RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

SITUATION ANALYSIS AND NEEDS ASSESSMENT REPORT

ROHAL SOUNG VILLAGE
Battambang Province, Cambodia

A Selected Climate Smart Village Site

February 2015

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Summary

Rohal Suong village is located in Battambang province, Cambodia. The Situation and Needs Assessment was conducted in the village as part of the major initial work to collect data that will serve as baseline information to inform planning of CCAFS intervention and to form the basis for monitoring change over time. The baseline work was conducted in November to December 2014. Rohal Suong is a typical farming village that is moderately diversified, with two rice cropping, some vegetables and fruits, with some surplus to sell in an average year. Rice fields are connected to the Sangke River as a source of water throughout the year and to Tonle Sap Lake and associated flooded forests as a source of fish, firewood, and other animals and plant products. Small-holder agriculture production system prevalent in the village appears to be not very profitable because of the high cost of inputs and limited market and value chain development. Farming families have taken several strategies to increase their overall income by expanding the farming area, intensifying rice production, and seasonal labor migration. These strategies have negative implications: loss of forest and grassland to farmland, degradation of water quality and soil, and labor shortage in the village for agriculture. Raising small livestock is widely practiced as an income generation option, while large livestock is becoming less popular due to the shortage of grazing land. The general perception among the villagers is that the condition of natural resources is declining. Flooded forests are declining because of deforestation and agriculture encroachment. Fisheries resources are declining because of overexploitation and loss of habitats. Meanwhile, the village is also vulnerable to extreme events such flash flood, drought, crop disease and insect outbreak. The village has been supported by a variety of external agents through agricultural development, natural resource management, and food security programs, including some large donor programs, and received in-kind support as well as direct agriculture input subsidies. Several community institutions exist and are functioning well. The local production systems are well adapted to the natural seasonal fluctuation in rainfall and flooding regime, but occasional extreme flooding events cause crop damage and food shortage situation. The existing interventions are not directly associated with specific climate-related issues. There is an opportunity for CCAFS to identify and enhance existing practices that can become good examples of "climate smart agriculture", and be promoted more widely as such, to increase the general awareness of the importance of climate smart agriculture practices.

Keywords

Rohal Suong, situation analysis, needs assessment, CCAFS

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Abbreviations

ADB	Asian Development Bank
AUSAID	Australian Government Aid Program
CDIA	Cities Development Initiative in Asia
CNMC	Cambodia National Mekong Committee
CSA	Climate-Smart Agriculture
CSV	Climate Smart Village
CVI	Climate Vulnerability Index
FAO	Food and Agriculture Organization
GMS	Greater Mekong Sub-region
ICEM	International Center for Environmental Management
JICA	Japan International Cooperation
KAP	Knowledge, Attitude, and Practice
MAFF	Ministry of Agriculture, Forestry and Fisheries
MLMUC	Ministry of Land Management, Urban Planning and Construction
MOE	Ministry of Environment
MOWRAM	Ministry of Water Resource and Meteorology
MRC	Mekong River Commission
NAPA	National Adaptation Program of Action to Climate Change
NCDD	National Committee for Democratic Development and Decentralization
PPCR	Pilot Program for Climate Resilience
RGC	Royal Government of Cambodia
SPCR	Strategic Program for Climate Resilience
UNDP	United Nations Development Program
WB	World Bank
WFP	World Food Program
KHR	Cambodia currency

1. INTRODUCTION

The Consultative Group on International Agricultural Research (CGIAR) Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic 10-year partnership between the CGIAR and Future Earth to deal with threats posed by a changing climate for achieving food security, enhancing livelihoods, and improving environmental management. Started in 2010, CGIAR-CCAF's major initial work include collecting baseline information through studies at the household and village levels, and the organization baseline study in selected sites in the three regions of East Africa, West Africa and South Asia.[1] The main aim is to collect data that serve as baseline information at each site to inform planning of CCAFS intervention and to form the basis for monitoring change over time (after 5 years and 10 years from the baseline period) in the selected sites.

In the Southeast Asian region, the six selected sites with potential to become climate smart villages (CSVs) are: (1) Rohal Soung village, Battambang province, Cambodia; (2) Ekxang village, Vientiane province, Lao PDR; (3) Pailom village, Savannaket province, Lao PDR; (4) Ma village, Yen Bai province, Vietnam; (5) My Loi village, Ha Tinh province, Vietnam; and (6) Tra Hat (VN03), Bac Lieu province, Vietnam. Complementing the baseline data collection activities is the Situation Analysis and Needs Assessment (SANA). The baseline data collection in these sites was conducted in 2014. The aim is to have a deeper understanding of the selected sites to enable the design of appropriate and feasible intervention that will support their transformation to climate-smart villages in time.

Specifically, the objectives of the SANA are: 1) To understand the current situation of the selected site, and 2) To identify the priority needs of the selected site in support of developing its agriculture and livelihoods while mitigating and adapting well to climate change.

This report presents the results of the SANA for Rohal Soung village, Battambang Province, Cambodia. Data collection activities at the Rohal Suong village were led by the WorldFish Centre, one of the CGIAR research centers. This report has five parts. Following this introduction is the section on Methodology that describes the data and the sources of data used in the report, highlighting the relations of data collection activities for this report to other baseline data collection activities in the area. The third and the fourth sections present the results of the Situation Analysis and the Needs Assessment, respectively. A Recommendation section ends this report.

1 More information about CCAFS sites is available at http://ccafs.cgiar.org/where-we-work

2. METHODOLOGY

To facilitate SANA, additional primary and secondary data were collected. Needed data were also partly drawn from the village baseline study (VBS) and from the organizational baseline study (OBS). Primary and secondary data at the province, district, commune and village levels were collected. The sources of primary data were key informant interviews (KIIs) and the three gender-differentiated focus group discussions (FGDs). Secondary data consisted of official documents and research reports collected from various offices in the province and those that were available on official websites.

Prior to the CSV activities, the WorldFish Centre conducted several projects in Rohal Soung village. Focus group discussions and a household survey were carried out in 2014-2015 in Rohal Soung village among seven other villages in the district. The results of these previous research projects were useful and were updated and used for the SANA. At the provincial and district levels, key informant interviews were conducted when secondary data was unavailable.

A list of topics for the SANA was drawn by a group of social scientist at a meeting during the planning workshop for the implementation of the CSV in July 2014. The list includes 15 topics with data needed at the provincial/district and village levels: Natural resource utilization, Organizational landscape, Information network, Mitigation measures, Production and livelihood systems (including markets), Current and past natural resource management initiatives, Food security status and trends, Demographics, Climate change perception, Institutional landscape and governance, Social and gender differentiation, Hazards and vulnerability, Local climatic information, Health and nutrition profile and other livelihood outcomes, and Stakeholders. Four topics were common with the VBS: natural resource utilization, organizational landscape, information network, and mitigation measures.

CCAFS has identified lead CG partners as well as local partners in every site in the implementation of its activities. For Rohal Soung, the WorldFish Center is the lead CG partner. For the baseline surveys, the teams in the six CCAFS sites were trained in September 2014 (for VBS, OBS, and SANA) and in November 2014 (for Household Baseline Study). Guide materials were given to the teams for reference.

With VBS and SANA as complementary activities, field data collection was conducted at the same time. The FGDs were conducted for VBS in Rohal Soung village from 28th to 30th October 2014 with participation of 90 villagers. The FGDs were organized for men and women separately. Topics relevant to SANA that were collected during the FGDs include on natural resource utilization, organizational landscape, and information network. Additional information was collected from November to December 2014. A feedback seminar was held in the village with 15 villagers who had not participated in the FGDs as well as leaders from the province down to the village levels.

Data on institutional landscape was collected through a participatory group exercise where important organizations were listed and their involvement in the community identified. From the list, the five most important organizations were selected by villagers for interviews using the protocol set under the OBS. Detailed information is given in the site analysis report of Rohal Suong.

3. SITUATION ANALYSIS

3.1 GEOGRAPHICAL LOCATION

Battambang province is situated in the northwest part of Cambodia (Figure 1), about 300 km from Phnom Penh via national road No 5. The province borders on Beanteay Meanchey, Siem Reap, and Pursat provinces. The western boundary is framed by the enclave of Pailin province and the national border with Thailand. At its eastern tip, the province is connected to the Tonle Sap Lake. The province covers an area of about 11,803 km^2, comprising 13 districts, one municipality, 96 communes, and 741 villages.

In recent years, Battambang has reactivated its strategic location as an economic and trading center. Climate change and the degraded natural environment pose as a threat.

Rohal Suong, one of CSVs in the Southeast Asia, is located in the Prek Norin commune, Eak Phnom district of Battambang province (Figure 2). It is About 15 km from Battamabang town. Rohal Soung village is a land-based village (Johnstone et al., 2013) situated along the Sangke River. The total land size of Rohal Soung village is 291 ha, comprised mainly by paddy field, crop plantation field (Chamkar), and residential areas (Praek Norint Commune, 2012).

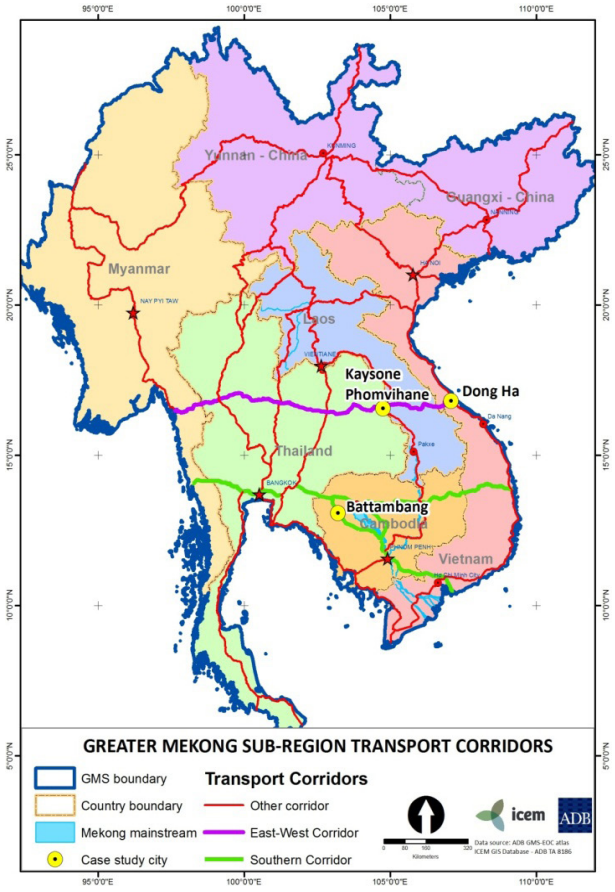


Figure 1. Location of Battambang in Greater Mekong Sub-region (GMS) (ICEM, 2014)

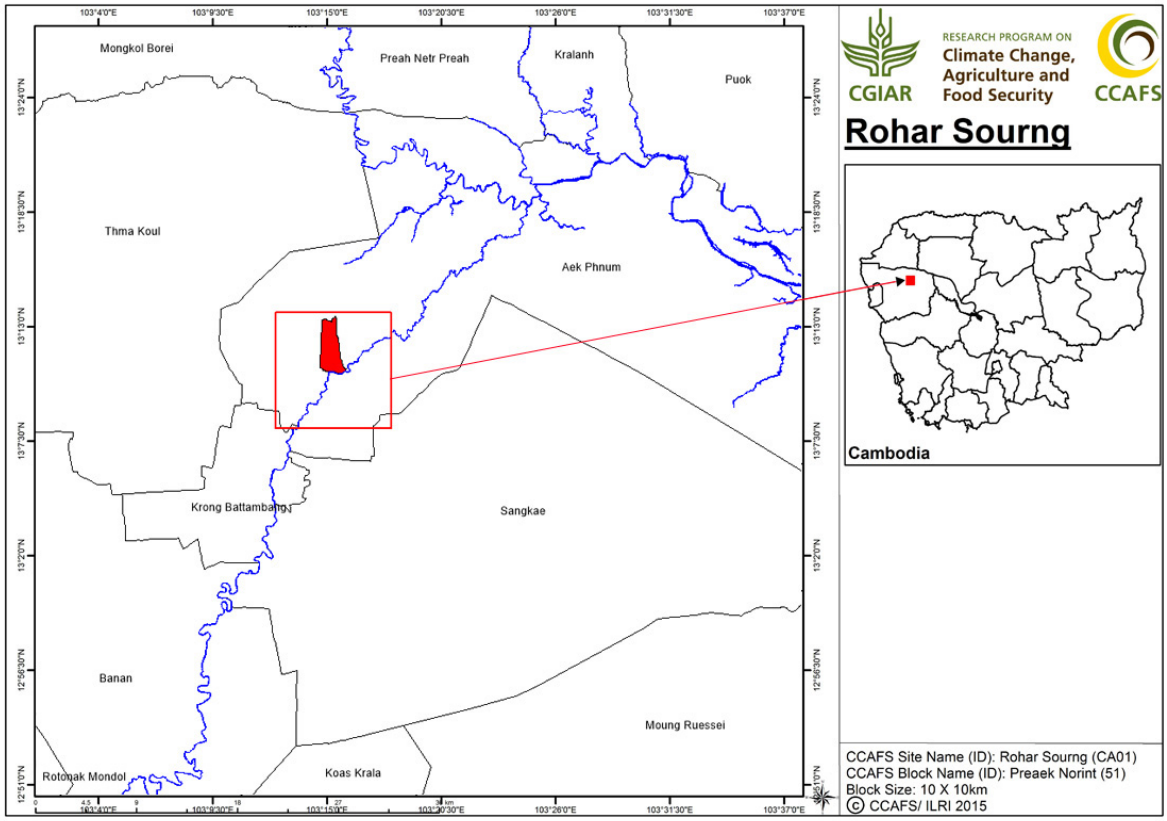


Figure 2. Location of the Rohal Suong village in Aek Phnom district, Battambang Province

3.2 DEMOGRAPHICS

In 2005, the total population of the province was 952,306 (185,868 families) and it increased to 1,043,928 (205,351 families) in 2008 (NCDD, 2009). Table 3 shows the population trend for years 2007 to 2010. During these years, the total population and a number of families were increasing, but the rate of increase was declining. Meanwhile, the number of female-headed households was increasing. Compared to other districts, Battambang has the highest population (151,656) in 2008 (Figure 3).

Table 1. Population trends in Battambang, 2007-2010

	2007	2008	2009	2010
Total population	998,896	1,043,928	1,048,214	1,071,209
% Increase/Decrease		4.5 %	0.4 %	2.2 %
Total number of families	196,721	205,351	212,294	218,843
% Increase/Decrease		4.4 %	3.38 %	3.1 %
Number of female headed households	29,492 persons	29,664 persons	30,410 persons	31,986 persons

Source: (NCDD, 2010)

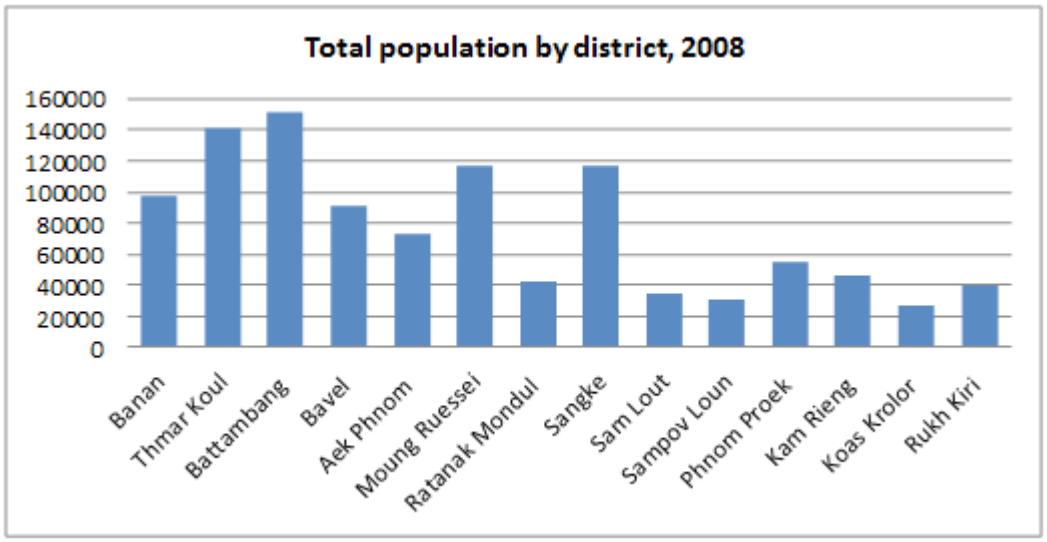
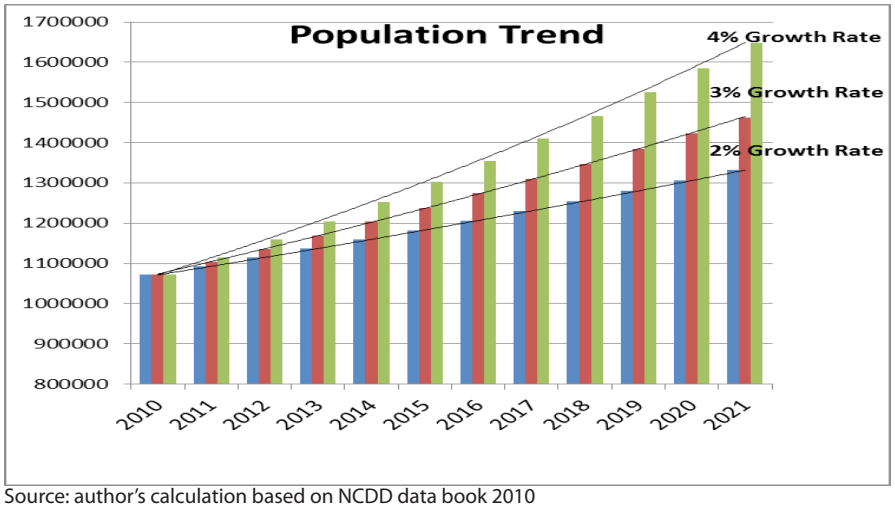


Figure 3. Total population by district of the province by 2009 (NCDD, 2009).

Over the next 10 years, the population of Battambang is projected to increase. Figure 4 shows the range of population projections based on three growth rate scenarios.



Source: author's calculation based on NCDD data book 2010

Figure 4. Population projection based on baseline 2010

Meanwhile, Rohal Soung village had a total population of 1,354 (342 families), comprised of 670 women and 684 men in 2014. About 36% of total families were identified as the poorest in the village (Praek Norint Commune, 2012).

3.3 LOCAL CLIMACTIC INFORMATION

During the southwest monsoon season from May to November, about 90% of the annual rainfall occurs. The remaining months are hot and less humid, leading to particularly high potential evapotranspiration in March and April. The average annual rainfall amount is extremely variable between different parts of the country.

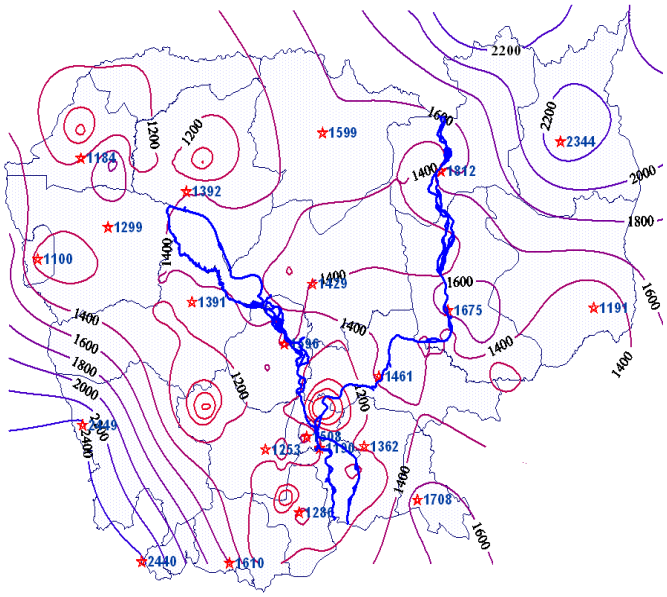
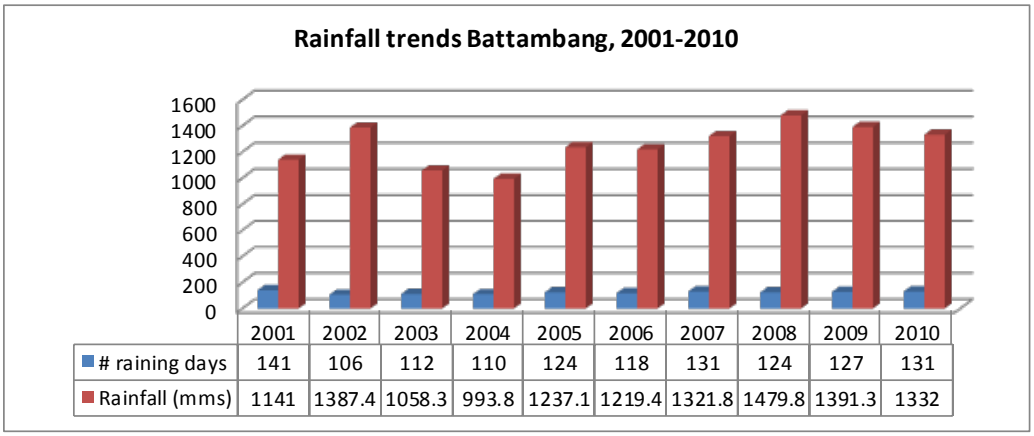


Figure 5 Distribution of annual rainfall in Cambodia (1991-2007) (ADB, 2013)

Figure 5 below shows the annual rainfall distribution in Cambodia. The observed maximum 24-hour rainfall is about 200 mm throughout the region.

In the northwest part of Cambodia and around the Great Lake, the rainfall is generally bimodal, with a first peak occurring between May and June, followed by a period of lower rainfall between June and August while the monsoon rains return during August through October. At this time, the rainfall is usually heavier and can cause widespread flooding. Yet this bimodal pattern is erratic and widely unpredictable, causing difficulties in farmers' crop planning.

Figure 6 below shows yearly rainfall trends in Battambang in 2001 to2010. The figure shows somewhat a cycle of increasing and decreasing amount of rainfall. The amount of rainfall declined from 2002 to 2004, increased in 2005 to 2008, and declined again until 2010. The highest number of rainy days was recorded in 2001 (141 raining days). In the following years, the annual number of days ranged between 106 and 131 days.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
# raining days	141	106	112	110	124	118	131	124	127	131
Rainfall (mms)	1141	1387.4	1058.3	993.8	1237.1	1219.4	1321.8	1479.8	1391.3	1332

Figure 6. Rainfall trends in Battambang from 2001 to 2010

Temperature

Figure 7 shows baseline average annual maximum temperature (°C) 1961-1990 at the country level.

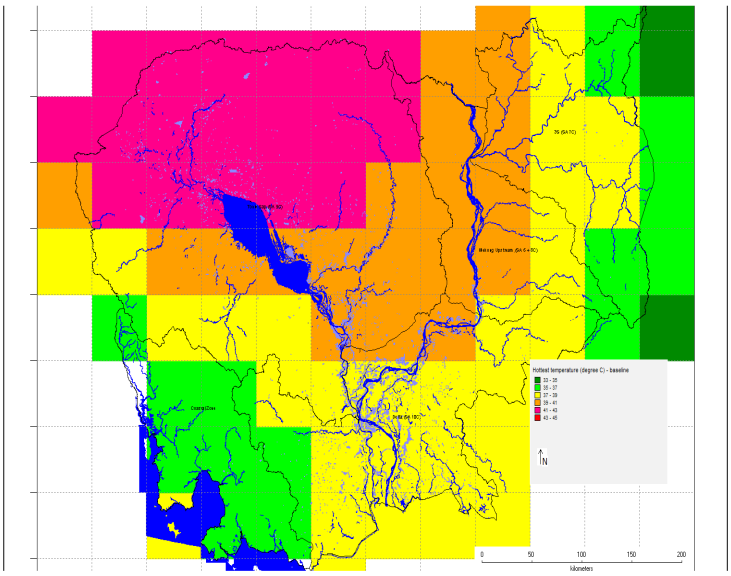


Figure 7. Baseline average annual maximum temperature at country level (MOWRAM/ADB, 2013)

Overall projection of climate change in Battambang

According to an ICEM (2014) case study on building urban resilience in cities in the Greater Mekong Subregion (GMS), climate change is projected to significantly impact Battambang. A combination of current land use change as well as change in hydrological flows from upstream down through the town and Tonle Sap Lake are expected. Table 2 below shows that average rainfall and maximum temperature are expected to increase by 2050.

Table 2. Projected rainfall and temperature changes by 2050, Battambang (ICEM, 2015)

Projected changes to average rainfall & maximum temperatures by 2050	Baseline	With C.C.	Change
Average annual rainfall	1300 mm	1365 mm	+5 %
Total rainfall in wet season	1170 mm	1267 mm	+8.3 %
Total rainfall in dry season (Mar - Aug)	230 mm	224 mm	-2.5 %
Average daily maximum temperature (annual)	32 °C	34.2 °C	+2.2 °C
Average maximum temperature in wet season	31 °C	33.6 °C	+2.6 °C
Average maximum temperature in dry season	32.5 °C	34.4 °C	+1.9 °C

By 2050, Battambang's total rainfall during the wet season would increase by about 8.3%. Battambang's average daily maximum temperature during the dry season would increase by between 1.8 -1.9°C. In summary, the expected climate changes by 2050 in Battambang are significantly hotter and wetter in the wet season and hotter and drier in the dry season

3.4 NATURAL RESOURCE UTILIZATION

Battambang is part of the greater natural landscape of the Cardamom region[2]. The natural habitats of this region form a complex network of interconnected landscapes and watersheds that provide important ecosystem services to the region (Killeen 2012). Table 3 shows the distribution of land use categories in the districts of Battambang province. More than half of the land area in Battambang province is agricultural land (596,497 ha). About 25% is forest land. Half of the forest land is flooded.

Table 3. Area (ha) of major land categories by district in Battambang province

District	Total area	Forest land		Agricultural land	Construction land	Others
		Total	Flooded Forest land			
Banan	79,600	33,443	-	32,171	12,843	1,143
Thmar Koul	81,700	15,400	15,400	60,100	3,540	1,660
Battambang	11,544	-	-	8,558	2,870	117
Bavel	92,300	17,471	601	49,293	4,541	20,995
Ek Phnom	63,500	46,940	46,940	13,700	2,860	-
Moung Russei	124,995	28,319	28,319	73,965	6,696	16,015
Rotanak Mondul	79,200	25,520	-	46,400	3,780	3,500
Sangkae	83,00	35,200	35,200	40,017	7,763	20
Sam Lout	180,300	80,181	-	55,20	6,410	38,509
Sampov Luon	51,900	9,100	-	36,396	450	5,954
Phnom Proek	70,400	8,276	-	32,397	2,602	27,125
Kam Rieng	56,600	5,821	-	47,009	2,100	1,670
Koas Kralor	105,000	30,000	-	60,000	15,000	-
Rukh Kiri	57,688	10,805	-	41,291	5,592	-
Total	1,137,727	246,476	126,460	596,497	78,047	116,708

Source: NCDD Battambang Province data book 2009.

2 This region covers approximately one third of the countrys's land surface and spans 24 of its provinces, including Koh Kong, Pursat, Battambang, Pailin, Sihanouk, Kampong Speu, Kampong Chhnang, Kam Pot and Kep.

3.4.1 Agriculture and forestry land use

The five main categories of agricultural and forestry land in Battambang province are as follows (JICA et al., 2007):

1. ***Paddy Field:*** Most paddy fields in the basin are rainfed. The irrigated paddy field is estimated at about 22,000 ha or 24% of the total paddy field area. The prevailing rice cultivation method is direct sowing and the prevailing cropping pattern is a single cropping of rice in the wet season. The area under receding or floating rice cultivation is limited to 270 hectares in the basin.
2. ***Field Crop Land:*** Field crop land makes up only 7,020 ha or 1.2 % of the basin and is almost exclusively found along small valleys in the mountain areas. The major crops cultivated in the wet season include corn, beans, and cassava. Fertile Cambisol field crop land in the basin of Pailin province was developed for commercial scale for upland crop cultivation.
3. ***Garden Crop Land:*** Garden crop land accounts for 15,990 ha or 3 % of the basin. It is divided into garden crop fields and village garden crop fields. These are mostly found along the Sangkae River and other rivers having access to water resources. Over 60% of the land is considered village garden crop fields. The major crops cultivated in these lands are vegetables and some upland crops mainly in dry season.
4. ***Forest:*** Forest accounts for the largest land surface, occupying 250,910 ha or 41% of the basin, and extends to the southeastern mountain areas in the basin. Forest land includes evergreen broad leafed, deciduous, and mixed forest of evergreen and deciduous.
5. ***Flooded Shrub/Forest:*** covers the lowland areas down to the Tonle Sap Lake and is composed of flooded shrub land and flooded forest. However, the former accounts for 98% of this category and the latter is limited in extent within the basin.

Table 4. Area (ha) of annual crops

Crop Type	2011	2012
Rice - dry season	-	9,000
Rice – wet season	-	27,7238
Red Corn	109,336	98,682
Soy Bean	22,909	22,384
Bean	17,513	16,002
Peanut	477	424
Cassava	56,355	46,969
Sweet potato	103	125
Sesame	13,586	10,496

Source: Provincial Department of Agriculture, 2013

Agribusiness is growing rapidly in Battambang. Most of the districts developing commercial farming are Ratanak Mondul, Sam Lout, Kam Rieng, and Phnom Proek. Table 4 shows that cultivated land for red corn has reduced from 109,336 ha to 98,682 ha and land for cassava reduced from 56,355 ha to only 46,963 ha during the periods 2011 and 2012, respectively.

3.4.2 Protected areas

Table 5 presents the three protected areas, totaling 710,000 ha, associated with the Sangker river system[3]. These partly encompass: Phnom Samkos Wildlife Sanctuary, Sam Lout Multiple Use Area, and Tonle Sap Multiple Use Area**.**

Table 5. Protected Areas in Battambang

Protected Area	Provinces	Total Area (ha)	Area in Basin (ha)	Location as relative to irrigation schemes	Some Unique characteristics
Phnom Samkos Wildlife Sanctuary	Crosses Battambang and Pursat Province	333,750	62,700	Upstream	High altitude areas with a wide diversity of forest types. Supports a range of threatened birds in the areas.
Samlot Multiple Use Areas	Crosses Pailin and Battambang Provinces	60,000	44,900	Upstream	An evergreen forest area within the watershed of the Sangke River. It has been degraded by mining operations causing severe erosion and increased sedimentation of the river, which flows into the Tonle Sap Lake.
Tonle Sap Multiple Use Areas	Battambang (Aek Phnom and Sangkae districts)	316,250	81,900	Downstream	Long –standing fish reserve, great biological, hydrological and cultural/economic importance.

Both Phnom Samkos and Samlaut are located upstream of most irrigation systems; therefore, there would be no adverse environmental impact through irrigation promotion in this basin. On the other hand, Tonle Sap Multiple Use Area is situated downstream of Sangkae River and this will be affected by water infrastructure development such as irrigation schemes and increased usage in fertilizer and pesticides. Attention needs to be paid to avoid negatively impacting downstream areas through irrigation (JICA et al., 2007).

The Tonle Sap Multiple Use Area is biologically diverse, with over 110 species of fish present. It is a home to 11 globally threatened bird species and four near-threatened species such as the Spot-billed Pelican, Greater Adjutant, Bengal Florican, and Oriental Darter, and also supports important populations of reptiles such as Siamese Crocodiles. The planned rehabilitation of existing irrigation schemes located upstream of Tonle Sap Lake does not appear to cause any additional negative impact on the environment. However, if there is an expansion beyond existing schemes, then the environmental monitoring plan must be considered as one of the project components in order to minimize future negative impacts in Tonle Sap Areas (JICA et al., 2007).

More natural forest areas, in particular from protected areas, are being granted to, or taken by, local communities or businessman for large-scale agricultural development. Since 2005, people have cleared forested areas to cultivate maize and/or cassava for sale to private factories or exported to Thailand. Newly

3 Sometimes known as the Battambang River Basin

cleared land requires a limited amount of fertilizer, but later on increasing amounts of fertilizer will be used as the land productivity, watershed, and water resources degrade.

Currently, an estimated 191,492 ha of forest cover is left, of which 150,992 ha is under the management of the forestry administration and 40,000 ha is under the provincial department of environment. However, protected areas are increasingly under threat from land encroachment for large-scale agricultural land development (Provincial Development of Planning, 2015).

Key informants from the Provincial Department of Agriculture reveal that the area under agricultural land will increase to 500,000 ha from 2015 to 2018, of which 100,000 ha will be dry season rice cultivation as well as upland rice crop. This trend for commercial cash crop production is likely to encroach significantly on both protected areas and recession flooded forest areas (Interview dated 22nd December 2014).

Interviews with officials from the provincial department of environment also confirm significant loss of protected areas, including:

- Samkos wildlife sanctuary[4]
- 14,000 ha of land has been taken from these protected areas, of which 8000 was provided to local communities with legal title while the land title to additional 6,000 ha was in a process of being issued to farmers.
- Roneam Dounsar wildlife sanctuary
- Covers an area of more than 170,000 ha in two provinces: Banteay Meanchey and Battambang (70,000-80,000 ha).
- Now there are only around 3,000 to 4,000 ha left in Batambang due to land concession and encroachment.
- Samlout multiple use area
- more than 60,000 ha in Battambang and Pailin, of which 40,000 ha in Battambang.
- Now, there are around 10,000 ha left due to land clearance for cash crops and commercial farming.

To prevent further loss of protected areas, a more effective land use and watershed management plan is needed in the Battambang River Basin. Such plans should consist of: (i) proper forest utilization as well as reforestation plans, (ii) diversified agriculture development for non-irrigated land, (iii) slope protection, and (iv) soil conservation. The report from JICA, MOWRAM, and MAFF (2007) suggested formulating an inter-ministerial coordination body consisting of MOWRAM, MAFF, MOE, and Ministry of Land Management, Urban Planning (MLMUC), Ministry of Construction, in collaboration with other relevant Ministries.

Meanwhile, Rohal Soung is an old village with a total land area of 717[5] ha. It was covered largely by flooded forest before the 1990s. The flooded forest provides a good habitat for fish that villagers catch for consumption. The flooded forests, however, were degraded rapidly as a result of agricultural expansions and high demands for firewood. The grasslands were also converted to rice field over the last 10 years; some parts, however, are kept as grassland for cattle.

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4 This Samkos wildlife sanctuary covers three provinces: Battambang with 59,000 ha, Pursat with >200,000 ha, Koh Kong with >90,000 ha.

5 Some areas are fallen into two categories; some plots of land can be cultivated rice and then other cash crops

The land is also categorized mainly as paddy field (wet and dry season rice field), crop plantation field, and residential areas. The area planted with rice is 135 ha during the wet season and 105 ha during the dry season. Wet season rice is cultivated in these fields with planting in May and harvesting in November. The farmers changed the long-period rice varieties to short-period rice varieties (dry season rice) as a result of changes in climate and the environment. Currently, local farmers cultivate rice in two cropping seasons per year. Planting during the first cropping starts in December and harvest is in February or March; while planting for the second cropping starts in April and harvesting is in June or July. Dry season rice provides higher yields with high market demands. Rice field generally floods in the rainy season from September to November every year.

Crop plantation field is 81 ha. This land is also flooded during the rainy season. During the dry season, Local farmers grow crops such as maize, mung bean, watermelon, cucumber, pumpkin, and yam bean.

The residential area covers 75 ha. There is no restriction where local villagers can build their house. They, however, prefer to build their houses along the Sangke river and in main roads located higher than the farmland. Residential areas are also flooded during the serious flood year.

Conservation pond (7 ha) and flooded forest (54 ha) are included in flooded forests. Ta Ek pond, one of the biggest ponds, was designated as a fish conservation pond and managed by the community fisheries. There are some small ponds and flooded forest associated with the conservation area. Small ponds are dried out during the dry season, thus all fish and brook stock move to survey in Ta Ek pond.

3.4.3 Water resources

Stung Sangker River is one of the key sources of water for the foundation of city development in Battambang. The river originates from the range of the Elephant and Cardamom mountains at an elevation of about 1,391 m, flows from the southwest to north across the Battambang Town and joins the Stung Mongkol Borey river at the Bac Prea village about 40 km downstream from Battambang Town. It then flows to the Stung Sreng river another further 10 km downstream, then flows into the Tonle Sap Great Lake. The upper Stung Sangker River is the combination of two rivers, namely, the Stung Sangker itself and the Stung Chamlang Kuoy (CNMC, 2012).

At O Dambang, which is located about 5 km upstream Battambang town, the river splits into two rivers: the Sangker itself and the Stung Chas river, then flows directly into the Tonle Sap Great Lake. The Stung Sangker river catchment has a total area of 6,052 km^2. More than one third of this catchment area is between 4 to 13 m in elevation, and the highest elevation is 1,391 m. The catchment above the Battambang river (also known as Sangkae river) gauging station is 3,230 km^2 (CNMC 2012).

In the past, before the civil wars, Battambang was considered as the rice bowl of the country. The province is endowed with good natural resources and certain environmental characteristics have shaped

the agricultural production systems and productivity. For example, key water sources for agricultural production include:

- ***Sangkae River:*** original source of water from Cardamom Mountains coming down through Battambang town and dividing the town into two parts (east and west), before going down to Tonle Sap Lake.
- ***Munkul Borey River:*** original source from Pailin goes through Bavel district of Banteay Meanchey and then to Tonle Sap Lake. In 2012, Bavel irrigation scheme could irrigate 37,000 ha in wet season and 9,000 ha in dry season.
- ***Daun Try River (Moung River):*** coming from Cardamom Mountains through Pursat (Veal Veng district) to Muong Russey (Ream Kun Dauntry river system), before flowing to Tonle Sap Lake. In 2012, the Muong Russey irrigation scheme could irrigate 25,000 ha in wet season and 1,100 ha in dry season.
- ***Kamping Pouy irrigation scheme:*** 15,000 ha in wet season and 9,440 ha in dry season.
- ***Chork Reservoir:*** 1,200 ha in wet season and 100 ha in dry season.
- ***Sangkae Lake:*** 500 ha in wet season and 100 ha in dry season
- ***Pheas Reservoir:*** 500 ha in wet season and 300 ha in dry season.
- ***Kong Hort flood control and irrigation scheme:*** This multi-purpose structure is built across the Sangkae River and functions include flood control, water supply in dry season to Battambang city, and agricultural crop production. The scheme is still under construction with potential irrigated areas covering more than 60,000 ha in five districts: Banan, Battambang city, Sang Kae, Kos Kralor, and Muong districts.

Based on the data from provincial development planning 2015-2019 (5 years planning), only 30% of agricultural land is irrigated, while 70% is rain-fed.

Figure 7. Villagers in Rohal Soung are building an irrigation canal

The Sangke River (or Stung Sangke in Khmer language) is one of the main rivers in Battambang province. It is approximately 250 kilometers long and it flows through 27 communes of 6 districts in Battambang before draining into the Tonle Sap Great Lake. The average depth of the river is 2.35 meters and 6.79 meters in dry and wet seasons, respectively (PDOWRAM, 2013).

The Prek Norint commune is one of communes that the Sangke River flows through, and it provides main water source to feed into the small irrigation system especially to irrigate dry season rice. The villagers also use water from the Sangke River for domestic uses. The Sangke river provides a pathway for fish to migrate from the Tonle Sap Lake to flooded forest, open fields and other river channel networks in the wet season. Thus the Sangke River is a great fishing ground for local people.

There are some small dike and water channel connected to paddy field, but these are of very limited capacity. The water channel plays a role to bring water from the Sangke River to the rice field. The culvert connection from the river to water channel was installed partly in 2013 and was completed in late 2014 with co-financing from WorldFish and the local villagers' contributions. Villagers have recently use pumping machine to pump water from the Sangke River to feed into culvert connection then drain to water channel. This pumping machine was lent by Ministry of Water Resources for the last two years; it is managed by the Water User Committees. Based on key informant interviews and FGD, the water channel and dike have a potential to expand and cover other parts of paddy field and crop land; farmers expect to get a high yield if their lands are irrigated.

3.5 INFRASTRUCTURE

Certain infrastructure characteristics have played an important role in economic activities and human interaction around Battambang. Key infrastructures include:

- National Road No.5 crosses through the municipality from northwest to southeast, connecting Sisophon, Poipet and Siem Reap in the north to Pursat and Phnom Penh in the south.
- National road No.57 connects national road No.5 to the urban center of Battambang municipality and connects Battambang to Pailin in the southwest.
- A national railway line from Phnom Penh to Sisophon crosses the municipality from southeast to northwest with a railway station in the urban center of Battambang.

A road connects Battambang town to Rohal Suong village and continues to other villages near the Tonle Sap Lake. The road is built by the Royal Government of Cambodia in 2011; this road can be accessed by truck, motor carts, tractors, motorbikes, and bicycles. It plays a very important role to transport the agriculture and fisheries products and to connect local people to towns and market. Some parts of the roads in Rohal Suong and adjacent villages are flooded during the heavy flooding season. A small road located along the Sangke river bank, dusty and bumpy, is also used to transport agricultural and fisheries products by hand-tractors, motor carts, motorbikes, and bicycles.

The primary school in the village is located in the middle of a village. The school condition is good; there are adequate classrooms, teachers, and school officials and also there is a running tape water system and playground. This school is supported and funded by external development agencies and the Royal Government of Cambodia. The children in the village and adjacent villages go to this school and continue to secondary school in the district town.

There is no heath care center in the village; the villagers seek local medics for basic treatments; there are only four local medics (two women) and two traditional midwives. Patients go to health center located in the district town for serious illness or for giving birth.

3.5.1 The PPCR (Pilot Program for Climate Resilience)

In 2013, the RGC, with technical and financial support from the WB/ADB Climate Investment Fund, has approved the second phase of the Pilot Program for Climate Resilience (PPCR[6]); called the Strategic Program for Climate Resilience (SPCR) for Cambodia.

The SPCR consists of eight projects focusing on climate resilient water resources sector, climate resilient agriculture, climate proofing of infrastructure, and technical assistance. At least four projects cover Battambang province. These includes climate proofing infrastructure in the Southern Economic Corridor (SEC) towns, including Battambang town, flood resilient infrastructure development as part of integrated urban environmental improvement in the Tonle Sap Project, and mainstreaming climate resilience into development planning. The overall cost of the investment fund including Technical Assistance (TA) is nearly US$400 million.

3.5.2 Railway rehabilitation project

The loan agreement[7] between Cambodia and the ADB (2010) for railway rehabilitation will help increase domestic and regional trade and facilitate commodity flow with neighboring Greater Mekong Sub-region countries via the railway, thereby further supporting sustainable economic growth and poverty reduction. According to AUSAID (2013), the Cambodia Railway Rehabilitation Project is a US$143 million project to be managed by the ADB in partnership with the Government of Cambodia. It will help to rebuild Cambodia's railways, including stations and terminals, which have deteriorated over many years through war, neglect, and asset stripping. The railway project will also help the poor of Cambodia through increased economic growth and better transport.

The Cambodian railway network consists of two lines:

- The northern line, which was built in the 1930s, connects Phnom Penh to Poi Pet (going through Battambang and Sisophone) on the border with Thailand
- The southern line, which was built in the late 1960s, connects Phnom Penh with Cambodia's main seaport in Sihanoukville. To date, approximately 93 % or 266 km of the southern line has been rehabilitated, and trains are operating between Phnom Penh and Sihanoukville port.
- Benefits from the project will include reducing the number of heavy vehicles on the road by up to fifty per cent, leading to:
- Fewer road accidents (almost 1,800 people die in Cambodia each year in road accidents and thousands more are injured)

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6 The Pilot Program for Climate Resilience (PPCR) is an integral part of the proposed "Cambodia: GMS Southern Economic Corridor Towns Development Project" (or the "Project" - hereinafter used in text). The PPCR will promote the mainstreaming of climate resilience in the Project. The project promotes the transformation of the Southern Economic Corridor of the Greater Mekong Subregion (GMS), from a transport corridor into a full-fledged economic corridor by improving priority infrastructure and building institutional capacity in selected towns.

7 Loan No.2288-CAM (SF): GMS: Rehabilitation of Agreement dated 2 March between Kingdom of Cambodia (borrower) and ADB with total funds around US$26,408,000.

- Savings (estimated at over $US1 billion) in road and sea transport costs in the first thirty years of operations (trains require less than 20 per cent of the fuel used by commercial trucks). The typical container transit time between Bangkok and Phnom Penh by sea and road is usually 11 days; this will drop to about 20 hours by rail, resulting in a 67 per cent reduction in costs
- Lower CO_2 emissions
- Savings in road maintenance costs of $39 million (one fully loaded truck causes as much wear and tear on roads as 7,000 passenger cars), and
- Removal of dangerous or inflammable cargo from roads to rail.

The railway project will directly affect 4,000 families, one quarter of them will be resettled[8]. The government, under ADB loan, is responsible for relocating those affected by the project in line with ADB standards. The core principle of these standards is that no affected person will be worse off as a result of the railway project (AUSAID 2013).

3.5.3 Roads & bridges under strategic plan

Local authorities consider investment in urban road and drainage structures the mobilizing factors in urban sector development. This is in recognition of the fact that Battambang is a market town with an urbanizing economy that serves local and regional functions. The planned development of the urban road system that integrates drainage structures will elevate Battambang as a regional economic growth center as well as ensure sustainable local economic development and investment. Thus, urban road infrastructure requirements according to classifications are as follows:

- Improvement of 406.3 km of the National Road (NR 5). NR 5 is the major road running through the urban centre of Battambang. Through investment, it will be imrpoved and visually enhanced. Requirements will be the construction of an avenue with tree-lined roads and intersections designed to connect the national road with the other main urban roads.
- Construction along almost 10 km of the inner and outer ring roads with drainage structures. This will connect NR 57 to the south of the new administrative area, and will continue further north to form a half-circular road leading northward. The planned investment for the construction of the by-pass ring road system in the urban centre of Battambang is intended to decongest traffic build up on the National Roads 5 and 57. The possible funding source for this investment is the JICA.
- Upgrading 22.3 km of the municipal road or the urban interior roads.
- Improvement of the existing provincial road with a total length of 21.3 km to be extended to a length of 105.3 km, connecting other provinces.
- Construction of two new bridges to complement the urban road network, one north of the urban area in Chamkar Samrong commune and one in the south in Wat Kor commune aligning with the planned urban ring-road.

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8 The Cambodian Government has agreed to provide compensation at replacement cost for the loss of their house (i.e. compensation for the cost of rebuilding the same house), or any of their property (including fruit trees or fences, for example), allowances to help families through the relocation transition, and to support and restore people's ability to earn an income.

3.5.4 Irrigation and hydropower

There is huge potential for irrigation schemes built during the Khmer Rouge regime, but most of them are not functioning due to poor structure and lack of maintenance. Potential hydropower development has also been highlighted in various studies, including the JICA hydropower development master plan in 2009 and 2007. These projects will contribute hugely to food security and food demand for both local and exporting oriented markets, as well as to the need for energy for both local urban residents and various business and enterprise developments within the municipality and the whole province.

Table 6. Potential irrigation and hydropower development and investment (JICA et al., 2007)

Irrigation Projects		**Proposed irrigation areas (ha)**	**Existing irrigation systems (no)**
1	Kong Hout Rehabilitation	12,773[1]	33
2	Sala Toan Weir Rehabilitation	10,400	17
3	Ratanak-Battambang Water Harvesting Rehabilitation	580	13
	Total	23,753	63
Hydropower Projects		Capacity (MW)	
1	Battambang I	24	
2	Battambang II	36	
	Total	60 MW	

The Battambang Development Master Plan (2008-2020) encapsulates the development pillars envisioned to achieve socially responsible, environmentally friendly, and economically successful development. In line with its socioeconomic goals, the development vision for Battambang is for it to be a competitive town, becoming the regional economic center for trade and investments in agri-industrial goods and services along the Southern Economic Corridor. Over the 15-year period, Battambang will aim to be a city of heritage and culture while sustaining its economic competitiveness for private sector investment.

3.5.5 Battambang - flood control

Based on an assessment of the current situation, the Battambang flood control subproject is composed of the following main components:

- Civil works for river embankment and flood control structures located at Wat Sophy in the Sophy village in Rattanak Sangkat. The structure is approximately 200 m long and 30 m wide.
- Civil works for a river embankment structure for erosion control located at Apsara Market in Kamkor village in Svay Por Sangkat. The structure is approximately 100 m long and 30 m wide.

The town of Battambang experiences flooding and periodic inundation during the June-December period, rainy season in the area. Based on a CDIA study in 2010, the highest levels of flooding occur in the Sangkats of Svay Por and Preak Preah Sdach, with depths of almost 0.5 m. In the town centre, flooding has become a nuisance to the local population, affecting the flow of traffic and movement of people in the major thoroughfares while disrupting access to economic services.

3.5.6 Local economic and market town development

The local economic and market town development plan along the transport corridor offers considerable opportunities as well as enormous economic and environmental challenges. The town center, with 90% of commercial and residential establishments, is on the west bank of the river. The topography is flat and the Tonle Sap Lake to the East is connected to the Sangkae River, which runs through the town. The plan provides a long list of potential investments in the urban environment and economic infrastructure. Through various consultations and criteria, the selected urban infrastructure for priority investment includes the following: Improvement of waste water system and installation of treatment plant includes 3 km of open and close channel drainage structures along existing canals in the northern and eastern portion of Battambang. A 5 ha area has been identified as the site of the plant.

River embankment protection and flood control measures involve civil works for the protection of the river embankment on the eastern side of the Sangkae River and the rehabilitation of drainage structures in the town center and adjacent sub-urban areas.

Establishment of sanitary landfill and material recovery facility to improve solid waste management through the establishment of a sanitary landfill and installation of a material recovery facility at the Battambang dumpsite. The sanitary landfill will address the perennial problem of waste collection and disposal and achieve the projected collection rate of 90 % by 2020.

3.6 PRODUCTION AND LIVELIHOOD SYSTEMS

3.6.1 Crops

Battambang has fertile land located near the Tonle Sap Lake, traditionally a rich agricultural area producing rice, cash crops and vegetables. Agriculture - including rice, vegetable, livestock, and poultry farming - still dominates as the main economic activity in the province. The economic growth rate of Battambang is 2.28%, which is above the national average, but much lower than in other provinces, such as Mondul Kiri, Oddar Meanchey, and Palin, where growth rates are above 6% (NIS 2008 cited (MOE et al., 2013).

Provincial statistics show that 79% of families in 2006 and 80% in 2007-2008 were involved in the agricultural sector (NCDD 2009), compared with about 1/3 of the families in Battambang municipality (28% in 2008, 31% in 2009 and 30% in 2010) (Battambang Municipality 2011).

Table 7 shows the average yield and production of annual crops in Battambang province in 2011 and 2012. Data shows that cassava and red corn are the main products in terms of production. There was a reduction, however, in their total production in 2011 and 2012: red corn from 562,448 to 510, 2995 tons and of cassava from 2,001,839 to 1,692,895 tons.

Table 7. Yield and production of annual crops in Battambang province

	2011		2012	
Crop Type	**Yield (ton/ha)**	**Production (ton)**	**Yield (ton/ha)**	**Production (ton)**
Rice - dry season			4.318	38,858
Rice – wet season			2.710	751,448
Red Corn	5.144	562,448	5.171	510,295
Soybean	1.84	42,155	1.888	42,261
Bean	0.89	15,591	0.897	14,348
Peanut	1.749	834	1.986	842
Cassava	35.522	2,001,839	36.043	1,692,895
Sweet Potato	11.66	1,201	5.574	697
Sesame	0.698	9,477	0.696	7,305

In 2010, an estimated 176,561 families were involved in the agricultural sector (Provincial Department of Planning 2014). Table 8 and Figure 8 show the proportion of the population involved in the agricultural sector in Battambang province and its districts in 2012. Although most of the labor in the province are in on-farm labor, the trend has decreased since 2012 to 2014.

Table 8. On-farm and off-farm employment in Battambang province in recent years

Description	**2012**	**2013**	**2014**
On-farm labors (%)	80.6	78.4	76.0
Off-farm labors (%)	19.4	21.6	24.0

Source: Provincial Department of Planning, 2014

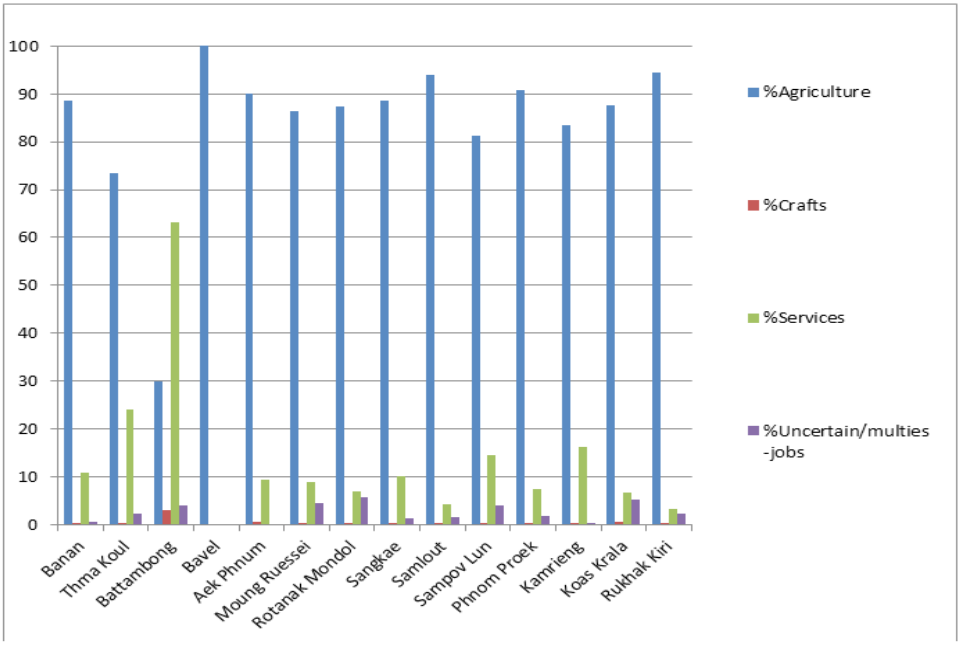

Figure 8. Four main sectors of employment in Battambang by district in 2010 (NCDD, 2010)

3.6.2 Livestock

Family-scale dominates animal husbandry. The most common livestock raised by local farmers are chicken (53.52%) and cow (19%). Livestock raising tends to decrease as more farmers shift to using ploughing machines instead of draft animals. Production values from 2012 to 2014 and situation of livestock are shown in Table 9.

Table 9. Animal and livestock production values from 2012, 2013, and 2014

Kind of animal	Unit price (USD)	Total value (USD)		2014		
		2012	2013	Total Value(USD)	Total Animal (head)	%Family raising animal
Cow	200	28,805,200	29,620,400	25,517,800	127,589	19.02
Buffalo	200	651,600	572,200	544,600	2,723	0.31
Pig	50	3,281,650	3,356,900	2,371,100	47,422	6.56
Chicken	4	2,829,084	2,985,064	3,157,380	789,345	53.51
Duck	3	1,622,052	1,578,894	1,617,030	539,010	4.57
Goat	50	27,450	25,150	38,100	762	0.03
Crocodile	10	137,030	199,410	213,550	21,355	0.23
Fish	2.5	1,276,358	2,110,135	1,533,575	613,430	0.37
Total value for all animals/ livestock		38,630,424	40,451,528	34,998,897	NA	NA

Source: Provincial Department of Planning (2014)

3.6.3 Fishery

The fishery sector in Battambang is dominated by capture fisheries rather than aquaculture. The province has 303,000 ha of flooded forest, or 26 % of the total provincial territory. This flooded forest area borders (30 km) the Tonle Sap Lake and covers paddy field floodplains and floating rice cultivated areas, creating a natural habitat for fish spawning, breeding, and biodiversity.

Currently, there are 48 fishery communities, 40 of which were officially registered and recognized by MAFF. An additional 43 fishery refuge for spawning/breeding are managed by local communities, and another seven fishery refuges, and 28 fishery ponds are managed by the provincial fishery administration (5 years strategic development planning 2015-19, Battambang).

Meanwhile, the fishery resources were abundant in Rohal Suong village. These resources have declined rapidly since flooded forest and natural water bodies were converted to rice fields and development projects. Local farmers, however, still catch fish during rainy and high peak season in the Sangke river, lake and water bodies near their village. The fish catch can be sold out and processed for household consumption.

In 2002, Rohal Suong village joined Sdey and Dourng Mea villages in establishing community fisheries (CFi). The purpose of CFi establishment was to manage and use fisheries resources in a sustainable manner. The CFi is composed of 13 committee members (including 3 women) and 856 members (296 women). A total of 1.814 ha was allocated as CFi area and 7 ha was designated as a fish conservation area in Rohal Suong. Only eight households have small scale aquaculture, which was introduced by Harvest Cambodia and Aphivat Srey (AS). Four households have eel culture.

3.6.4 Off-farm employments

Employment in the services and manufacturing sector in Battambang province has been increasing (Table10). The province has 10 active small-scale rice mills and 23 active large-scale rice mills, 33 electronics shops, 33 brewery factories, 153 small service providers (massage parlors and cosmetics), 183 small enterprises, 10 clinics, and 50 pharmacies in the municipality.

Tourism is another employment sector. Key tourism sites include cultural villages, Khmer traditional houses, and colonial buildings, museums, and entertainment areas. Currently, there are 24 hotels, 32 guest houses, 46 restaurants, and 15 gasoline stations (Table 9) (Battambang Municipality, 2011).

Given its strategic location and geographic advantage in terms of agriculture, Battambang has high potential to be transformed into an agro-industrial hub, tourist attraction, and become a competitive city for public and private sector investment.

A study by ACI (2010) showed that the production of vegetables in Cambodia is insufficient to supply the market. Production is highly seasonal. Import of vegetables from Vietnam and Thailand occurs throughout the year and in particular during the dry season. About 50 % of all vegetables consumed in Cambodia are imported (70% during the dry season and 30% during the wet season). In Battambang, farmers have not been able to reap the benefits of upgrading and improved post-harvest practices due to lack of organization, production planning and their dependency on collectors who are reluctant to share margin with farmers.

Table 10. Manufacturing and services in Battambang

Type of local businesses	**2008**	**2009**	**2010**
Rice mills (small)	9	10	10
Rice mills (medium and big)	22	20	23
Local power supply	20	3	0
Motor repairing shop	125	155	146
Car repairing shop	17	15	16
Electricity tools shop	33	31	33
Win producer shop	28	37	33
Wooden handcrafts	52	50	51
Furniture shop	61	50	81
Service shop (hair dress, phones, massage, karaoke)	127	152	152
Small food shop	135	167	183
Market (big)	3	3	5
Market (small)	9	9	8
Pharmacy	41	42	50
Health clinics	8	8	10
Hotels	12	22	24
Guesthouses	37	25	32
Restaurants	28	36	46
Gasoline stations	13	14	15

The strategic development plan 2015-2019 (draft) also acknowledges key constraints on commercial crops, including red corn and cassava, resulting in both a reduction of cultivated areas, and production.

Table 11. Summary key processing sites and enterprises in Battambang province, 2012-2014

Description	Number of locations			Number of workers in 2014	
	2012	2013	2014	Total	Female
Rice mill (medium or big size)	624	551	610	2,716	894
Power supply enterprise	203	52	54	383	103
Brick production	54	55	61	718	359
Salt production	2	4	13	155	75
Handicraft	1	3	2	4	4
Rattan, bamboo production	12	8	12	88	72
Furniture from wood	160	188	185	505	118
Sculpture from stones, skin, metal	19	18	16	72	28
Metal, aluminum production	90	84	95	413	46
Plastic production	3	3	3	18	5
Fresh water production	32	33	37	272	141
Crops packaging or processing	63	54	56	287	141
Aquaculture packaging or processing	28	27	29	117	73
Other production	141	103	78	554	323

Source: Provincial Department of Planning (2014)

Battambang has a surplus of rice production, with total production of 790,306 tons in 2012 and 789,899 tons in 2013. A study conducted by Gergely, Pierre, and Chanty (2010) shows that primary marketing systems in rice trade and production are very fluid and involve a large number of actors:

- ***Farmers:*** The majority of farmers keep paddy for their own consumption and only sell their harvest when they are short of cash or have extra requirements. The home consumption is estimated at 40 % of the net production; this brings the consumption per head to 195 kg of rice.
- ***Collectors and middlemen:*** The trade of paddy involves many actors: collectors, intermediary traders called "middle persons" and traders. Collectors generally cover 4 or 5 villages and gather the rice from individual farm lots into small warehouses. Depending on the price, they sell paddy to medium and large millers but most of the quantity is sold to middlemen. These intermediary traders are typically involved in the inter-provincial and cross border trade with Vietnam and Thailand. In such a case, they usually sell their paddy to traders located close to the border, who are in direct contact with Vietnam millers (they are, in particular, pre-financed by them). They are also involved in the trade of other commodities, such as soybean, sesame, and fertilizers.

- ***Export paddy rice to Vietnam and Thailand:*** Cambodia exports the majority of its surplus rice production as paddy rice to Vietnam and Thailand, bypassing the milling stage. Middlemen sell paddy rice to traders who transport the bags to Vietnam and Thailand traders across the borders (although export paddy is not allowed). Most of the paddy rice exported to Vietnam comes from the dry season harvest of the rice IR variety.
- ***Medium and large millers:*** Rice millers buy paddy rice from primary collectors, traders, or farmers themselves. Milled rice is then distributed from mills back to collectors and traders and to wholesalers in towns and larger markets. From these wholesalers, the rice is distributed to consumers through retailers.
- ***40 % of production is exported as paddy rice:*** Rice consumption per head is estimated between 170 kg and 230 kg rice per head/year. The flow of paddy rice for export to Vietnam and Thailand have increased substantially as production of paddy rice has increased in Cambodia.
- ***Dependency on exports:*** If Vietnam or Thailand close their borders or tax the paddy rice imports to protect their own market, the domestic paddy rice price will drastically decrease in Cambodia resulting in a major income crisis. Opening a Cambodian export rice chain is largely an economic safety priority.

Overall, market access remains unreliable within the province. Rice markets are strongly controlled by middlemen who own commercial rice mills within the village and in major district or provincial towns. A case study in Kampong Pouy shows that large scale rice milling associations and private rice mill owners from provincial towns determine the price of rice (Try, 2013).

According to a feasibility study on the establishment of an open paddy rice market in Cambodia conducted by JICA and the Royal Government of Cambodia in 2003, 51 commercial rice mills existed within Battambang province, with 31 of these in three districts in the irrigated areas: Bannan with 5, Thmor Koul with 24 and Moung Russey with 12 rice mills (JICA and RGC 2004). By 2007, the number of commercial rice mills decreased to 20 and transformed from individual ownership into networks and associations. Rice milling in the province is controlled by the provincial chamber of commerce, which has close ties with the ruling political party.

According to the 2011 Economic Census (RGC, 2013) Battambang ranked 2nd among 24 provinces by various indicators derived mainly from the results of the 2011 Economic Census (Table 12). The total number of commercial establishments in Battambang was 34,097 while the total number of persons engaged in these establishments was 84,790. Battambang accounts for 6.8% of the total number of establishments in Cambodia (505,134 establishments) and for 5.1% of the total number of persons engaged in establishments (1,673,390 persons) in the Kingdom of Cambodia.

Table 12. Key results from economic census in Battambang 2011

District	No. of commercial establishments	No. of persons engaged	Annual sales (mil. USD)	Annual expenses (mil. USD)	Population (2008)	No. of communes
Banan	2,696	5,704	30	24	92,138	8
Thma Koul Krong	3,434	7,955	52	40	113,443	10
Battambang	9,345	29,216	237	191	144,323	10
Bavel	2,436	6,312	34	30	100,000	6
Aek Phnum	2,179	4,751	22	19	68,276	7
Moung Ruessei Rotonak	3,497	7,425	57	48	112,704	9
Mondol	1,266	2,367	18	16	41,170	4
Sangkae	2,269	6,060	25	20	111,663	10
Samlout	1,183	2,189	13	9	39,701	7
Sampov Lun	1,124	2,855	32	27	35,248	6
Phnom Proek	1,730	3,403	24	17	49,722	5
Kamrieng	1,562	3,478	18	15	51,053	6
Koas Krala	706	1,694	9	8	25,766	6
Rukhak Kiri	670	1,381	5	4	39,967	2
Total	34,097	84,790	576	466	1,025,174	96

Figure 9. Direct seeding in Rohal Suong village

In Rohal Soung village, the average family size is six and the average land holding is 7 Rai[9] including rice field, crop planting and residential areas. The main occupations are rice production and agriculture-related activities and followed by fishing, and small trading. Most rice farmers increased rice cultivations from

9 Rai is local measurement unit, one hectare equals 6.25 Rai

single cropping to two cropping per year. New rice varieties have been introduced in the village by dealers, NGO and government projects; those rice varieties are *Sen Kra Ob, Sen Pidor, Sar Kra Nhanh, OM,* and *IR*. The new varieties generally provide higher yields, but also require intensive inputs such chemical fertilizer, pesticides, machineries and water.

Beside rice cultivation, local farmers grow other crops such as maize, mung bean, watermelon, cucumber, pumpkin, and yam bean. Tables 13 and 14 show the results of a focus group discussion with the villagers during data collection for the situation analysis exercise.

Table 13. Crop Calendar

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Season(DS)												
Wet Season												
Dry Spell												
Flood												
Rice farming												
Vegetables												
Water melon												
Cucumber												
Mung bean												
Bitter gourd												
Corn												
Pumpkin												
Cabbage												
Fishing												

There is no official market venue in Rohal Suong village. There are few small local shops operated by villagers that offer very basic supplies and groceries. There are a few shops selling agricultural materials/ inputs. Some farmers, who do not have enough money, buy on credit the seeds and chemical fertilizers in the early season and pay at a higher price during harvest season. In recent years, rice traders visit the village to buy rice directly from the villagers during the harvest season.

Generally, rice has a high market demand, but its price is unstable. Farmers complain about the low rice price for years, and they sometimes cannot make any profits. Farmers in Rohal Suong are also challenged in marketing their other agricultural produce such as watermelon, bean, and other vegetables. During the peak harvest period, the price of these agricultural products falls rapidly.

Meanwhile, fish marketing is dominated by traders who buys the fish in the village and transport the fish in bug buckets by motorbike. The big fish is transported to Battambang, Phnom Penh and Thailand; while small fish is sent to a processing area, about 10 km distance from Rohal Suong village.

Table 14. Summary of main occupation activities of households

	Livelihood strategies	% of HHs	Gender involved	Trend	Pressures	Driving forces	Responses
Men Group	Major						
	Farming	70%	Both men and women	More intensive with new rice varieties	Low price Lack of water & irrigation	Unpredictable climate New rice varieties provide high yields	Community mobilize their resource to rehabilitate the small irrigation cannels
	Cropping	70%	Men, women & children	Irregular, it depends on market demands	Unstable market and sometimes price is too low	Market	Individual strategy and solution
	Minor						
	Fish raising	2.50%	Both men and women	Decrease	Lack of technical inputs Expensive inputs Lower price	Lack of technical inputs Expensive inputs Lower price	Some households stopped doing fish culture
	Fishing	60%	Both men and women	Decrease	Increased bumber of fishers and illegal fishing Natural water are polluted	Increased illegal fishing	Go fishing to other fishing grounds Just do fishing during high peak season
	Wage Labour	30%	Women 70% Men 30%	Increase	Away from home and family	Farm production were destroyed Regular incomes	
	Taxi motor	2.50%	Men	Same	No job to do after farming Increase price of gasoline	Try to diversify the incomes	
	Traditional band	<1%	Men	Decrease	Not enough skill especially the next generation people (hard to practice)	More modern band	Nothing
	Sewing	<1%	Women (99%)	Increase	cheap wage	Market demands	

	Livelihood strategies	% of HHs	Gender involved	Trend	Pressures	Driving forces	Responses
Women Group	Major						
	Rice Farming	80%	Both men and women	stable but changing in the rice variety	Low price	New rice varieties provide high yields	
	Cropping	50%	Men do more than Women	Decrease of crop plantation	low production	Unstable market and price	-Reduce cropping -Migrate to work as a wage labor
	Vegetable gardening	50%	Women(do more than men)	Stable	Lack of land to grow the vegetable		Continue growing as usual
	Fishing	70%	Men, Women and children	Increase	More fishers but less fish	Increased illegal fishing	Increased fishing efforts and fishing gears
	Cow fattening	90%	Men and Children (Boys)	Decrease	Lack of grassland and labor	Introduced machinery for agriculture	Baying machineries for agriculture
	Wage labour	40%	Women & Men (50%+50%)	Increase	farming production is low Introduced machinery for agriculture	Try to find alternative options for surviving	
	Livestock	90%	Women, elder & children	Stable	- livestock declines due to diseases		Livestock raising continues despite diseases Applied new techniques and vaccination
	Minor						
	Small trading	30%	Women do more	Increase	Very slow during lower agriculture productions	Try to find alternative options for surviving	
	Machine repairing	10%	Men do more	Increase	Limited skill	Increased machinery utilizations	
	Fish farming	<1%	Men more than women	Decrease	Lack of techniques and high inputs	Lower price	Stopped doing fish culture

3.7 FOOD SECURITY STATUS AND TRENDS

FAO/WFP (2012) shows there are no consensus on the actual per capita consumption of cereals in Cambodia. The rice balance sheet prepared by the MAFF uses 143 kg per person as the average annual rice consumption and other government figures indicate 153 kg. This is similar to the estimates published by FAO/WFP at 152.2 kg for 2012. The FAOSTAT data can be used to compare per capita consumption in Southeast Asian countries. At 153 kg per person per year, consumption in Cambodia is below that of Vietnam, Lao PDR, and Myanmar but above the Philippines and Thailand. Hence, there is a need for a more reliable survey-based estimate. For the purpose of this balance sheet the following per capita consumption requirements are used: rice 153 kg, maize 5 kg, wheat 3 kg and soybeans 8 kg. The maize and wheat rates are derived from the FAO estimates of the apparent average annual consumption during the past five years. Soybean per capita consumption is based on the assumption of zero net trade and stock exchange. Based on total rice production, both in wet and dry season, Battambang has managed to produce major surpluses and also leads exports to neighboring countries such as Thailand and Vietnam, mostly through informal channels.

3.7.1 Nutrition of children

Nutritional status is the result of complex interactions between food consumption and the overall status of health and care practices. Numerous socioeconomic and cultural factors influence decisions on patterns of feeding and nutritional status. Adequate nutrition is critical to child development. Measurement of nutrition status among young children covers three major indices: Height-for-age (stunting), Weight-for-height (wasting), and Weight-for-age (underweight).

In Cambodia, 40 percent of children under age 5 are stunted, and 14% are severely stunted. Analysis by age group indicates that stunting is apparent even among children less than 6 months of age (10%). Table 15 summarizes the percentage of children under 5 years old classified as malnourished according to three anthropometric indices of nutritional status: height-for-age, weight-for-height, and weight-for age (Background Characteristics, Cambodia, 2010).

Table 15. Child nutrition status in Battambang 2010

Height for age	% below-3SD	6.1
	% below -2SD	26.5
	Mean Z-score(SD)	-1.2
Weight-for- height	% below-3SD	3.2
	% below -2SD	14.4
	% above + 2SD	3.5
	Mean Z-score(SD)	-0.7
Weight-for-age	% below -3SD	6.1
	% below -2SD	22.3
	% above + 2SD	0.2
	Mean Z-score(SD)	-1.2
Number of children		274

3.7.2 Nutritional status of women

The height and weight of women aged 15-49 were measured among a 50 percent subsample of households selected in the 2010 CDHS (Figure 11). Results show that while undernutrition is declining, obesity is increasing during the years 2000 to 2010. In Battambang, out of the 654 women, 6.27% were found to be below 145cm in height, 74% with normal weight, 13.9% total thin and 9.6% mild thin, 4.3% severely thin and 12.1% with total overweight, 10.5% overweight and 1.6% obese.

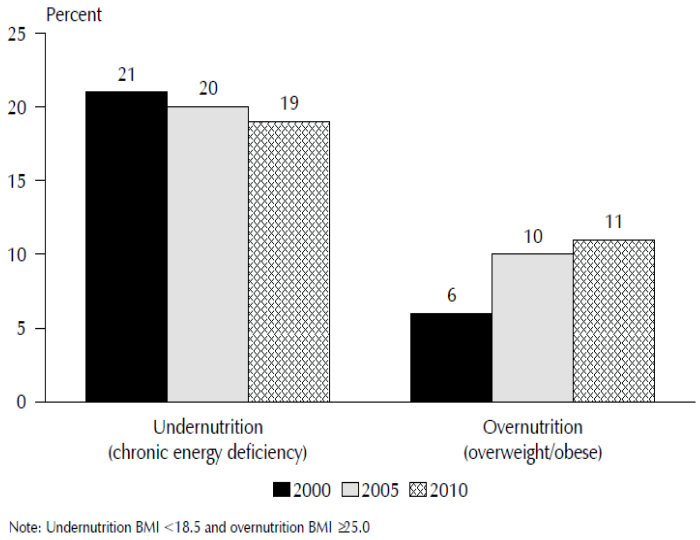

Figure 10. Trends of nutritional status among women aged 15-49 at national level (Ministry of Planning (2010) Cambodia Demographic Health Survey 2010)

3.8 HAZARDS AND VULNERABILITY

A study conducted by MOE (2010) for the Second National Communication for UNFCCC shows that Battambang is the most vulnerable province to drought and second-most vulnerable to floods based on the level of fatalities, property losses, and contaminated wells. In an earlier study conducted by MOE (2005,2006) on Vulnerability and Adaptation to Climate Hazard covering 17 provinces[10] showed the impact of flood, drought, warning and post disaster responses, windstorm, and malaria, in Battambang:

- Records of droughts and floods from 1982 to 2002 clearly indicate that the provinces that are vulnerable to floods are equally vulnerable to droughts.
- Prey Veng is one of the provinces most vulnerable to floods and Battambang is ranked second.
- Battambang is most vulnerable to droughts, followed by Prey Veng and Bantey Meanchey provinces.

10 These provinces include Bantey Meanchey, Battambang, Kampot, Kandal, Koh Kong, Kampong Cham, Kampong Chhnang, Sihanouk Ville, Kampong Speu, Kampong Thom, Kratie, Prey Veng, Pursat, Rattanakiri, Siem Reap, Svay Rieng, and Takeo.

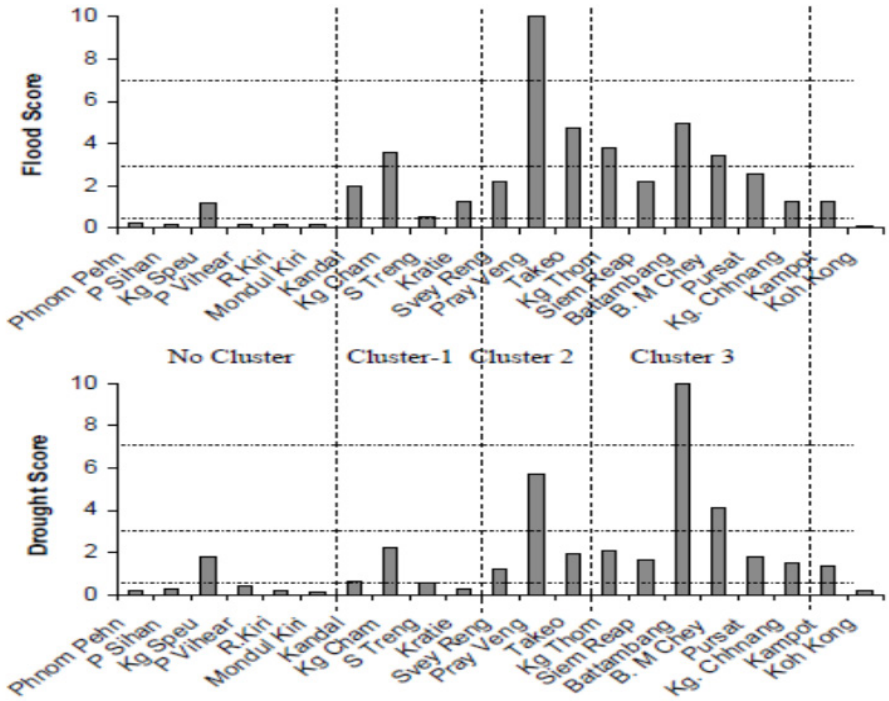

Figure 11. Provinces vulnerable to flood and drought (MOE et al., 2013)

Other reports also indicate the vulnerability of Battambang to changes in climate. MOE/PPCR (2013) Vulnerability and Adaptation Assessment shows a medium vulnerability to floods, but very high vulnerability to drought for Battambang. In addition, this province receives a high score in terms of priority for adaptation compared to other provinces. Results from this report are below:

- Drought is an increasing concern for Battambang. Generally, between December and March Battambang receives very little rainfall (5.6% of the annual total).
- Drought in districts: Moung Ruessei, Rukh Kiri, Banan, Koas Kralor , Rotanak Mondul, Sam Lout, Bavel, Phnom Proek, Kamrieng, and Sampov Loun.
- Districts along the Tonle Sap Lake and Stung Sangkae River (e.g., Thma Koul, Aek Phnum, Sangkae, Moung Ruessei, Banan, Rotonak Mondol and Samlout) experience flooding two-to-three times per year.

ADB (2011) indicated that Battambang is one of the provinces surrounding the Tonle Sap Lake that often received flash floods, recorded back in 1961, 1966, 1996, 2000, 2001, 2004 and 2006. JICA, MOWRAM and MAFF (2007) published a survey on river basins surrounding the Tonle Sap Lake, of which Stung Snagke or Battambang is one of the key river basins. Table 16 below shows total catchment of the Battambang river basin (Sangkae, and Moung Russy).

Table 16. Percentage of River Basin catchments and elevation in Battambang (JICA et al.,2007)

River Basin	Area (Km²)	Lower Area EL 4-13 (Km ²)	%	Lower Area EL 14-30 (Km²)	%	>EL 30 *2 (Km²)	%	Highest Point (m, amsl)
Battambang	6,053	2,254	37	704	12	3,095	51	1,391
Moung Russey	3,696	1,533	41	969	26	1,194	33	1,280
Pursat	5,965	957	16	433	7	4,575	77	1,717
Boribo	7,154	1,545	22	1,077	15	4,532	63	1,764
Total	22,868	6,289	28	3183	14	13,396	58	1,764

According to the Provincial Water Resource Department in Battambang, a river water level above 12.5 meters high would flood the city as the water flows out of the Sangker River. Table 17 below summarizes the water level from Sangker River and its flooding frequency.

Table 17. Flood records and flood frequency analysis (CDIA and ADB, 2010; PDOWRAM, 2013)

Year	Max. Annual Water Level (m)	Annual Flood (m^3/S)	Return interval (years)	Max. annual water level (m) - GEV	Annual flood (m^3/s) - EV1
1999	12.37	634	Average flood	12.66	760
2000	13.44	1009	5	13.46	987
2001	12.14	569	10	13.86	1171
2002	11.59	433	20	14.16	1347
2003	13.02	846	50	14.46	1576
2004	12.08	552	100	14.63	1747
2005	13.39	988	200	14.77	1918
2006	13.71	1125	500	14.91	2143
2007	13.50	1034	1000	15.00	2313

3.8.1 Floods

Flooding has been recorded in every Sangkat (communes) of Battambang municipality during the rainy season from June to December. In 2013, flooding seriously affected the whole province (flooding occurred mostly in October to December). The highest level of flooding occurred in Sangkats Svay Por and Preak Preak Sdach, with water depth ranging from one to two meters.

Table 18 shows that 7 out of 10 Sangkats experienced flooding in 2010, 2011 and 2013. Toul Ta Ek and Prek Preah Sdach, as well as Ou Char are most vulnerable to flooding due to a majority of land being situated in wetland areas with seasonal flooding, and more intense flooding from overflow from the river.

Table 18. Extent of flooding by Sangkat in Battambang town (CDIA and ADB, 2010)

Sangkat	Total area(ha)	% flooding	# of sites	Flood duration (days)
Svay Por	1,999	25	3	<5
Prek Preah Sdach	296,825	50	3	>7
Toul Ta Ek	296,975	40	7	>7
Rottanak	507	45	3	>7
Ou Char	119.12	40	5	>7
Chamkar Samrong	6,466	10	1	<3
Sla Ket	6,059	5	3	<2

Based on a CDIA/ADB report (2010) flooding also happens along the rail line due to the reduced capacity of drainage canals blocked by new construction and filled with sediment and water. In several locations lateral roads have been built without proper drainage works.

Official records from various documents shows that in 2011 (with water levels up to 13.95 m) floods affected 31,458 people (7,111 households in 31 communes in 9 districts), inundated 52,503 ha, and destroyed 36.266 ha of rice fields. Flood in in 2013 was even more serious as the water level was the highest in history at 14.2 m high along Sangke River (normally 12.5 meters, water start to overflow from the river to the town and areas in lowland or wetland).

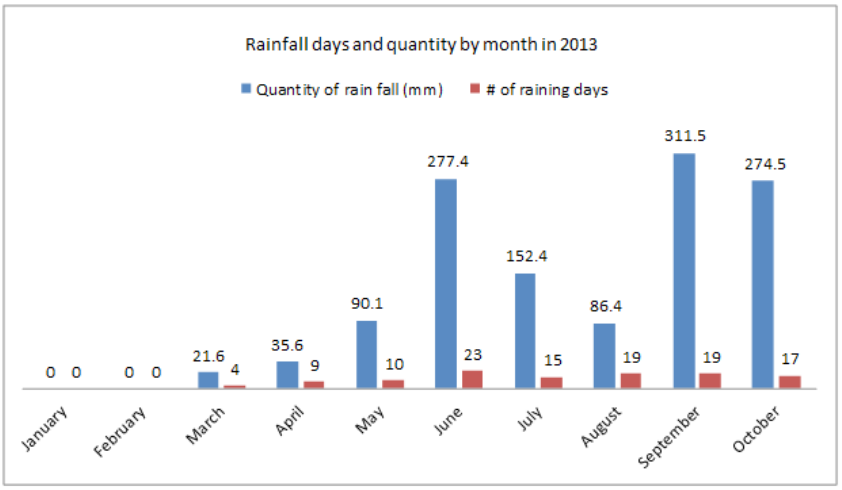

Figure 12. Total monthly rainfall in 2013, Battambang (Provincial department of Water Resource and Meteorology, 2013)

Flood in late 2013 is considered as the worst case in a history of 70 years based on personal interview with water resource official in Batmbang in late October 2013. Various sources of water from upstream including torrential rain have concentrated through Sangker River, including other watershed areas down to river and the province.

Currently, large-scale infrastructure works are being built by the Chinese across the Sangker River, for flood control and water diversion for irrigation (potential irrigation area of 70,000 ha). Domestic use also faced

problems during the 2013 flooding. Investment for this project was US$100 million, with additional loans from China.

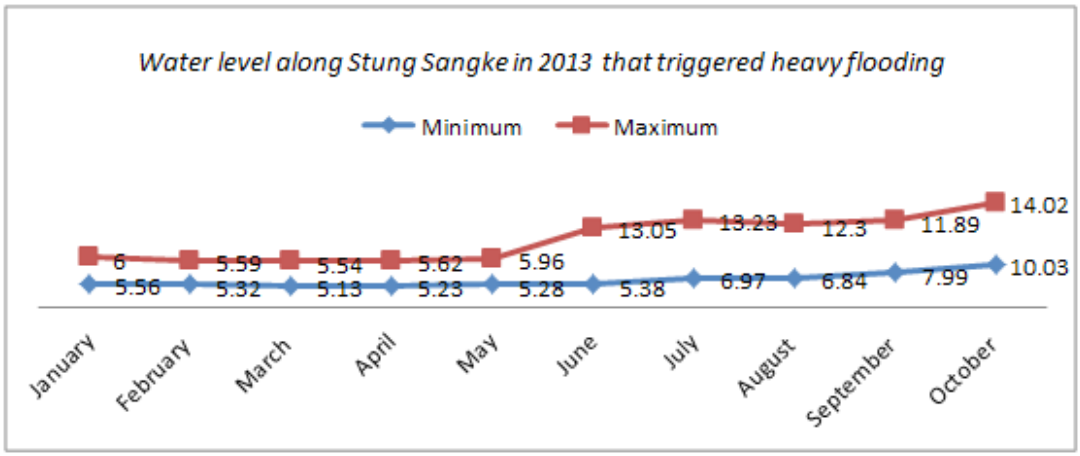

Figure 13. Monthly water level Sangkae River in 2013 (PDOWRAM, 2013)

3.8.2 Impacts of Flooding

It was reported during the fieldwork in late October 2013 that floods have significant impact in the area. The flood started in early October and lasted around 7 to 10 days while in some areas, the flood lasted longer, around 20 days. Among the provinces affected, Battambang and Battey Meanchey were the worst affected in terms of numbers of households and infrastructure (social sector, agriculture, and infrastructure value) (Table 19).

Table 19. Social sector affected by the district in Battambang province

	Districts/town	No. commune /sangkat	Affected people (family)	Affected people (person)	Evacuated people (family)	No. of houses affected	No. of houses destroyed	No. of people dead
1	Banon	8	2,721	13,060	1,721	2,721	58	1
2	Thmorkol	10	10,952	52,570	3,663	10,953	0	4
3	Battambang	10	8,439	40,507	1,553	8,132	3	0
4	Borvil	8	14,122	67,786	1,274	7,277	11	4
5	Ek Phnom	7	9,664	46,387	197	7,877	0	1
6	Mongreusey	9	4,450	21,360	3,315	4,331	6	5
7	Ratanak Mondule	5	192	922	105	189	16	0
8	Sangker	10	12,906	61,949	1,926	12,764	1	1
9	Samlot	7	592	2,842	102	132	5	0
10	Sampovlunn	6	0	0	0	0	0	0
11	Phnom Prurk	5	2,643	12,686	95	1,774	18	0
12	Kamreang	6	2,204	1,059	832	1,930	47	1
13	Kos Krorlor	6	3,090	14,832	156	3,090	1	0
14	Rokhakirie	5	2,185	10,448	233	1,282	0	0
	Total	132	74,160	346,408	15,172	62,451	166	17

Figure 14 shows the effects of flooding on agriculture in 2013. In particular, out of 131,553 ha of agricultural land dedicated to rice, 36,895 ha were destroyed. Other crops such as fruit trees and cash crops were also reported to be affected, with 51,437 ha and 35,543 ha, respectively, destroyed.

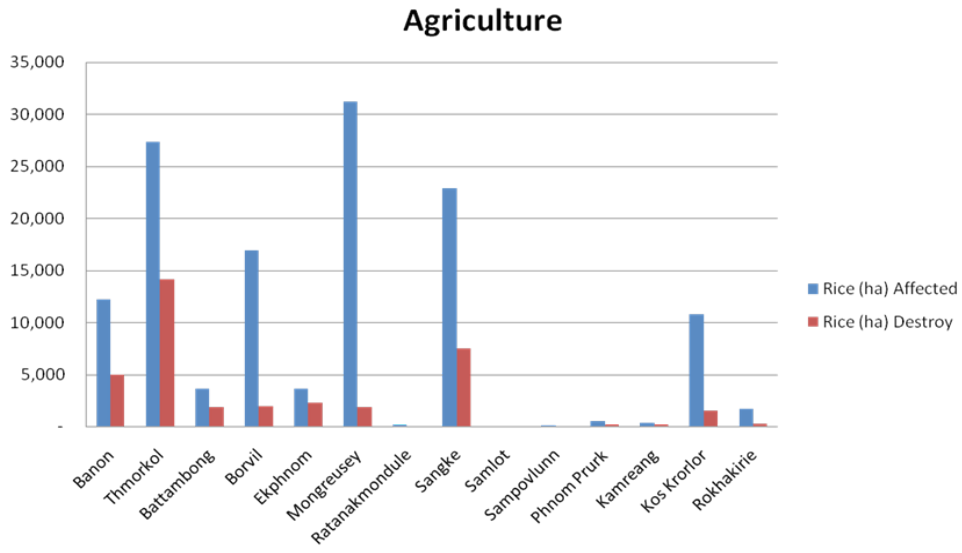

Figure 14. Impact on agriculture of 2013 flood (Provincial Disaster Management Committee, 2014)

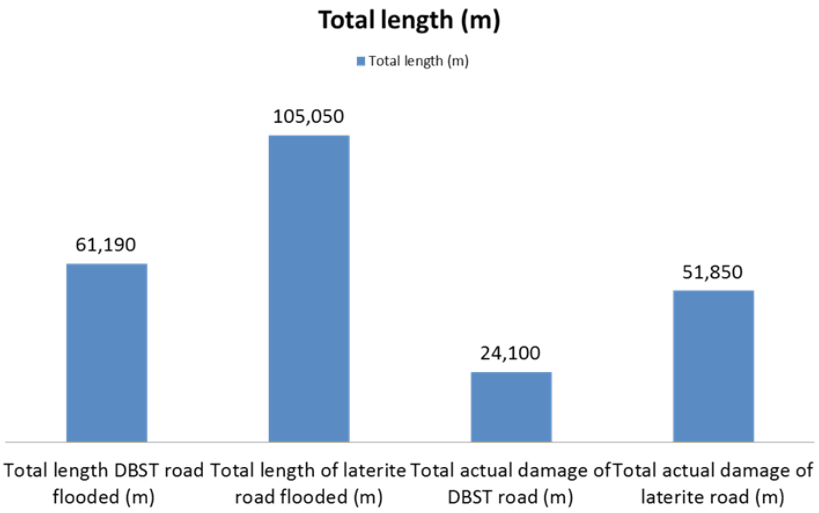

Figure 15. Impact on roads and infrastructure of 2013 flood (Provincial Disaster Management Committee, 2014)

As a result of flooding in 2013, 16 irrigation schemes were destroyed with a total 31,072 m of main canals, 1,247 m of dikes and 15 construction sites. The total cost of repair was estimated at US$ 700,000. As discussed with local community groups in Rohal Soung, local villagers experienced extreme events such flash flood, drought, crop disease and insect outbreak. Flood in late 2013 was considered as the worst flood over 70

years; it rose up to 14.50 m high along the Sangke river. Normally water starts to overflow from the river to the town and areas in lowland once the water level reaches 12.50 m high in the Sangke river (Try, 2015).

About 80 per cent of rice production in Rohal Suong were destroyed by flood in 2013; moreover some livestock and infrastructures, such as paths and channels, were also damaged during a flood (Sat Ch., 2014, per. comm.). Table 20 shows the extreme events which occurred in the village

Table 20. Extreme events which occurred in the village

Hazards/ disaster	When	Damage and extent of damage	Affected population	Assistance/Support received	Coping strategies
Flood	1990, 2000, 2011, 2013	Rice, crops, fruit crops, livestock, houses and infrastructures	People (children & older people); farmers	Cambodian Red Cross, Cambodian Government and donators(local & overseas)	Replanting the rice and the crops and re-raising the livestock
Storm	2011, 2012, 2013	Destroyed the houses, damaged the house roofs, the big tree and fruit trees	Poor household who have a small house, Fishers	No one	Rebuild the houses by helping each other after the storm
Drought	2000, 2010, 2012, 2013	Rice, crops, livestock, and fish in conservation ponds	People (children & older people);	Cambodian Government	Built the water channels and irrigation systems for rice and the crops -Change the rice & crops varieties(from the long duration crops to short duration crops)
Thunder	2000	People, animals and fruit trees	Fisher and farmers	Nothing	No solution

3.8.3 Vulnerability sectors

The climate vulnerability index published by MOE, WB/ADB and Hatfield (2013) focuses on key sectors including agriculture, water, and infrastructure. Vulnerability was mapped in terms of population density and location of important biodiversity resources. Adaptive capacity was mapped using various socioeconomic indices (e.g., human development index) and indicators such as access to technology and availability of infrastructure. The agriculture, water, and infrastructure sectors are summarized below:

Agriculture

The impacts of climate change to the agricultural sector in Battambang, and in Cambodia as a whole, are especially significant due to the sector's importance for rural livelihoods. Eastham et al. (2008) predict that by 2030:

- Agricultural productivity would increase
- Food availability in excess of demand decreases
- Temperature, annual precipitation and runoff increase
- Dry season precipitation and runoff decrease
- The high probability of increased flooding (not quantified)
- Seasonal fluctuation in Tonle Sap Lake area and levels increases

- Minimum areas of Tonle Sap Lake increases
- An area of flooded forest permanently submerged increases and possibly be destroyed
- Maximum areas of Tonle Sap Lake increase with possible negative impacts on agricultural areas, housing and infrastructure.

Under wet and median future climate scenarios for 2030, productivity of rice in the Tonle Sap catchment (which includes Battambang) is expected to increase slightly from historical productivity measures (Eastham et al. 2008). Rice production in Battambang is expected to increase under climate predictions for 2025, 2050, and 2100 (MOE, 2002). Analysis of yield anomaly of rice productivity (i.e., the difference between observed and estimated data) for Battambang suggests that, under elevated CO_2 emission rate projections, yields of wet-season (mostly rain-fed) rice may increase (0.1 or 0.2 tonnes/ha in 2050 or 2100) compared to those of dry-season rice (MOE, 2001). For wet-season rice in Battambang, rice production under the projected climate change trends would become more variable (MOE 2002). These scenarios only consider projected climate change for different increases in CO_2 emission rates and do not take into account other variables that influence crop growth and development.

Contrary to the findings above, analysis of changes in soil water content under future climate change (MOE, 2010) reveals that western and northwestern provinces (including Battambang) will be exposed to higher drought risk due to higher temperature, evaporation rates, and extended dry seasons. Growing seasons in these areas may be reduced from five months to 2-3 months, affecting agricultural production in the province.

In addition to increased drought risk (with a shorter wet season and longer dry seasons), more intense rainfall and flooding may cause damage to crops. Rural farmers may not have adequate resources and capacity to cope with reduced harvests during drought and heavy rainfall years (MOE, WB/ADB and Hatfield Consultants 2013).

Farmers in Battambang will be particularly vulnerable to livelihood and food security impacts resulting from reductions in the length of growing seasons and reduced agricultural productivity.

Water sector

Various studies have suggested that climate change will alter the water cycle and hydrology in the Mekong basin and tributary catchments (especially in the Tonle Sap catchment, which includes Battambang), shifting the timing, duration, and intensity of rainfall patterns and affecting the quantity, availability, quality, and distribution of water resources (ICEM 2014).

Temperature and annual precipitation are expected to increase with high probability of flooding. Increased flooding is expected to affect all parts of the Mekong basin, with the greatest impacts felt in the downstream catchments of the Mekong River due to the cumulative impact of upstream runoff (Eastham et al. 2008). The Tonle Sap catchment (including most of Kampong Thom) is likely to be wetter, flooded for a longer period, and to experience higher water levels and more extensive flood inundation.

Construction of upstream hydropower dams along the mainstream Mekong River and its tributaries will also affect future water availability. Hydropower dams will regulate flow in the Mekong, reducing it during the wet season and increasing it during the dry season (Lamberts 2008; Sarkkulla et al. 2009). Under various hydropower development scenarios (MRC 2010), dams are expected to help offset extreme fluctuations in river flows caused by the frequent floods and droughts predicted under climate change. However, regulation of Mekong River flows will have a significant impact on the annual flood pulse of the Tonle Sap River, with potentially disastrous impacts to the Tonle Sap Lake ecosystem and, therefore, the livelihoods that depend on it for agriculture and fisheries.

Impacts of climate change on water resources will affect livelihoods, primarily through changes to agricultural productivity (see section above) and fishery resources (which have not been quantified), which sustain over 80% of the rural population in Battambang. However, the precise nature and levels of these impacts are uncertain and difficult to predict, as they depend not only on uncertain future climate conditions but also on uncertain future demographic and socioeconomic conditions.

Infrastructure

Vulnerability of infrastructure to future climate risks has not been quantified in Cambodia (including Battambang province), except for the coastal regions subjected to sea-level rise. Roads in Battambang are susceptible to flooding throughout much of the rainy season. With a high likelihood of increased rainfall intensity, causing stronger floods, it will be necessary to climate-proof the roads (i.e., to build them in such a way as to make them more resilient to extreme climate events) (PPCR 2011).

Infrastructure in Battambang will remain vulnerable to intensified flooding and drought risks unless climate-proofing is done (enhancing flood resilience of roads, sanitation, solid waste management, public markets, and other infrastructure). Construction of flood-resilient infrastructure in a number of provinces (including Battambang) is planned under the Strategic Program for Climate Resilience. Planned activities for reducing infrastructure vulnerability involve both soft and hard interventions. Hard interventions include climate-proofing roads and drainage systems and improving riverbank flood-protection, water, and sanitation facilities under a concessional credit scheme (PPCR 2011).

3.8.4 Rohal Soung

Climate in Rohal Suong is pretty similar to the climate in the Tonle Sap Great Lake region; the first rainfall peak occurs between May and June and followed by a period of lower rainfall between June and August. During a period of lower rainfall, some dry spells are occurring, in some year dry spells were taking too long. Then the monsoon rains return during August through October, at this time the rainfall is usually heavier. Meanwhile water from the Mekong flow over to the Tonle Sap Great Lake and spread out to lowland, thus it can cause widespread flooding. Farmlands in Rohla Suong are flooded from August to mid-October every year, while residential areas are also flooded in the big flooding year. The remaining months are hot and less humid, leading to particularly high potential evapotranspiration in March and April.

Previously, the locals believed that the rain is coming when they hear the frog croaking during drought or dry spell. However, they have observed changes and this belief have become unreliable. The weather and climate have become unpredictable.

3.9 MITIGATION MEASURES

A recent study conducted by MOE, WB/ADB and Hatfield Consultants (2013) shows rural infrastructure in Battambang is very poor; a factor that contributes to climate change vulnerability (MOE 2010) and, at the same time, inhibits socioeconomic development and wellbeing in the province. In this context, improving and upgrading key infrastructure – drainage networks (particularly in flood-prone areas), rural water-supply systems, rural electrification systems, and the rural road network – remains an immediate/short-term priority not only for climate change adaptation, but also for development and economic growth. These investments, however, entail relatively high economic costs.

Continued risk assessment and identification of high-risk areas under both current and future climates will be important in reducing the vulnerability of infrastructure under changing conditions. In the short term, institutional capacity needs to move toward mainstreaming current and future climate risks in planning infrastructure. This does not occur in Cambodia under present environmental impact assessment regulations. Mainstreaming requires both greater technical knowledge and improved managerial capacity, as well as improved systems for inter-agency coordination in infrastructure development planning.

Medium-term pilot actions will be beneficial, particularly in climate-proofing rural roads and in constructing flood-protection dykes, culverts, gates, and canals in flood-prone areas near the Tonle Sap Lake and tributary rivers (e.g., Stung Sangkae River). Rehabilitation of water pumps, pumping stations, and other infrastructure for water distribution management will be important in water-stressed, drought-prone, and/or mountainous districts (such as the western, northwestern, and southern districts of Battambang).

Over the medium to long-term, protection of the rural infrastructure sector will require the adoption of building regulations and proper land-use planning and regulatory controls to discourage inappropriate forms of land development. In the long-term, potentially high-cost, proactive efforts to minimize future risks in the face of uncertainty should be investigated, including the relocation of people and the rehabilitation of degraded catchments and ecosystems.

3.10 CLIMATE CHANGE PERCEPTION

The Knowledge, Attitude, and Practice (KAP) study in 2011, published by the Ministry of Environment (MOE), shows that Cambodians perceive changes in their weather and environment. They indicate that extreme weather events, particularly drought, are more frequent and more intense than they once were, and that temperatures have increased:

- Nine in 10 Cambodians said they experienced at least one extreme weather event in the year preceding the survey. More than a third of people (36%) had not received any information about the extreme

weather event, and of those who did receive information, almost three-quarters (72%) only received this information during or after the event.

- Almost all recognized at least one of the terms 'climate change' and 'global warming'.
- Broadcast media (TV and radio) and word-of-mouth (neighbors, family members, friends and colleagues) seemed to be the main sources of information for most people.
- Most considered deforestation as one of the country's highest priority issues, and 67% indicated deforestation within Cambodia causes weather patterns to change. Deforestation was also a concern for key informants, for them trees were understood to provide shade and shelter from strong winds, to purify the air, to prevent extreme weather events such as floods and storms, and to play a role in bringing rain and ensuring that groundwater supplies are maintained.
- Just 18% mentioned industrial pollution, while just over 11% mentioned driving cars and other vehicles, as causes of the changing weather patterns.
- When prompted, 72% agreed that human activities are causing weather patterns around the world to change over time. One third (33%) of people indicated that their own actions contribute to climate change. Individual actions linked to weather change include using of machines, cutting wood for cooking, burning waste, cooking, and using chemicals.

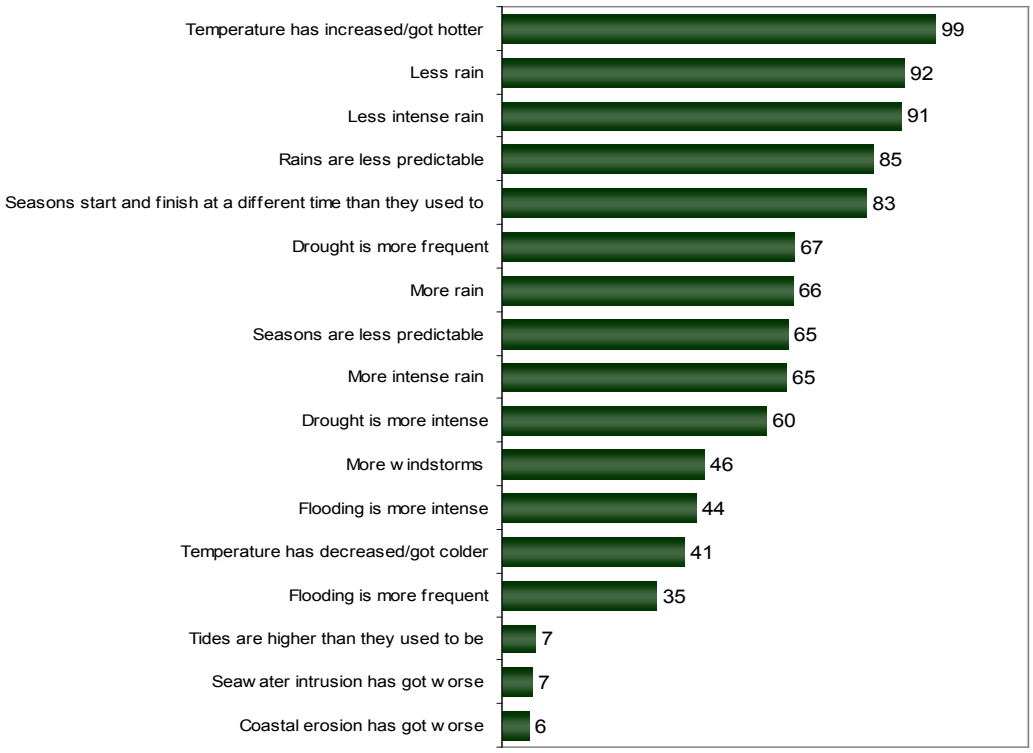

Figure 16. Experience of climate change (KAP, 2011)

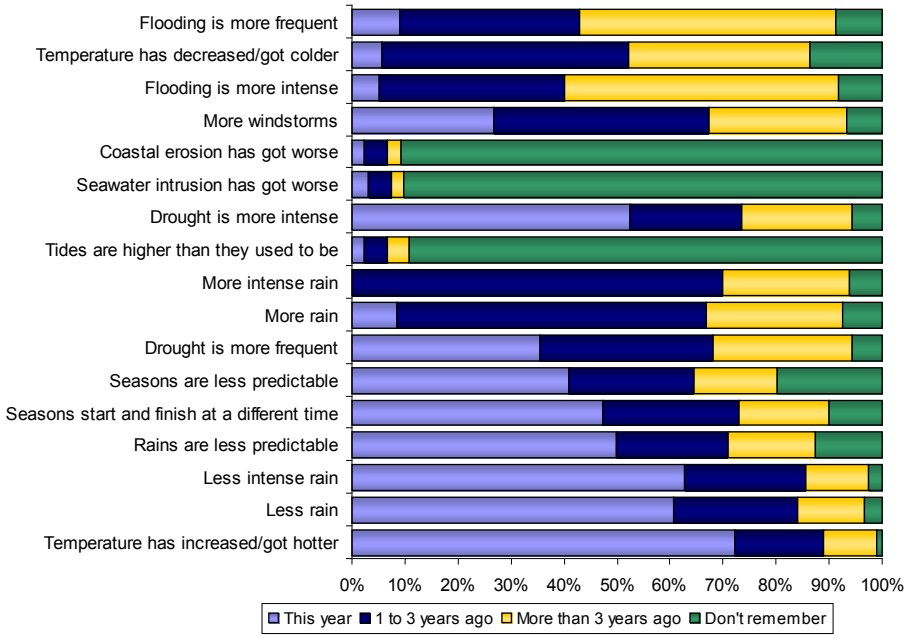

Figure 17. Observation of climate change (KAP, 2011)

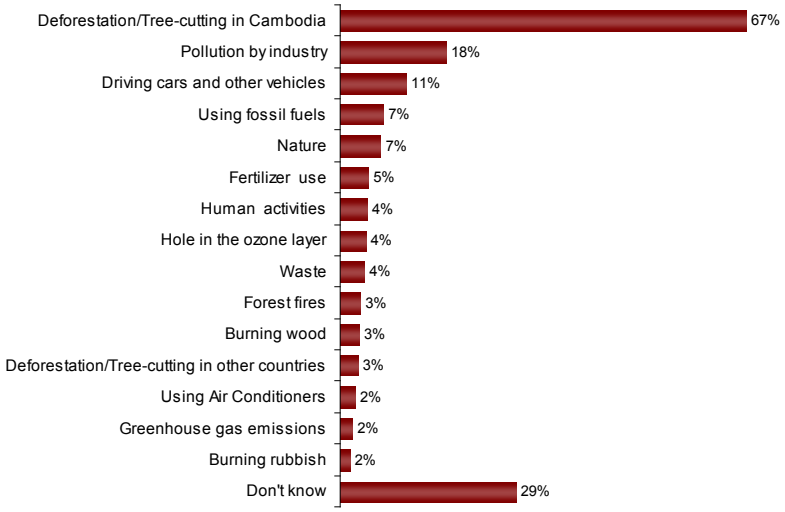

Figure 18. Causes of weather pattern change in Cambodia (KAP, 2011)

Based on the participants' responses in the KAP study (2011), 67% believed that deforestation in Cambodia causes the weather patterns to change, while just 3% mentioned deforestation outside the country's borders. A significant number (18%) but a much lower percentage of survey participants mentioned industrial pollution as a cause. A substantial proportion of (29%) indicated that they do not know what causes the changing weather patterns, while just 11% mentioned driving cars and other vehicles.

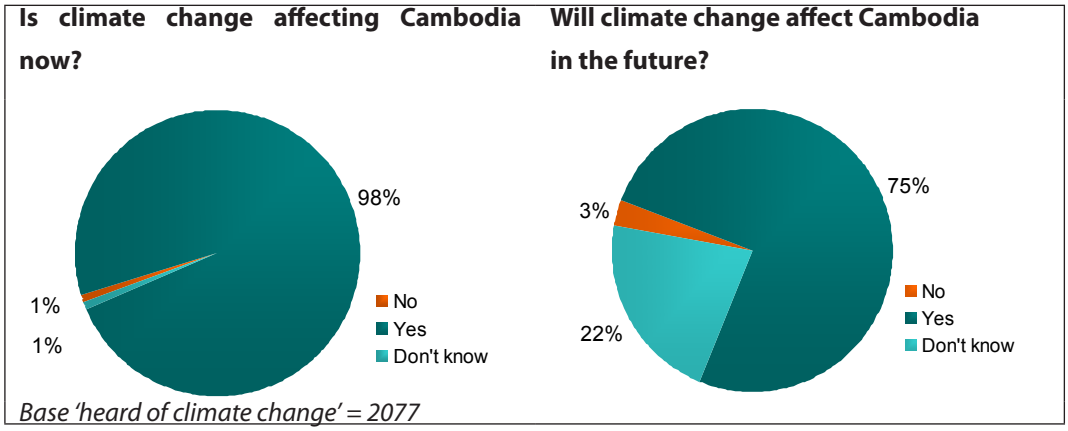

Figure 19. Understanding the present and future impact of climate change to Cambodia (KAP, 2011)

In Rohal Soung, generally local people defined "**climate change**" as the changes in temperature, weather and environment. They believed the changes of temperature and weather, natural disasters and extreme events as a result of huge deforestations and high motorizations. They also recognized the implication of changes make very negative impact to people, animal, livestock, and environment as well. They also shared their experiences that they had been faced so far, as summary in Table 21 below:

Table 21. Observed manifestations of climate change

Climate change manifestation	Start year	Reason (i.e. human and natural factors)	Trend	Effects	Affected group (identify sector – men/women; farmers/fisher/etc)	Strategy
Higher temperature (in general)	1998	Deforestation	Increase temperature	Living condition of human, animals and natural resources	All people in the community especially old people	Replanting the trees
Irregular rain	2002	Deforestation	More frequency of irregular rain	Living condition of human, animals and natural resources Destroyed the crops and also effected to the family incomes	All	Build the dam, water gate and irrigation systems
Less rain in wet season	2009	Deforestation	Unpredictable	Not enough water to supply farming productivities; some crops were died or less productive	everyone	-Build the dam, water irrigation to keep the water stay longer -Dig the ponds or wells
Stronger storm	2000	Break the houses & the trees	Stronger and more often	Destroy the houses, animals & food crops	all	Replanting the trees
Higher water level in seasonal flooding	2000	Deforestation and changing environment -Not enough places to stay for human & animals	Higher water level More often and unpredictable	-Destroy the crops -Destroy the infrastructures -Habitat of people and animal were flooded and destroyed -Disease outbreak	all	Plant more trees, build the dams and build more water gates to avoid the flood destroying the houses and the crops.
Longer period of dry spells in wet season	2000	Deforestation	Longer dry spell periods and drier	-Lack of water consumption -Diseases -Health issues for human & animals	all	Replanting the trees
Lower temperature in cold season	2010		Unpredictable	Crop cold damage or/and less productive crops	Older people and children	Nothing
Thunder	1997	N/A	More thunder	Effects to the human & animals lives	all	Nothing

3.11 ORGANIZATIONAL LANDSCAPE

Several organizations, both formal and informal, were identified during Village Baseline Survey and by key informant interview. Those organizations were classified into three levels, community, locality, and beyond local locality level. Table 22 shows the list of 18 organizations working in Battambang province and their operation level.

Table 22. List of organizations identified by local community groups

No.	Name of Organization	Operation Level
1	DSR Irrigation Committee	Community
2	Rohal Suong CFi	Community
3	Aphivat Strey (AS)	Locality
4	Buddhist monks and Buddhists in Australia	Beyond Locality
5	HARVEST Project	Beyond Locality
6	WorldFish	Beyond Locality
7	Vision Fund	Beyond Locality
8	Prasak	Beyond Locality
9	Government of Cambodia	Beyond Locality
10	Acleda bank	Beyond Locality
11	AMK	Beyond Locality
12	FACT project	Beyond Locality
13	Thoneakea Phoum	Beyond Locality
14	Belgium Friends for Sanitation	Beyond Locality
15	Sustainable Livelihood Tonle Sap Project (Cow Bank)	Locality
16	Saving groups	Locality
17	Students' parent committee	Community
18	Other micro finance institutes	Locality

Figure 20. Discussing organizational landscape with villagers in Rohal Suong village

However, there are organizations that are not so important to local villagers and have finished their project duration. Seven organizations were found in operation in Rohal Soung (Table 23).

Table 23. List of key organizations that play an important role in Rohal Suong

No.	Organization name	Main activities	Type of Organization	Operational Level	Existed Period	Formal/ Informal
1	AS	Facilitate and build community spirits Build capacity of Rohal Suong CFi committee Raise general awareness among community members Provide seeds, technologies, inputs	NNGO	Locality	>5 yrs.	Formal
2	HARVEST Cambodia Project	Build fence Build guard post Provide boats Provide patrol equipment Home garden program Fish raising program Rice program Nutrition	INGO	International	3 yrs.	Formal
3	WorldFish	Build community visioning and action plan Facilitate community visioning Provide capacity and awareness to the community Provide funding for irrigation canal development	INGO	International	3 yrs.	Formal
4	Department of Agriculture	Provide seeds, feed, technologies, implements, inputs	Government	Int'l	> 5 yrs.	Formal
5	DSR Irrigation Committee	Canal rehabilitation Extend the existing canal Provide additional culverts	Local community	Community level	> 5 yrs.	Informal
6	Rohal Suong CFi	Control illegal fishing Establish conservation area Plant flooded forest Expand conservation area Build guard posts Place post markers for boundary of conservation area	Local community	Community level	> 5 yrs.	Formal
7	Buddhist monks and Buddhists in Australia	Repair dirt road Provide toilets for Rohal Suong primary school Assists poor school children	Male Buddhist followers	Int'l	> 5 yrs.	Informal

3.11.1 Organizations related to food security

Based on focus group discussions with both men and women's groups, only five organizations were working on food security: DSR irrigation/water user committee, AS, Harvest Cambodia, WorldFish, and department of agriculture (DoA) (Table 24).

- DSR/water user irrigation committee, a community-based organization, mobilized the internal and external resources to install the culverts and rehabilitate the water channel.
- AS, a local NGO, plays a key role to provide the farming techniques, market information, and awareness on the importance of nutrition and food security to farmer households.
- Harvest Cambodia plays main role to provide the farming techniques including vegetable gardening, fish farming, rice farming and some input materials as well. Harvest Cambodia also focuses on food safety, which provides awareness and food provision program in the community.
- The WorldFish plays a very important role to provide capacity building to the community, WorldFish mobilize the local community to build a community vision and community action plan. A lot of guidance, motivation supports and matching funds were provided to the community in order to achieve their action plan of small irrigation rehabilitation.
- The DoA, a provincial government department, used to provide farming techniques, seeds, and some input materials to farmer households.

Figure 21. Identifying organizations related to food security with villagers

Table 24. Summary main activities of organizations that working on food security

Name of organization	Availability			Access			Utilisation		
	Production	Distribution	Exchange	Affordability	Allocation	Preference	Nutritional value	Food safety	Social value
DSR Irrigation Committee	Canal rehabilitation, canal extension, and additional culvert provision to enhance farm production for HH food security	Access to water for all season rice production							Increase farm productivity and improve livelihood
AS	Provision of farming techniques	Provision of market information to farmers					Provide training and capacity on nutrition	Education on importance of nutrition and food security	
HARVEST Cambodia Project	Vegetable garden Fish farming Rice farming	Provide market info to farmers				Provide quality rice and other crop seeds to farmers to improve their health and enhance crop production and to generate higher income from sale of their products	Deliver child nutrition program	Educate farmers on importance of chemical free food and sufficient consumption before sale	
WorldFish	Collaborate with the DSR Irrigation Committee for canal rehabilitation, canal extension, and culvert provision to enhance dry season farm production								
Department of Agriculture	Provide seeds for farming							Support for irrigation and seeds	

3.11.2 Organizations related to natural resource management

Men and women's groups shared similar perceptions on organizations who are working on natural resource management. Women group identified four: Community Fisheries (CFi), AS, Harvest Cambodia, and local authority. The men's group identified three organizations: CFi, AS, and Harvest Cambodia (Table 25). The focus of their work was on fisheries resources, flooded forest, and pond conservation. Specifically, the fish pond and associated flooded area was designated to be a conservation area where fishing is banned; CFi replanted the flooded forest and conduct sea patrol to combat illegal fishing. AS works with community people groups and other stakeholders to designate areas as CFis management regime. CFi is officially recognized by the Ministry of Agriculture, Forestry and Fisheries (MAFF). AS provided the capacity building to CFi committees and members, which include training on resource management, community leadership, and communication.

Harvest Cambodia has provided equipment and facilities to CFi such as a guard post, patrol boats, boundary markers in the conservation area, planting flooded forest surrounding the conservation lake. Local authorities, commune councilors, did not have fund to work on natural resource directly but they always provide good collaboration and support to community fisheries.

Table 25. Summary main activities of organizations that working on natural resources

Organisation Name	Main Activities	Type of Natural Resource
CFi	Conservation of natural resources and flooded forest Planting flooded forest Patrol and control of illegal fishing	Flooded forest Fisheries resources
Local authority	Support CFi and protect natural resources	Fisheries and natural resources
AS	Support and establish CFi Provide training to build people's capacity and awareness on the importance of natural resources and their management Conserve fisheries resources and flooded forest	Flooded forest Fisheries resources
HARVEST Cambodia	Provide equipment and facility such as guard post, patrol boats, boundary markers for the conservation area, planting flooded forest surrounding the conservation lake	Forest around conservation lake Fisheries resources

3.12 INFORMATION NETWORK

Sources of information include radio, TV stations, telecommunication services, and internet in each district (Provincial Department of Information, 2013). Table 26 shows the list of radio stations and their frequency in Battambang province.

Table 26. Radio stations and their frequency in Battambang province

No	Direct broadcasting station		Extension broadcasting station	
1	Kallan Mit	FM 88.50 MHz	Kos Santepheap	FM 87.50 MHz
2	Khmera	FM 90.00 MHz	Vear Yor International	FM 88.00 MHz
3	Natural	FM 92.25 MHz	ABC	FM 89.50 MHz
4	National	FM 92.70 MHz	Pha Sokhapheap	FM 89.75 MHz
5	My TV	FM 93.20 MHz	Khlearng Meourng	FM 90.25 MHz
6	Mongkol Sovann	FM 93.50 MHz	Engel FM	FM 91.25 MHz
7	Bopha	FM 95.25 MHz	Music FM	FM 93.25 MHz
8	Battabong Sation	FM 98.25 MHz	WMC	FM 99.75 MHz
9	Sturng Khiev	FM 98.75 MHz	RFI	FM 104.50 MHz
10	Tambong Krornhung	FM 100.00 MHz	Khemrak Phumin	FM 101.50 MHz
11	People	FM 100.25 MHz	Star	FM 102.25 MHz
12	Sangke	FM 104.50 MHz	Sweet FM	FM 103.25 MHz
13	New (no name yet)	FM 105.75 MHz	Bayon	FM 104.00 MHz
14	Morha Chhun	FM 106.75 MHz	Sovann Angkor	FM 106.50 MHz
15	Blind People	FM 107.25 MHz	Town	FM 107.70 MHz

3.12.1 Telecommunication Services

There are 10 internet provider companies: Camintel, Chuan Wei, Opennet, City link, Ezecom, Metfone, Online, Mekong net, SL net (moov) and Telecom Cambodia (TC). The number of internet access points by district is listed below:

1.	Battambong Town	424 places	6. Ek Phnom District	04 places
2.	Banan District	03 places	7. ThmorKol district	02 places
3.	Sanke District	05 places	8. Kamreang district	03 places
4.	Phnom Prerk	02 places	9. Bor Vil district	01 place
5.	Sampov Lunn	01 place	10. Mong Reusey	06 places

Battambang also has 50 internet coffee shops. Seven telephone service providers working in the province include Hello, Mobitel, Metfone, Beeline, Cootel, Smart Mobile, Camintel, and Telecom Cambodia (TC). The three optic cable systems are CFOCN (Cambodia Fiber Optic Communication Network); Metfone, and TC.

According to an interview with the commune chief in Rohar Soungh of Aek Phnom, most of the local villagers watch TV for entertainment while mobile phones are used for a variety of purposes.Community people access a wide range of community-level information since more than 60% of households have TV and/or radio. However, most information is not related to agriculture, weather, climate, or environmental changes. Information on agriculture came from a variety of formal and informal sources such as peer farmers, provincial and district line agency officials, NGO staff, donor project staff, and traders/brokers.

Information networks were analyzed in order to be able to describe how people access and share information within the community. The aim was to understand the diversity of options people use for accessing information on agriculture and weather, how people take advantage of sources of information available, and if some sources are not used and why. Table 27 presents the sources or networks from which individuals receive information regarding the information topics. These sources include other individuals, organizations, and the media.

Table 27. Information network existing in Rohal Suong village

	Information Sources			
Topic	**Individual**	**Organization**	**Media**	**Other**
Weather forecast			TV (CTN, My TV, Hang Meas, Apsara, Bayon) Radio (FM 88, Mongkol Sovann, FM 98, Chamkar Chek FM 92)	
Hydrology forecast			TV (CTN, My TV, Hang Meas, Apsara, Bayon)	
Storm			TV (CTN, My TV, Hang Meas, Apsara, Bayon)	
Agriculture			TV (CTN, Apsara, TV 5)	
Livestock farming	famers	AS; District agricultural officials, Provincial Department of Agriculture	TV (CTN, TV 5)	NGOs
Rice price	farmers	Brokers	TV (TVK, CTN, Hang Meas, Bayon)	
Price of agricultural products	Peer farmers	Brokers	TV (CTN, My TV, Hang Meas, Apsara, Bayon) Radio (FM 88, Mongkol Sovann FM98, Chamkar Chek FM 92)	
Price for consumer products	Villager or peer farmers	Brokers	TV (CTN, My TV, Hang Meas, Apsara, Bayon) Radio (FM 88, Mongkol Sovann FM98, Chamkar Chek FM 92)	
Fishing		Village CFi committee, Village authority (village chief and relevant stakeholders), Fisheries officials	TV (CTN, My TV, Hang Meas Apsara, Bayon) Radio (FM 88, Mongkol Sovann FM98, Chamkar Chek FM 92)	
Canal construction	Peer farmers	Dry season rice committee, AS WorldFish, Relevant village committees		Village chief
Migration			TV (CTN, My TV, Hang Meas, Apsara, Bayon, CNC) Radio (FM 88, Mongkol Sovann FM98, Chamkar Chek FM 92)	
Illegal fishing		CFi committee	TV (CTN, My TV, Hang Meas Apsara, Bayon) Radio (FM 88, Mongkol Sovann FM98, Chamkar Chek FM 92)	
Illegal transport of timber			TV (CTN, My TV, Hang Meas Apsara, Bayon) Radio (FM 88, Mongkol Sovann FM98, Chamkar Chek FM 92)	
Use of rice variety	farmers	AS, HARVEST Cambodia, District Agricultural Officials, Provincial Department of Agriculture	TV (CTN, Bayon, TV 5)	
Farming of frogs, eels, cattle, chickens, ducks and pigs		AS, HARVEST Cambodia, District Agricultural Officials	TV (CTN, Bayon, TV 5)	

3.13 SOCIAL AND GENDER DIFFERENTIATION

In 2010, Cambodia had an active agricultural population of 5,869,633, or 62 % of the overall agricultural population. Of the active agricultural population, 47 % were males and 53 % were females. All zones within the so-called Tonle Sap region (that includes Battambang) had a higher percentage of females than males in the active agricultural population, with the Coastal Zone recording the highest percentage females in the active agricultural population at 55 % (FAO and MOP 2010).

Migration status in Battambang

The northwest provinces of Cambodia experience both internal and international migration due to a variety of reasons: experience with civil wars for more than three decades, for livelihood improvement, and as a response to climate change. Cambodia migrants consider migration as a short–term coping strategy to mitigate unexpected income shocks, and not a long-medium term process aimed to increase the socioeconomic status of the family (Middleton, Borin and Naruemaon, 2013).

Seasonal migration, both domestic and international, is emerging as an important livelihood option intended to reduce household vulnerability and exposure to new risks (Hienonent cited in Middleton, Borin and Naruemanon 2013). Based on NCCD (2010) data, Battambang experiences in-migration, outmigration, and temporary migration (staying temporarily). Table 28 shows number of female migration out of total number and Table 29 shows the number of job migration from 2006 to 2008. The number of people working outside their home villages in companies/factories, and the number of people with uncertain jobs is shown in Table 30.

Table 28. Migration status in Battambang (female out of total) (NCDD, 2010)

Description	2006	2006	2008
Total # families permanently in-migrated	2,342	2,177	3,586
Total # of people	9,308	9,190	15,168
Total # of female	4,712	4,680	7,506
Total # of families permanently out-migrated	2,159	1,521	2,099
Total # of migration people	9,165	6,766	8,887
Total # of families staying temporarily	3,140	2,502	2,644
Total # of people	11,221	9,138	9,760
Total number of female	5,763	4,684	5,015

Table 29. Job migrations in Battambang (NCDD, 2010)

Description	2006	2007	2008	Total persons
People migrated to work with company/factory	1%	1%	1%	7,661
People migrated to work, but have uncertain jobs	4%	4%	4%	20,956

Table 30. Number of people working outside their home in 2008

District	Working with companies	Uncertain jobs
Banan	618	1764
Thmar Koul	1017	3396
Battambang city	2200	2447
Bavel	570	1482
Aek Phnom	378	748
Moung Russei	1245	2446
Ratanak Mondul	168	291
Sangkae	662	1647
Samlout	56	108
Sampov Loun	22	333
Phnum Proek	202	2629
Kam Rieng	119	1390
Koh Kralor	181	767
Rukh Kiri	223	508
Total: 27617 persons	7661	19,956

Source: NCDD Provincial profile, Battambang province (2010)

A study conducted by Middleton, Borin and Naruemon (2013) shows an increase in migration and indicates that Battambang has the highest proportion of migrants compared to other provinces surrounding the Tonle Sap Lake (Table 31).

Table 31. Domestic migration for six provinces around Tonle Sap Lake (Middleton et al., 2013)

	Number of people not born in their place of residence (per province)					
Reason for migration	Battambang	Kampong Cham	Kampong Chhnang	Kampong Thom	Pursat	Siem Reap
Transfer of work place	32,638	19,111	10,083	8,221	11,767	17,551
Search for employment	75,723	45,677	11,396	13,272	7,574	40,566
Education	7,570	5,522	1,784	2,286	1,433	6,125
Marriage	35,350	61,902	19,226	25,547	4,604	29,741
Family moved	189,393	72,555	34,251	36,245	9,786	62,488
Lost land or house	9,374	3,111	871	1,642	2,040	1,783
Natural calamity	922	706	86	120	191	146
Insecurity	15,679	2,387	5,772	2,125	3,820	2,199
Repatriation	10,852	8,336	28,483	7,917	7,735	8,397
Orphaned	1,689	603	474	619	361	860
Visiting	14,250	8,106	3,478	3,718	3,630	5,111
Other	2,655	3,538	975	2,882	924	1,635
Total migrants	396,095	231,554	116,879	104,594	113,865	176,602
Total non-migrants	627,862	1,447,765	355,129	526,581	283,048	719,167
Percent of migrants	38.7	13.8	24.8	16.6	28.7	19.7

Middleton, Borin and Naruemon (2013) provide two principal factors at the village level that push people to migrate: lack of work in the villages and debt in the families. A lack of work in villages is linked to three factors. First, declining fish stocks have reduced opportunities to make a living as a fisher. Second, the number of family members exceeds the needed labor for farming the available land; and third, the households are landless or land poor. The latter is also compounded by increasingly fragmented landholdings that are not viable to make a full-time living. The mechanization of farming also reduces the opportunity for local laborers to be hired. Furthermore, local work in farming is seasonal, and is perceived by potential farm laborers as short-term, irregular, and low-paid work. This makes work outside Cambodia, or domestically in urban areas, more attractive as it is perceived to be more regular and to have better wages.

With regard to debt, most are from failure of agriculture. This push factor is influenced by access to, and the quality of, natural resources. Natural resources are in turn impacted significantly by the flood in a particular year given that the annual flood cycle is a precondition for the productivity of natural resources around the Tonle Sap Lake.

With regard to international migration, the main destination countries are Thailand, Malaysia and South Korea. In Thailand, most Cambodian migrants end up working in dirty, difficult, or dangerous (3 Ds) jobs, including construction, manufacturing, plantations, domestic help, the entertainment and/or sex industry, and fishing. In Malaysia, most Cambodians work as domestic workers, and in South Korea, in factories facilitated by bilateral government (Middleton et al., 2013).

3.14 HEALTH/NUTRITION PROFILES AND OTHER LIVELIHOOD OUTCOMES

Health status in Battambang

Table 32, Figure 22, and Table 33 below summarize the current health status of women, using births among women aged 15-45, delivery methods, and proportion of women using the toilets in the province.

Table 32. Women health situation

Description	2012	2013	2014
# of women age 15-45	260,163	263,870	271,228
# baby born for every 1000 women (age 15-45)	49.6	50.1	52.5
# women delivering baby by traditional midwife	1,079	477	510
% of women deliver baby by trained midwife	91.6	96.2	96.4
# of midwife	605	542	491
# midwife for every 1000 people	0.6	0.5	0.4

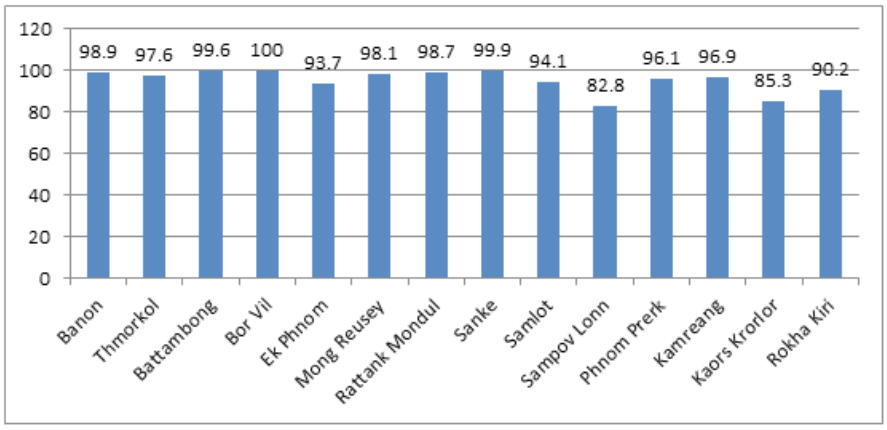

Figure 22. Percentage of women delivering a baby by a trained midwife in each district in the province

Table 33. Number of families using toilet, 2012-2014

Description	2012	2013	2014
# of families using toilet	115,805	117,809	128,691
# of families using technical toilet	84,588	91.903	103,889
% of families using technical toilet	37.3	39.1	43.5
% of total families using toilet (simple toilet)	51.1	50.1	53.9
# of family have water resources closer than 150 meters from home	63,073	57,511	59,608
% of family have water resources closer than 150 meters from home	27.8	24.5	25.0

4. NEEDS ASSESSMENT

4.1 STRENGTHS AND WEAKNESS

Battambang today is the main hub of the northwest, connecting the entire region with Phnom Penh and Thailand. As such, it is a vital link to Cambodia. The province has experienced unsatisfactory law enforcement and sometimes monotonous and unsuitable design in recent infrastructure and agricultural development and investments.

The key remaining challenges stem from inadequate infrastructure investments and the limited institutional capacities at the provincial and district levels to manage urban sector development and provide essential urban services. The increasing population and rapid growth of the urban areas are creating considerable pressures on the part of the local authorities to provide urban infrastructure that can sustain the liveability and competitiveness of Battambang as a trade and investment center.

In recent decades after the civil war, this province has experienced rapid land use changes and now has a vision to become regional trade and commercial center in the GMS countries, not only in Cambodia. Most of the development is situated in Battambang town and along Sangkae River while watershed and forest land along the river has been under threat due to large-scale farmland expansion and conversion of forest land to farmland. Climate change projections suggest increases in temperature, floods, and droughts. For instance, the recent flood in October 2013 resulted in huge losses and damages for various sectors including social and trade services, the production sector, and infrastructure.

Key informants interviewed consider intervention in the agricultural sector, including farmer cooperative development, seed improvement and extension support, as well as additional water resource intervention, highly important. Pilot actions will be beneficial, particularly in climate-proofing rural roads and in constructing flood-protection dykes, culverts, gates, and canals in flood-prone areas near the Tonle Sap Lake and tributary rivers (e.g., Stung Sangkae River). Rehabilitation of water pumps, pumping stations, and other infrastructure for water distribution management will be important in water-stressed, drought-prone, and/or mountainous districts (such as the western, northwestern, and southern districts of Battambang).

Over the medium to long-term, protection of the rural infrastructure sector will require the adoption of building regulations and proper land-use planning and regulatory controls to discourage inappropriate forms of land development. In the long-term, potentially high-cost, proactive efforts to minimize future risks in the face of uncertainty should be investigated, including the relocation of people and the rehabilitation of degraded catchments and ecosystems (MOE, WB/ADB, and Hatfield 2013). Market infrastructure and connectivity for agricultural products remain challenges of which most farmers often complained.

Interviews and other sources of information suggest that Battambang still needs irrigation, fertilizers to improve soil fertility, as well as seed production and technical support for farmers. In addition, the master plan prepared by the Japan International Cooperation (JICA) team on socioeconomic factors remains one of the most relevant for agricultural and social economic development in the provinces. These findings can be summarized in Table 34 below and are based on the survey sample of farmers and their responses and/or activities.

Table 34. Constraints in Socioeconomic development in Battambang River Basin (JICA et al., 2007)

Observations	**Constraints**
Farming/agronomy	low yield of paddy; crop losses due to pest & disease weed problems (direct sowing prevails in the Battambang River Basin).
Irrigation and drainage	irrigation water shortage in wet season irrigation water shortage in dry season and inundation/flooding.
Marketing	unstable market prices of paddy/rice low market prices of paddy/rice unstable market prices of other crops.

Observations	Constraints
Reasons for low rice yield	drought in wet season poor soil conditions water shortage in dry season.
Activities implemented to improve rice productivity in past 3 years	increased fertilizer doses used quality seed (local variety) applied compost/manure.
Necessary activities to improve rice productivity	improvement of farming practices use of quality seed (high yielding variety) use of quality seed (local variety)
Necessary physical works to improve rice productivity	irrigation water supply in wet season irrigation water supply in dry season and drainage improvement.
Expectations for improvement: farming conditions (agronomic and farm management)	productivity improvement of wet season, productivity improvement of field crops productivity improvement of dry season rice.
Expectations for improvement: farming system	double cropping of rice multiple farming composed of crop & livestock single cropping of rice.
Expectations for improvement: physical works	adequate irrigation water supply in wet season adequate irrigation water supply in dry season drainage improvement.
Required for improvement: extension services	field extension services (demonstration/field guidance) provision of quality seed farmer training (technical & post-harvest operation)

Rohal Suong is endowed with several types of natural resources. The majority of the households seems to own farmland and have access to the Sangke River as a source of water throughout the year. The river water is distributed in the village through a rudimentary canal network and water storage ponds of various sizes. Tonle Sap Lake and associated flooded forests are also traditionally used as a source of fish, firewood, and other animals and plant products. A natural cycle of seasonal flooding from the lake and river replenishes the top soil and soil nutrients. Rice fields become connected to large water bodies during the wet season and are also used as fishing grounds.

The typical farming system is moderately diversified, with two rice cropping of rice, some vegetables and fruits, with some surplus to sell in an average year. Raising small livestock is widely practiced as an income generation option, while large livestock is becoming less popular due to the shortage of grazing land. Basic infrastructure exists. There is paved road access to provincial town and other tertiary roads to access key community resources.

The village has been supported by a variety of external agents through agricultural development, natural resource management, and food security programs, including some large donor programs, and received in-kind support as well as direct agriculture input subsidies. Several community institutions exist and are functioning well.

The general perception among the villagers is that the condition of natural resources is declining. Flooded forests are declining because of deforestation and agriculture encroachment. Fisheries resources are declining because of overexploitation and loss of habitats (including flooded forests).

Small-holder agriculture production system prevalent in the village appears to be not very profitable because of the high cost of inputs and limited market and value chain development. With the exception of wild fish, markets and value chains for agricultural products are not well established, and rely on traders from outside. The cost of agricultural inputs is generally high and market prices are not stable.

Farming families have taken several strategies to increase their overall income; to expand the farming area, to intensify rice production, to seasonal labor migration. These strategies have negative implications: loss of forest and grassland to farmland, degradation of water quality and soil, and possible labor shortage in the village for agriculture.

Coverage of dry season irrigation is limited to some part of the village and the farmers report water shortages in the dry season. The local production systems are well adapted to the natural seasonal fluctuation in rainfall and flooding regime, but occasional extreme flooding events cause crop damage and food shortage situation, most recently in 2011.

4.2 PRIORITY ISSUES

Resuls from the visioning exercises, conducted by AAS and CCAFS, the villages seem to prioritize increase in agriculture productivity/profitability and restoration of natural resources, namely fisheries. Both of these are a key element of the income generation strategy of the community. Priority interventions identified by the villagers are the improvement of the irrigation infrastructure, water distribution network, and its management. This also includes improvement of associated water storage ponds network for supplementary irrigation and for fisheries resource productivity.

Other more general needs include farming skills training and market/value chain improvements to increase the efficiency and profitability of small holder agriculture production. The list below is summary prioritization provided by local community people:

- Build capacities of farmers on farming techniques (including rice disease treatment)
- Range of crop options that can be grown by the farmers
- Enhance soil and water management since water is the main constraint to farming
- Build local capacity on how to manage and use water efficiently.
- Extend the water channel and increase the number of ponds
- Increase water connection system and build a fish refuge pond
- Replant flooded forest
- Build capacities to community fisheries and farmers on fish refuge pond management and rice field fisheries improvement
- Build paths and bridges to paddy fields
- Market for agricultural product with a reasonable price and market information

5. RECOMMENDATIONS

Rohal Suong experiences seasonal and year-to-year climate variability, and has devised production systems that are well adapted to the natural conditions. However, these existing interventions are not directly associated with specific climate-related issues. There is an opportunity for CCAFS to identify and enhance these existing practices that can become good examples of "climate smart agriculture", and be promoted more widely as such, to increase the general awareness of the importance of CSA practices.

Some of the priority interventions identified by the local community--namely water management--can directly contribute to the increasing climate resilience of the community. CCAFS can focus its effort in supporting those interventions. On the other hand, there are many other possible climate smart practices that are either common sense "no regret" interventions, such as basic skills training and information access, or those that have potential and can be tested and validated in this site, such as crops and crop varieties that are more tolerant to flood conditions. CCAFS can also support local communities to explore these additional options for possible adoption in the future.

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Annex

Guideline for desk review and key informant interview at provincial level

	Topic	Key information needed	Suggested Method of Data Collection
1	Natural Resource utilization	Availability, access, utilization and stability of natural resources Issues and actions (if any) being taken to address such issues; Drivers of change	Desk review
2	Organizational Landscape	Development partners/ organizations present in the area and their activities, particularly on climate change, agriculture , and food security	Desk Review
3	Information Network	Information available, shared Presence/operation of quad -media (radio, TV, print, internet) Projects conducted in the area	KI (Find a KI who is knowledgeable on this, probably the information officer of the province, or head of the office with
4	Mitigation Measures	Projects related to mitigation measures	Desk Review
5	Production and livelihood systems (including markets)	Major and minor livelihood strategies livelihood profiles and categories, levels poverty	Desk Review
6	Current and past NRM initiatives	Trends in changes in resource (land and water) use, pressures, forces driving the change in agriculture.	Desk Review, KI
7	Food security status and trends	Experience with food shortage Food security trend (10 years) Issues, drivers of change Past and current programs, projects and activities related to food security	Desk Review; KI
8	Demographics	Current Population, population density, Population trend, Population growth rate, drivers of change	Desk Review
9	Institutional landscape and Governance	Policies and other statutory issuances ; Local leadership and authority; historical trends; Issues, pressures, driving forces; interactions of institutions	Desk review
10	Social and Gender Differentiation	Distribution of benefits and burdens between men and women, households and other social division Access to education, health services, employment, and political position	Desk Review, KI
11	Hazards and vulnerability	History of natural disasters, shocks and stresses (what, year, impact, damage), Traditional coping strategies, Mechanisms normally available to target food assistance to the most vulnerable/ food insecure) during disasters Vulnerable population Vulnerable sectors	Desk Review

	Topic	Key information needed	Suggested Method of Data Collection
12	Local climatic information	Historical trend of rainfall, temperature pronounced seasons	Desk Review
13	Health/Nutrition Profiles and other Livelihood Outcomes	Health Indicators (mortality, morbidity, mental health) Nutrition indicators (undernutrition, stunting, wasting, etc) Projects on Health and nutrition (e.g. food supplementation, drinking water and sanitation,)	Desk Review