reforestation	- Build sea water protection dam 12 km.	- Build sea water protection dam 12 km.	- Rehabilitate reservoirs 3120 meters
2	Livestock sector - Train on livestock farming to fit the season - Train on how to treat livestock	- Deepen lakes, rivers, canals drainages, etc. - Construct water weirs	- Train on how use proper fertilizers and insecticides.	- Provide new varieties with high yield. - Provide short term rice varieties and with high yield
3	Fisheries sector - Provide accurate and in time climate information (storm) - Train (awareness raising) on fishery law.	- Select new rice varieties that can be adapted to climate changes. - Increase agricultural circles	- Train on livestock farming and provide good seedlings.	- Train on livestock farming and provide good seedlings like pigs, cows and buffalos.
4		- Train on livestock farming and agriculture with new technologies.	- Rehabilitate channels for transporting of fishermen - Construct water weirs for agriculture and livestock farming.	- Dig ponds for aquaculture - Promote fish farming in natural rivers lakes, etc.

Question No.4 – Recommendations on demonstration activities

	Prey Nob Generally	Toek Thla	Toek Laork	Sammaki
1	- Provide new rice varieties with high yield and adaptable to the climate changes.	- Provide appropriate seasonal rice varieties.	- Soil quality surveys.	- Soil quality surveys for agriculture.
2	- Provide fertilizer and insecticide for agriculture.	- Provide new techniques for livestock farming and provide good seedlings like pigs, cows and buffalos.	- Select rice, crops and livestock varieties that can adapt to climate changes.	- Provide new rice varieties with high yield and adaptable to the climate changes.
3	- Repair the infrastructures.	- Provide fish seedlings for family aquacultures (Tilapia specie).	- Provide resources to buy seedlings.	- Provide techniques in insecticide utilizations.
4	- Develop proper water management plans.		- Provide knowledge and techniques in agriculture and livestock farming.	- Provide fish seedlings and technique for aquacultures.
5			- Integrate these action plans into government investment program.	

3.2 Koh Kong Mini-Workshop

For Peam Krasaob and Tuol Koki Communes information was gathered regarding the most serious climate impact, sources of household income, recommendations for changed agricultural practices and recommendations on demonstration activities at a mini-workshop on Monday 23rd April 8-12 with Peam Krasaob and Tuol Koki Commune councillors and representatives. Main results are given below:

Question No.1 – Most serious climate impact

	Peam Krasaob Generally	Peam Krasaob	Tuol Koki
Short-term (now)		- Sea water level rises up. - Storms occur frequently - Irregular rainfall - Increase temperature - Degrade seashore - Lack of water sources - Lost income from fisheries - Agricultural land and villages were flooded - Infrastructures (roads, schools, etc.) were destroyed - Mangrove forests were destroyed	- Sea water level rises up. It intrudes rice fields, decreases productivity, degrade soil fertility and fisheries decreases - Local people migrate to find job outside their villages. - Increase temperature - Irregular rainfall - Decrease agricultural production yields, plans do not fruit and die - Big storms - Animal and poultries ill and die - Fishery yield like shrimp, fish, crab, shell, etc. decreases.
Medium-term (in 2020)		- Sea water level rises up every year. - Increase temperature - Heavy rain and serious thunder occur very often - Lost income from fisheries	- Sea water level rises up will cause: ➢ Sea water intrudes rice fields ➢ Degrade soil fertility ➢ Decrease agricultural productivity ➢ Increase population ➢ Insufficient land for agriculture
Long-term (2020-2050)		- Lost natural seashore - Decrease fishery resources	- Sea water level rises up will cause: ➢ Lost rice fields ➢ Lost resident land ➢ No land for agriculture ➢ People migrate to other places - Increase temperature will cause: ➢ Decrease agricultural yields ➢ Livestock and poultries ill and die. It

			will be difficult to farm.
Very long term (2050-)	N/A		N/A

Question No.2 – Main sources of household income

	Peam Krasaob	Peam Krasaob Community	Tuol Koki
Crops	0%	4%	55%
Livestock	0%	0%	20%
Fisheries	76%	60%	10%
Wage (private and government)	3%	8%	10%
Remittances	0%	3%	3%
Tourist boat	10%	10%	
Other income (small business, garment and palm oil factories)	11%	15%	2%

Question No.3 – Recommendations for changed agricultural practices

	Peam Krasaob Generally	Peam Krasaob	Tuol Koki
1	- Build sea water protection dam	Rice plantation - Select rice varieties that are resistant to salt water	Rice plantation - Select short term rice varieties - Select rain (flood) resistance rice varieties - Increase rice production circles (tow times a year).
2	- Promote planting fruit trees, rice and vegetable - Promote livestock farming - Promote processing fisheries	Fruit tree plantation - Plant coconut trees, sapodilla trees, pineapples, rose-apple trees, otaheite-apple trees (Mkak), custard apple trees, mango trees, etc.	Plant plants that are resistant to hardship of climate like - Rubber trees - Cassava - Cashew net - Fruit trees
3	- Demarcate fishing zones in shallow water areas. - Promote aquaculture for example fish, shell, crab and shrimp farming.	Vegetable plantation - Plant Nonoung, potato, bitter melon (Mreh), chili, water convolvulus, mushrooms.	Fisheries sector - Promote aquaculture like fish and crab farming - Livestock farming
4		- Livestock farming like chickens, ducks, pigs, cows, buffalo, goats, - Aquaculture like fish, frog and crab framing.	Technical support - Provide techniques on livestock farming and nursing

Question No.4 – Recommendations on demonstration activities

	Peam Krasaob Generally	Peam Krasaob	Tuol Koki
1	- Demarcate fishing zones in shallow water areas	- Build dam to protect village from water intrusion	- Rehabilitate Norng Nay lake
2	- Improve seashore for tourist.	- Demarcate community fishing zones	- Rehabilitate sea water protection dam 1400 meters.
3	- Build sea water protection dams.	- Create tourist fishing zones.	- Repair 3 water gates (sluice gate).
4	- Build reservoirs.	- Process fish resources and seek for markets.	- Build sea water protection dam 2300 meters in Tuol Koki Kraom village.
5	- Provide aquaculture techniques like fish, crab and shell farming	- Train tourist guides	- Build (concrete) boxes used as fish shelters put in Tuol Koki Kraom and Koh Chak villages
6	- Extend potential tourist areas	- Set up teams to protect community fishing zones.	- Provide vegetable seeds
7	- Train tourist guides	- Build shelters and bathrooms for tourists	- Provide chicken for rearing
8	- Train poly-techniques like tailor, hairdresser, cosmetic etc.	- Build latrines at seashore for tourists	- Provide techniques for agriculture and livestock farming
9	- Plant mangrove trees.		- Plant mangrove trees.

3.3 Poverty Profiles

Level of Income

The average gross daily income of household is 9,915 Riel in Prey Nob and 18,310 Riels in Peam Karsob. Average gross annual income of household in three communes of Prey Nob district is US$871 per year. The average gross income of household in two communes of Mondul Seima District is US$1,608.

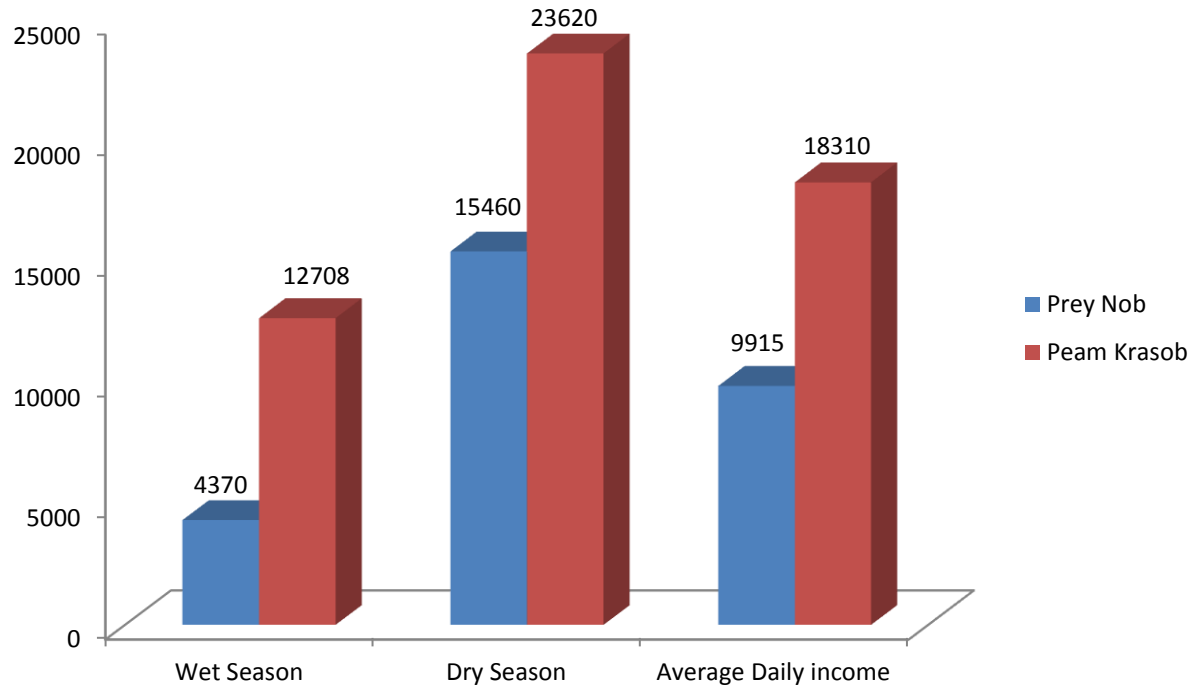
The Source of cash income in Prey Nob is from actual sales of livestock, paddy, fishing and poultry. Livestock – although not often sold or traded – is clearly an important source of value, providing some form of security to households in times of need.

The sources of cash income in Peam Krasob are from actual sales of fisheries products, tourist services, wet paddy product and sales labor.

Average Gross Income in Prey Nob & Peam Krasob

Target Area	Commune	Gross Income per HH Wet Season (Riel/Daily)	Gross Income per HH Dry Season (Riel/ Daily)	Average Gross Income per HH (Riel/daily)
Prey Nob	Samaki	4,370	15,460	9,915
	Toek Laork			
	Toek Thla			
Mondul Seima	Peam Krasob	12,708	23,620	18,310
	Toul Korki			

Source. Data sheets of "Assessment of Coping Strategies", CARP june 2012.



Livelihood Profile for Income GroupPoverty classification by National Level (Ministry of Planning)

Criteria for poor assessment

The assessment of poor households (surveyed by provincial authorities) was based on 16 criteria which are defined by the Ministry of Planning. The 16 criteria are listed below:

1. This house belongs to you or you rent it from other person.
2. Material used to make roof of the house (interviewer examines and fill up, do not ask)
3. Material used to make the wall of the house (interviewer examines and fill up, do not ask)
4. General condition of the house (interviewer examines and fill up, do not ask)
5. What is the size of your house? (interviewer asks and examines)
6. Household income

6a. What is your major income among the income activities: rice cultivation, vegetable planting or crop planting, and other activities?

6b. How much area of rice cultivation, vegetable planting or crop planting land? (include your own land, rented land and land surround the premise)

6c What kind of fishing tools do you have?

6d What are your major income activities?

7. Livestock raising activities
7a. Do you raise pig, goat, cow, buffalo, horse? If yes, how many are they? How many of them do you exchange raising with other people? (for people who live on land)

7b. Do you raise pig? If yes, how many are they? How many of them do you exchange raising[66] with other people? (for people who live on water)

8. Within the last 12 months did you owe someone's rice? If yes, how many month?
9. Household members
9a. How many member does your family have?

9b. How many member of your family that do not have income?

10. How much property do you have? List down
11. How many transportation means do you have? List down
12. Within the last 12 months is there any even happen that make you lose income, face food shortage, sold your properties, or borrow money from other people?
13. School attendant of children in between 6-11 years old
13a. How many person in your family are 6 years old to 11 years old?

13b. How many of them do not go to school?

13c. What reasons that cause those children do not go to school?

14. Special condition that causes their livelihood goes down
15. Special condition that causes their livelihood goes up
15a. Within the last 12 months did you receive any support from your children or your relations?

15b. Within the last 12 months, what even that improves your family's livelihood?

16. The interviewer should check, is there any doubtful answers?

Poor household condition

The poor households conditions in the target areas differs depending on proximity to town areas. Therefore, poor households are divided in two categorys: close to urban areas and remote areas. In general, population density in areas close to urban areas is higher than areas in more remote locations. In more relatively urban areas people are facing sanitation problems as there is little space for building toilets or even latrines.

Also, poor households' conditions differ in terms of occupation and numbers of family involve in earning income. The conditions of poor households are based on the following factors:

1. They don't have their own cultivated land
2. They have their own cultivated land but less than one hectare
3. Low income
4. Most of family do not have income
5. The number of livestock that they raise
6. They have met the even that make their family lose income, face food shortage, sold your properties, or borrow money from other people for the last 12 months.

3.4 Commune Information

1. Poverty

Commune	Total HH	Poor G1	Percentage (%)	Poor G2	Percentage (%)	Total Poor (G1+G2)	Percentage (%)
Samaki	959	162	17	162	17	324	34
Toek Laork	861	103	12	127	15	230	27
Toek Thla	1133	112	10	218	19	330	29
Prey Nob	1382	218	16	142	10	360	26
Toul Tortoeng	855	83	10	212	25	295	35
O Oknha Heng	1566	166	11	244	16	410	26
Peam Krasob	277	55	18	103	33.8	158	57
Toul Korki	241	52	17.5	68	22.9	120	50

Poor G1: Poor grade 1 or Poorest

Poor G2: Poor grade 2 or Poor

Source: Provincial Planning Department Sihanoukvill and Koh Kong Province 2011

2. Occupation

Main Occupation in two communes in Mondol Seima District, Koh Kong Province

Main Occupation	Peam Krasob	Toul Korki
agriculture	2%	45%
Long time crop		6%
Short time crop		5%
Vegetable		2%
Raising Animal	3%	
Fishing	64%	12%
Business	8%	6%
Eco-tourist	13%	
Government service	3%	
Sale labor	5%	
Other job	2%	13%
Work outside commune (Thai, other provinces..)		11%

Sources: Commune Profile 2012

Main Occupation in six communes in Prey Nob district, Sihanoukville

Main Occupation	Samaki	Toek Laork	Toek Thla	Prey Nob %	Toul Totoeng %	O Oknha Heng%
Agriculture	86.25	92.74	40.34	47.33	52.85	54.53
Long time crop	0.00	0.11	1.42	0.07	0.08	0.49
Short time crop	0.00	0.00	2.49	3.63	1.85	1.95
Vegetable	0.00	0.00	0.53	1.23	1.49	1.26
Raising Animal	0.00	0.00	1.69	3.24	0.56	0.49
Fishing	0.00	0.00	47.02	0.96	0.56	5.75
Bussiness	0.22	0.00	3.29	5.59	4.06	3.08
Eco-tourist	9.79	2.53	0.00	0.00	0.00	0.00
Government service	2.31	0.55	1.51	2.97	2.21	1.11
Sale labor	0.66	1.21	0.00	16.19	15.91	22.23
Other job	0.77	2.86	1.71	18.79	20.43	9.11
Work outside commune (Thai, other provinces..)	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

Sources: Commune Profile 2012

3. Livestock

Percentage of HH raising Buffalo-cow

Commune	Total HH	Total HH Feed Buffalo-cow	Number of Buffalo-cow	Average Buffalo-cow/HH
Samaki	909	424	1078	2.5
Toek Laork	876	438	912	2.1
Toek Thla	1,123	367	859	2.3
Prey Nob	1,397	95	415	4.4
O Oknha Heng	1,571	237	906	3.8
Toul Tortoeng	859	95	239	2.5
Peam Krasob	277	1	5	5
Toul Korki	241	547	152	3.6

Source: District Profile 2012

Percentage of HH raising Buffalo

Commune	Total HH	Total HH Feed Buffalo	Number of Buffalo	Average Buffalo-/HH
Samaki	909	N/A	N/A	
Toek Laork	876	N/A	N/A	
Toek Thla	1,123	N/A	N/A	
Prey Nob	1,397	54	187	3.5
O Oknha Heng	1,571	95	377	4.0
Toul Tortoeng	859	30	67	2.2
Peam Krasob	277	N/A	N/A	
Toul Korki	241	N/A	N/A	

Source: Commune Profile 2012

Percentage of HH raising cow

Commune	Total HH	Total HH Feed cow	Number of cow	Average cow/HH
Samaki	909	N/A	N/A	
Toek Laork	876	N/A	N/A	
Toek Thla	1,123	N/A	N/A	
Prey Nob	1,397	33	104	3.2
O Oknha Heng	1,571	144	491	3.4
Toul Tortoeng	859	51	108	2.1
Peam Krasob	277	N/A	N/A	
Toul Korki	241	N/A	N/A	

Source: Commune Profile 2012

Percentage of HH raising pig

Commune	Total HH	Total HH Feed pig	Number of pig	Average pig/HH
Samaki	909	634	N/A	
Toek Laork	876	703	N/A	
Toek Thla	1,123	253	N/A	
Prey Nob	1,397	209	495	2.4
O Oknha Heng	1,571	283	875	3.1
Toul Tortoeng	859	85	279	3.3
Peam Krasob	277	N/A	N/A	
Toul Korki	241	N/A	N/A	

Source: Commune Profile 2012

Percentage of HH raising hens

Commune	Total HH	Total HH Feed Hens	Number of Hens	Average Hens/HH
Samaki	909	806		
Toek Laork	876	827		
Toek Thla	1,123	773		
Prey Nob	1,397	892	5666	6.4
O Oknha Heng	1,571	1416	15060	10.6
Toul Tortoeng	859	687	4795	7.0
Peam Krasob	277	N/A		
Toul Korki	241	N/A		

Source: Commune Profile 2012

Percentage of HH raising duck

Commune	Total HH	Total HH Feed duck	Number of duck	Average duck/HH
Samaki	909	47		
Toek Laork	876	110		
Toek Thla	1,123	176	N/A	
Prey Nob	1,397	202	6492	32.1
O Oknha Heng	1,571	184	3580	19.5
Toul Tortoeng	859	184	1874	10.2
Peam Krasob	277	N/A		
Toul Korki	241	N/A		

Source: Commune Profile 2012

4. Mari or Aquaculture (Fish)

Commune	Total HH	Total HH Feed fish	Number of fish (kg)	Average fish /HH
Samaki	909	7	N/A	
Toek Laork	876	8	N/A	
Toek Thla	1,123	63	N/A	
Prey Nob	1,397	4	2000	
O Oknha Heng	1,571	3	750	
Toul Tortoeng	859	N/A	N/A	
Peam Krasob	277	N/A	N/A	
Toul Korki	241	N/A	N/A	

Source: Commune Profile 2012

.5 Poor household distribution

The number and percentage of poor households category 1 & category 2 in each commune is shown in the Table 3.5.

Table 3.5: Poor households in Prey Nob & Mondol Seima

No.	District	Commune	Poor 1	Percentage	Poor 2	Percentage	Not poor	Percentage	Total HH
1	Mondol Seima	Peam Krasaob	55	18%	103	33%	115	49%	277
		Tuol Kokir	52	18%	68	23%	127	59%	241
2	Prey Nob	Sameakki	162	17%	162	17%	635	66%	959
		Tuek L'ak	103	12%	127	15%	631	73%	861
		Tuek Thla	112	10%	218	19%	803	71%	1133

Source: Provincial Planning Departments, Sihanoukville and Koh Kong Province, 2011

There are four types for poor households category 1.

1. Poor households have not land, they live on illegal land like road side, river banks or public land;
2. Poor households have no land but live on other people's land to look after land or farm of other people;
3. Poor households have no land but live with their relative like son or daughter live with their parents or their auntie or their uncle or the parents live with their son or daughter etc.;
4. Poor households have their own house and land, these are often located quite far from the main road and scatter, only foot path they use to reach their houses.

In terms of the conditions of poor household category 2, most of them have their own house and land, and most of their houses are located no less than 100 meters from the main road.

The percentage of household have a land holding of less than 1 ha are 37% in Toek Thla, 55% in Toek Laork and 30% in Samaki commune. For the household with no land the percantage is about 24% in Toek Thla, 10% in Toek Laork and 14% in Samaki commune. These households were classified as poor category 1. About 53.7% of households in Toul Korki have less than 1 ha of land and the other 20.37% has no land holding which classified as poor category 2 . However, in Peam Krasob commune there is only 30 ha of cultivatable land for paddy, vegetable and other crops.

Poverty classification by income group

The table below shows the percentage of income group through the analysis from CSES 2011 for Costal Region.

Table 2: The Composition of Net Income by Quintile (with household weights)[67][68]

	Numbers					Percent				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Coastal Region										
Agriculture	940	3274	4366	4514	7113	89	85	70	44	34
-Crop dry season	454	712	1153	1658	2773	43	19	19	17	13
-Crop wet season	12	219	383	443	621	1	6	6	4	3
-Livestock	112	1787	2155	1482	1921	11	46	35	14	9
-Fishing	62	171	209	339	1010	6	4	3	3	5
-Forestry	300	385	465	592	788	28	10	7	6	4
Wages	0	418	1745	5347	13008	0	11	28	52	63
Remittances	22	95	51	66	24	2	2	1	1	0
Other income	95	60	40	316	681	9	2	1	3	3
	1057	**3847**	**6202**	**10243**	**20826**	**100**	**100**	**100**	**100**	**100**

Note:

1. Poorest, 2. Next Poorest, 3. Middle, 4. Next richest, 5. Richest

Based on the table 2 shows that the net income of poorest and next poorest is more than 80% earned from agriculture such as crop, livestock, fishing and forestry while 50% net income for richest and next richest received from wages.

[67] The table is based on a special run by the Statistics Department on Cambodia Poverty Assessment Survey data 2011. However, there might be errors in these calculations – because the result seem very different from the more stringent survey of 2004. We have therefore been relectant to use the data, which are also general for the Coatasl provinces as a whole.

[68] "with household weights" imply that the table is upscaled from the CSES samples to mirror the total population.

Annex 4: Vulnerability and Risk Assessment Matrixes

Annex 4.1: Vulnerability and Risk Assessment Matrix for Peam Krasaob

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
Crops	Destruction/loss of crops in wet season	Sea level is predicted to rise by up to 0.56 meters by 2090.	Salinization of soil and groundwater. Inundation of farming land (loss of cultivable land) near coast areas has a detrimental effect on soil fertility and quality of ground water	• In Peam Krasaob crop farming plays only a small role in terms of sources of income, considering that there only exist few ha of cultivable land.	4	2	M
		More and heavier rain downfall	An increase in frequency and intensity of flooding events due to more frequent episodes of heavy rainfall.				
	Destruction/loss of crops in dry season	Sea level is predicted to rise by up to 0.56 meters by 2090.	Salinization of soil and groundwater. Inundation of farming land near coast areas has a detrimental effect on soil fertility and quality of ground water	• In Peam Krasaob crop farming plays only a small role in terms of sources of income, considering that there only exists few ha of cultivable land	2	1	L
		Rise in average temperature and heatwaves	Mean annual temperatures are predicted to rise by 0.3 to 0.6 °C by 2025,				

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
			by 0.7 to 2.7 °C by the 2060s and by 1.4 to 4.3 °C by the 2090s. Higher temperatures and heatwaves entail that crops need more fresh water (in turn droughts cause less water to be available)				
Livestock	Loss of livestock	More variable weather	More storms and flooding.	• Livestock, seemingly, do not provide any source of income.	2	1	L
		Sea Level Rise	Salinization of soil and groundwater. Fertility of soil and drinking water for livestock. Poorer quality of living for livestock, and as such increased health problems for livestock.				
		Rise in average temperature and heat waves	Increase the likelihood of heat stress of livestock.				
Fisheries	Change of aquatic ecosystems	Rising water temperatures	Alter the habitat of fish, causing their metabolic rates to change and as such possibly reduce numbers.	• Negatively alter the distribution and productivity of fish, which would have a detrimental effect on the livelihoods of the people, considering that fisheries is the most important source of	5	5	H
		Sea Level Rise	Saltwater intrusion (into freshwater areas). Destruction of				

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
			natural habitat of coastal fish (destruction of mangrove forest, sea grass etc.)	income in Peam Krasaob. • Decrease availability of certain fish.			
		Rise in average temperature and heatwaves	Droughts and the rise in temperature could result in inland water sources (e.g. small lakes, ponds) drying up.				

Risk Category: E/Extreme (Risk Value = 25), H/High (Risk Value 15-20), M/Medium (Risk Value: 6-12), L/Low (Risk Value: 1-5)

Annex 4.2: Vulnerability and Risk Assessment Matrix for Tuol Kokir

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
Crops	Destruction/loss of crops in wet season	Sea level is predicted to rise by up to 0.56 meters by 2090.	Salinization of soil and groundwater. Inundation of farming land (loss of cultivable land) near coast areas has a detrimental effect on soil fertility and quality of ground water	• In Tuol Kokir crops provide the main source of income. A loss of this would spell disaster for the community.	5	5	E
		More and heavier rain downfall	An increase in frequency and intensity of flooding events due to more frequent episodes of heavy rainfall.				
	Destruction/loss of crops in dry	Sea level is predicted to rise by up to 0.56	Salinization of soil and groundwater. Inundation of farming	• Vegetables (however, only on a small scale)	4	2	M

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
	season	meters by 2090.	land near coast areas has a detrimental effect on soil fertility and quality of ground water	will be lost. The loss of the most significant crop, rice, will not at risk, as rice is only grown in the wet season,			
		Rise in average temperature and heatwaves	Mean annual temperatures are predicted to rise by 0.3 to 0.6 °C by 2025, by 0.7 to 2.7 °C by the 2060s and by 1.4 to 4.3 °C by the 2090s. Higher temperatures and heatwaves entail that crops need more fresh water (in turn droughts cause less water to be available)				
Livestock	Loss of livestock	More variable weather	More storms and flooding.	• Detrimental effect on food security. Some livestock are used as work force (e.g. buffalo), whereby loss of these will be hugely damaging to agricultural cycle (f.ex. related to crops). Some livestock used in terms of own direct consumption. Either	3	5	H
		Sea Level Rise	Salinization of soil and groundwater. Fertility of soil and drinking water for livestock. Poorer quality of living for livestock, and as such increased health problems for				

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
			livestock.	way, food security is threatened.			
		Rise in average temperature and heat waves	Increase the likelihood of heat stress of livestock.				
Fisheries	Change of aquatic ecosystems	Rising water temperatures	Alter the habitat of fish, causing their metabolic rates to change and as such possibly reduce numbers.	• Fishing in Tuol Kokir is only a supplementary source of income, as such the consequences would not be severe.	4	2	M
		Sea Level Rise	Saltwater intrusion (into freshwater areas). Destruction of natural habitat of coastal fish (destruction of mangrove forest, sea grass etc.)				
		Rise in average temperature and heatwaves	Droughts and the rise in temperature could result in inland water sources (e.g. small lakes, ponds) drying up.				

Risk Category: E/Extreme (Risk Value = 25), H/High (Risk Value 15-20), M/Medium (Risk Value: 6-12), L/Low (Risk Value: 1-5)

Annex 4.3: Vulnerability and Risk Assessment Matric for Prey Nob

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
Crops	Destruction/loss of crops in wet season	Sea level is predicted to rise by up to 0.56 meters by 2090.	Salinization of soil and groundwater. Inundation of farming land (loss of cultivable land) near coast areas has a detrimental effect on soil fertility and quality of ground water.	• Loss of most important source of income and source of livelihoods (rice). • Expenses in substituting livelihood. • Other sources of income needed, i.e. fishing – causing extra competition and overuse of natural resources. • Migration to bigger towns/cities?	5	5	E
		More and heavier rain downfall	An increase in frequency and intensity of flooding events due to more frequent episodes of heavy rainfall.				
	Destruction/loss of crops in dry	Sea level is predicted to rise by up to 0.56	Salinization of soil and groundwater. Inundation of farming	• Vegetables (however, only on a small scale)	4	3	M

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
	season	meters by 2090.	land near coast areas has a detrimental effect on soil fertility and quality of ground water	will be lost. The loss of the most significant crop, rice, will not at risk, as rice is only grown in the wet season,			
		Rise in average temperature and heatwaves	Mean annual temperatures are predicted to rise by 0.3 to 0.6 °C by 2025, by 0.7 to 2.7 °C by the 2060s and by 1.4 to 4.3 °C by the 2090s. Higher temperatures and heatwaves entail that crops need more fresh water (in turn droughts cause less water to be available)				
Livestock	Loss of livestock	More frequent and heavier rainfall	More storms and flooding. This could in turn kill livestock or damage livestock's grazing area / habitation.	• Detrimental effect on food security. Some livestock are used as work force (e.g. buffalo), whereby loss of these will be hugely damaging to agricultural cycle (f.ex. related to crops). Some livestock used in terms of own direct consumption. Either	3	4	M
		SLR	Fertility of soil and drinking water for livestock. Poorer quality of living for livestock, and as such				

Component	Risk Scenario	Climate Change Scenario (cause)	Climate Change Impact	Risk Description	Likelihood	Consequence	Risk Category
			increased health problems for livestock.	way, food security is threatened.			
		Rise in average temperature and heat waves	Increase the likelihood of heat stress of livestock.				
Fisheries	Change of aquatic ecosystems	Rising water temperatures	Alter the habitat of fish, causing their metabolic rates to change and as such possibly reduce numbers.	• Food security would be an issue. However, fishing in Prey Nob is only a supplementary source of income.	4	2	M
		Sea Level Rise	Saltwater intrusion (into freshwater areas). Destruction of natural habitat of coastal fish (destruction of mangrove forest, sea grass etc.)				
		Rise in average temperature and heatwaves	Droughts and the rise in temperature could result…….				

Risk Category: E/Extreme (Risk Value = 25), H/High (Risk Value 15-20), M/Medium (Risk Value: 6-12), L/Low (Risk Value: 1-5)