

Report on Identification of Case Study Site:
Battambang Municipality, Battambang Province, Cambodia



Ngin Chanrith, Heng Naret, Thuon Try, Faculty of Development Studies, Royal University of Phnom Penh
Kim Nong, Ministry of Environment

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Introduction

The Urban Climate Resilience in Southeast Asia Partnership (UCRSEA) is a collaborative project between academics in Canada, Cambodia, Myanmar, Thailand, and Vietnam, to conduct research on and promote dialogue around building resilience in cities experiencing urbanization and climate change. The research and dialogue activities are being conducted in eight secondary cities – two cities per country in the region. Cities are selected on the following criteria: clarity of climate related issues, urbanization processes (i.e. cities that are growing/urbanizing), links to regionalization, background of engagement and supporting data, political buy-in from local governments and leaders, replicability and transferability to other locations, and logistical and practical accessibility.

This report provides reasons and data to support the selection of Battambang municipality of Battambang province as a case study site in Cambodia. It is premised on the existing scholarship and a field visit to and a consultation workshop with relevant stakeholders in the province by the research team. The sections to follow entail each of the criteria that corroborate the selection of the municipality.

1. Clarity of climate issues

Location (Source: ADB's Great Mekong Subregion (GMS) Corridor Towns Development Project (TA 7644-REG))

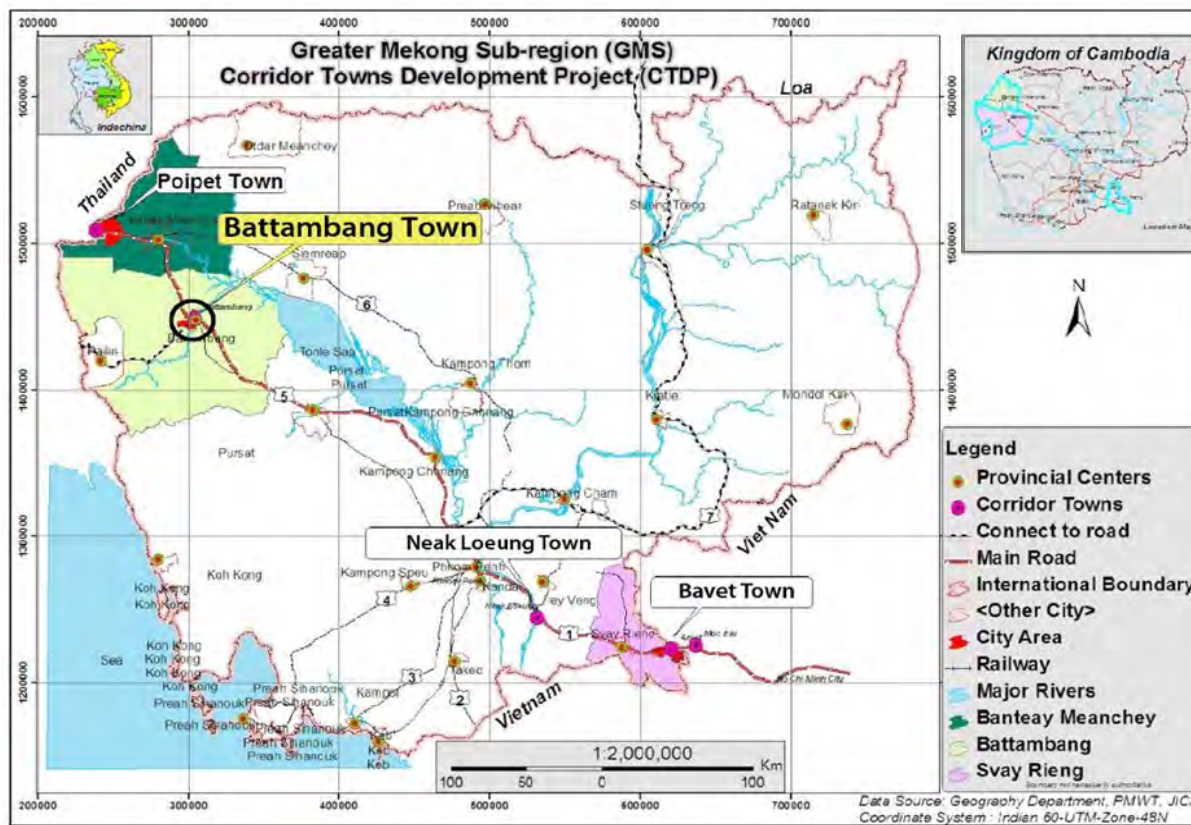


Figure 1: Location of Battambang town inside Battambang province

Battambang is part of the greater natural landscape of the Cardamom region¹. 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).

Sangkae River is one of the key sources of water for the foundation of city development in Battambang. It originates from the range of the Elephant and Cardamom Mountains at an elevation of about 1,391 meter sea level (msl) , flows from the southwest to North across Battambang Town and joins the Stung Mongkol Borey River at Bac Prea village about 40 kilometers downstream from Battambang Town, and the Stung Sreng River at another further 10 kilometers downstream. It 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 (Cambodia National Mekong Committee-CNMC 2012).

At O Dambang, which is located about five kilometers upstream from Battambang Town, the river splits into two rivers: the Sangker itself and the Stung Chas rivers, then flows directly into the Tonle Sap Great Lake. The Stung Sangker River catchment has a total area of 6,052 km², and more than one third of this catchment area is within an elevation from four to 13 meters, and is 1,391 meters at the highest point. The catchment at Battambang town gauging station is 3,230 km² (CNMC 2012).

The province is situated in the northwest part of Cambodia about 300 kilometers from Phnom Penh via National Road No. 5. The province borders on Beanteay Meanchey, Siem Reap, and Pursat Province. The enclave of Pailin Province and the national border with Thailand frames the western boundary. At its eastern tip, the province is connected to Tonle Sap Lake. Battambang Province is approximately 11,803 km², and comprises 13 districts, one municipality, 96 communes and 741 villages. In 2005, the total population was 952,306 (185,868 families). By 2008, it had increased to 1,066,928 with 205,351 families (NCDD 2009).

Resource stresses exacerbated by climate change

There are three protected areas associated with the Sangker River system². These partly encompass: Phnom Samkos Wildlife Sanctuary, Sam Lout Multiple Use Area, and Tonle Sap Multiple Use Area, totalling 710,000 ha. These areas are characterized below:

¹ This region covers approximately one third of the country's land surface and spans six of its 24 provinces, including Koh Kong, Pursat, Battambang, Pailin, Sihanouk, Kampong Speu, Kampong Chhnang, Kam Pot, and Kep.

² Sometimes known as the Battambang River Basin.

Table 1: 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, (10.8%)	Upstream	High altitude areas with a wide diversity of forest types. Supports a range of threatened birds in the area.
Samlot Multiple Use Areas	Crosses Pailin and Battambang Provinces	60,000	44,900 (74.8%)	Upstream	An evergreen forest area within the watershed of the Sangke River. It has been degraded by mining, 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 (25.9%)	Downstream	Long-standing fish reserve; Great biological, hydrological, and cultural/economic importance.

Source: Japan International Cooperation Agency, Ministry of Water Resource Management and Meteorology, Ministry of Agriculture, Forestry and Fisheries (2007)

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 it will be affected by water infrastructure development such as irrigation schemes and the increased usage in fertilizer and pesticides. Attention needs to be paid so as to refrain from negatively impacting downstream areas through irrigation (JICA, MOWRAM, and MAFF 2007).

The Tonle Sap Multiple Use Area is biologically diverse, with over 110 species of fish present. It is 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 on Tonle Sap Areas (JICA, MOWRAM, and MAFF 2007).

Table 2: Land classification by each district, 2009

District	Total area (ha)	Forest land Area (ha)		Cultivation area (ha)	Construction area (ha)	Other area (ha)
		Total	Flooded Forest Area			
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	79,200	25,520	-	46,400	3,780	3,500

Mondul						
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: National Committee for Democratic Development and Decentralization (NCDD), Battambang provincial Data Book 2009

Resource stresses and trends

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 to market to private factories. Most of such products are exported to Thailand. Newly cleared land requires limited amounts of fertilizer, but later on more and more fertilizer will be used as the land productivity, watershed, and water resources degrade if no countermeasures are taken.

Currently, an estimated 191,492 ha of forest cover is left, of which 150,992 ha is under the forestry administration's management and 40,000 ha is under the provincial department of the 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 with deputy director, provincial department of environment, dated 22 December 2014).

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

- Samkos Wildlife Sanctuary³
 - 14,000 ha of land has been taken from this protected areas, of which 8,000 ha was provided to local community members with legal title while the land title to an additional 6,000 ha was in a process of being issued to farmers.
- Roneam Donsar Wildlife Sanctuary
 - Covers an area of more than 170,000 ha in two provinces: Banteay Meanchey and Battambang (70,000 to 80,000 ha).

³ This Samkos Wildlife Sanctuary covers three provinces: Battambang with 59,000 ha, Pursat with less than 200,000 ha, and Koh Kong with less than 90,000 ha.

- Now there are only around 3,000 to 4,000 ha left in Battambang due to land concession and encroachment.
- Samlout Multiple Use Area
 - More than 60,000 ha in Battambang and Pailin, of which 40,000 ha is located in Battambang.
 - Currently, there are around 10,000 ha left due to land clearance for cash crops and commercial farming.

Natural disasters

According to the provincial water resource department in Battambang, a river with water levels above 12.5 meters high would flood the city. Table 18 below summarizes the water level from Sangker River and its flooding frequency.

Table 3: Flood record and frequency

Year	Max. Annual Water Level (m)	Annual ³ Flood (m /S)	Return interval (years)	Max. annual water level (m) - GEV	Annual flood ³ (m /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
2008	12.14	569			
2009	12.08	552			
2010	11.12	337			
2011	13.95	1235			
Average	12.66	760			

Source: Cities Development Initiative for Asia and Asian Development Bank (2010) and Provincial Department of Water Resource and Meteorology (2013)

Flooding has been recorded in every Sangkat (commune) of Battambang municipality during the rainy season from June to December. In 2013, serious floods 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 4: Extent of flooding in each sangkat in Battambang town

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

Source: *Cities Development Initiative for Asia and Asian Development Bank (2010)*

Table 4 above shows seven out of 10 sangkats experienced floods in 2010, 2011, and 2013. Toul Ta Ek, Prek Preah Sdach, and 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.

Based on a Cities Development Initiative for Asia/Asian Development Bank 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.

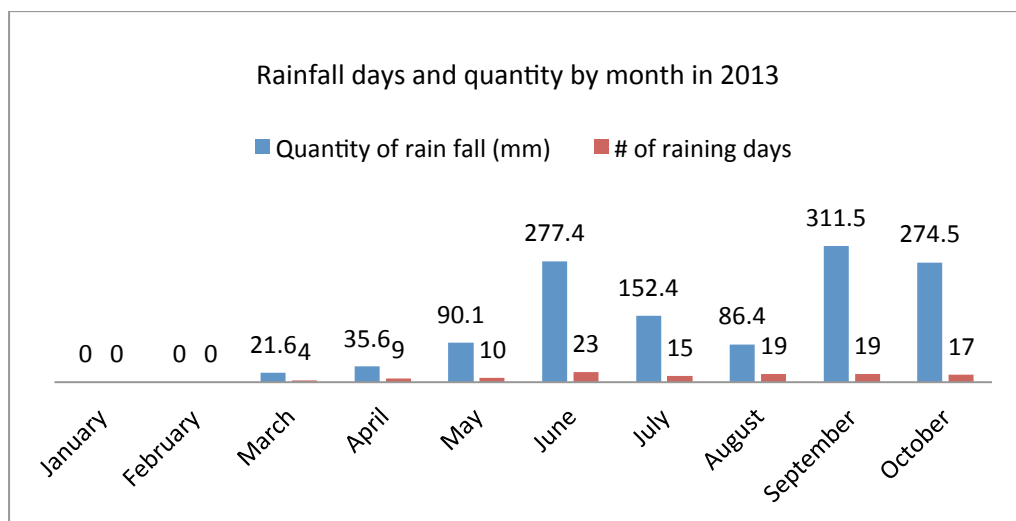
Floods in 2013

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 nine districts), inundated 52,503 ha, and destroyed 36,266 ha of rice fields. Flooding in 2013 was even more serious as water levels reached a historical height of 14.2 meters high along Sangke River (normally 12.5 meters, water started to overflow from the river to the town and areas in lowlands or wetlands).

Floods in late 2013 are considered as the worst in 70 years based on an interview with a water resource official in Battambang in late October 2013. Various sources of water from upstream, including torrential rain, concentrated throughout the Sangker River including other watershed areas down the river and across the province.

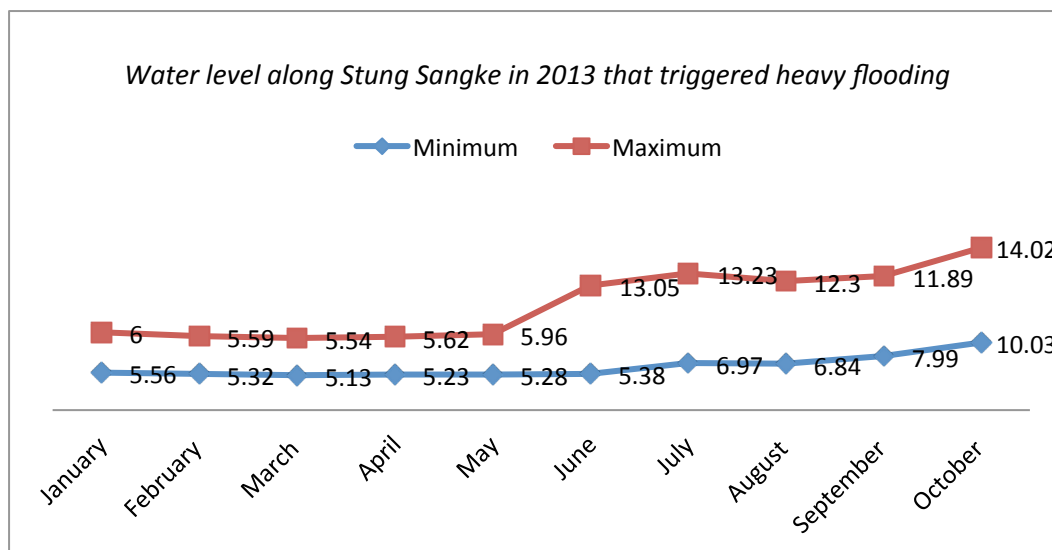
Currently, the Chinese are building large-scale infrastructure works across the Sangker River for flood control and water diversion for irrigation (potential irrigation area of 70,000 ha) and domestic use. This project also faced setbacks after the late 2013 flooding. Investment for this project is US\$100 million, with additional loans from China.

Figure 2: Total monthly rainfall in 2013



Source: Provincial department of Water Resource and Meteorology, 2013

Figure 3: Monthly water level in Sangkae River in 2013



Source: Provincial department of Water Resource and Meteorology, 2013

Significant impacts of 2013 flooding

- Flooding started in early October and lasted for seven to 10 days while in some areas, flooding lasted longer, around 20 days.
- Among provinces affected, Battambang and Banteay Meanchey were the worst affected in terms of numbers of households and infrastructure affected (social sector, agriculture, and infrastructure value). See Table 20 below.

Table 5: Social sectors affected by flood in 2013

	Districts/town	# commune /sangkat	Affected people (family)	Affected people (person)	Evacuated people (family)	Affected house (#)	Destroyed house (#)	# 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

Source: Provincial Disaster Management Committee (2014)

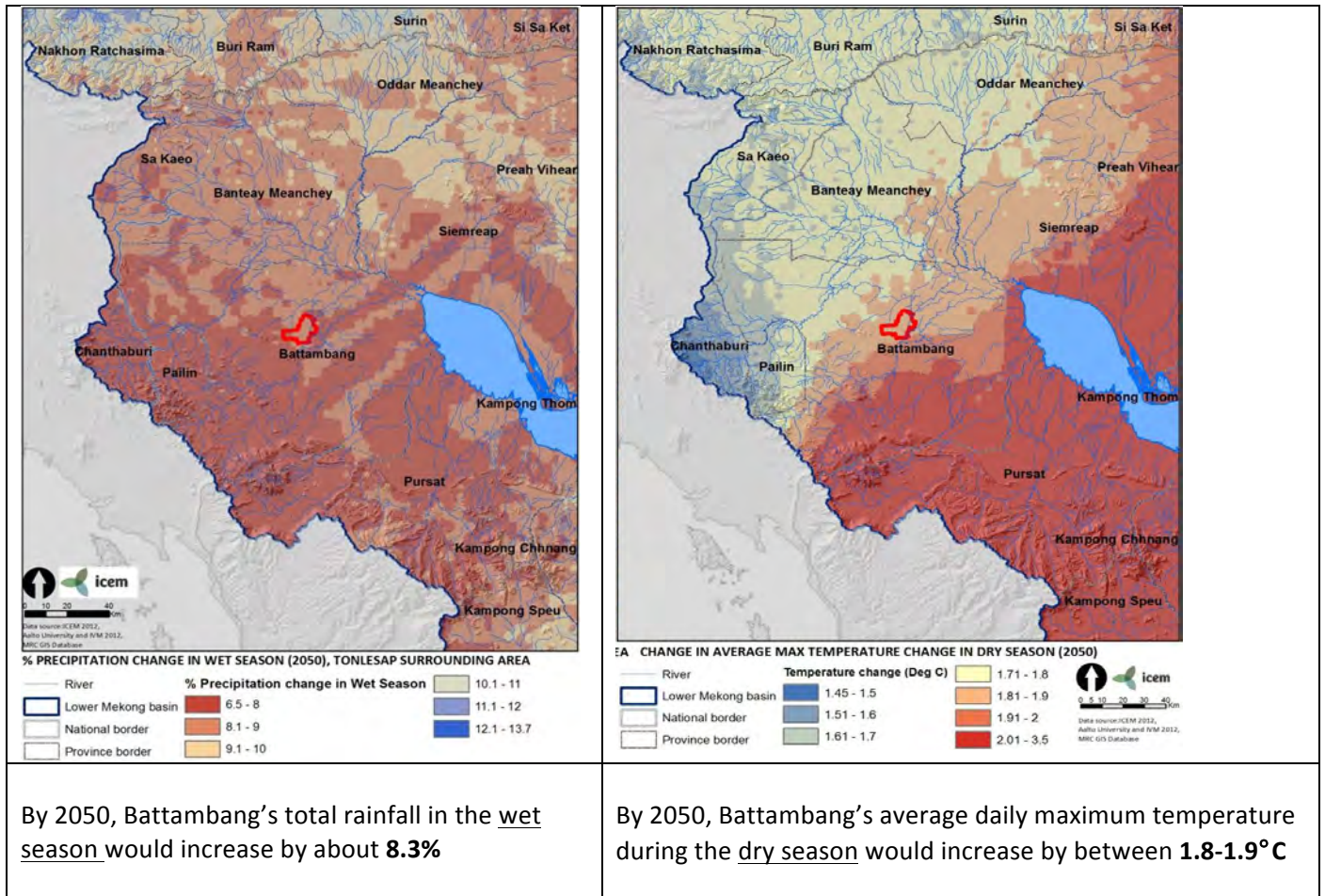
Climate data availability

Climate change is projected to have a significant impact on Battambang with a combination of current land use change as well as changes in hydrological flows from upstream down through the town and to Tonle Sap Lake. In the figure below, it is projected that by 2050, the average rainfall and maximum temperature will increase.

Projected changes to average rainfall & maximum temperatures by 2050 (Source: International Center for Environmental Management, 2015)

	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 (March - August):	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

Figure 4: Maps showing rainfall and temperature with climate change (Source: International Center for Environmental Management, 2015)



By 2050, Battambang’s total rainfall in the wet season would increase by about **8.3%**

By 2050, 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 in 2050 Battambang are expected to be:

- Significantly hotter and wetter in the wet season
- Hotter and drier in the dry season

2. Rapid urbanization

Rapid spread of the city

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

- 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.

- 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.
- Battambang Airport is situated close to the urban center but stopped service in 2003.

Population growth at provincial level

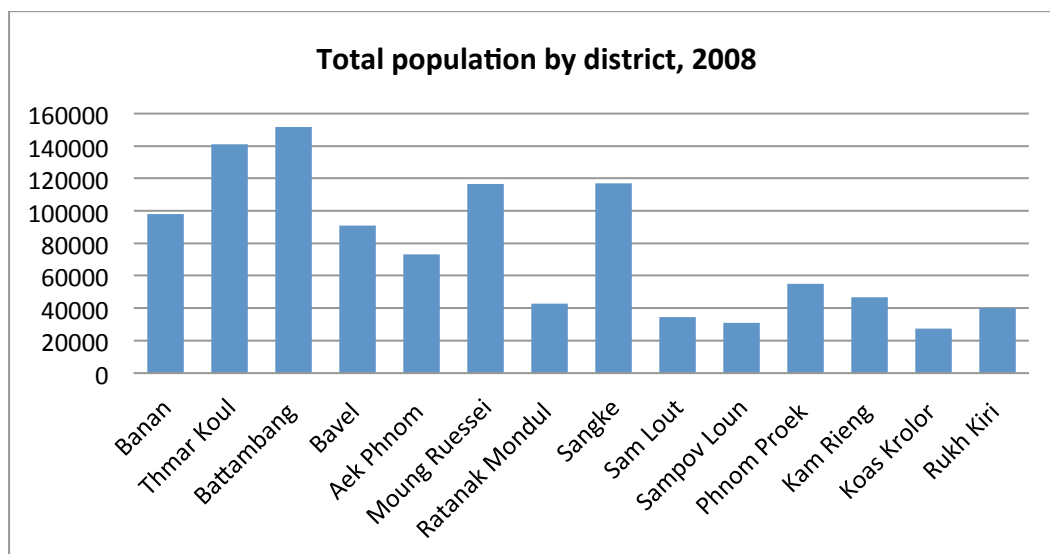
In 2005, the total population of the province was 952,306 (185,868 families) and in 2008, it increased to 1,066,928 (205,351 families) (NCDD 2009).

Table 6: Population trend in Battambang province

	2007	2008	2009	2010
Total population	998,896	1,043,928	1,048,214	1,071,209
% Increase/ Decrease		5 %	0 %	2 %
Total number of families	196,721	205,351	212,294	218,843
% Increase/ Decrease		4 %	3 %	3 %
Number of female Headed households	29,492 persons	29,664 persons	30,410 persons	31,986 persons

Source: National Committee for Democratic Development and Decentralization Battambang Province Data Book 2010

Figure 5: Total population by district of the province in 2008

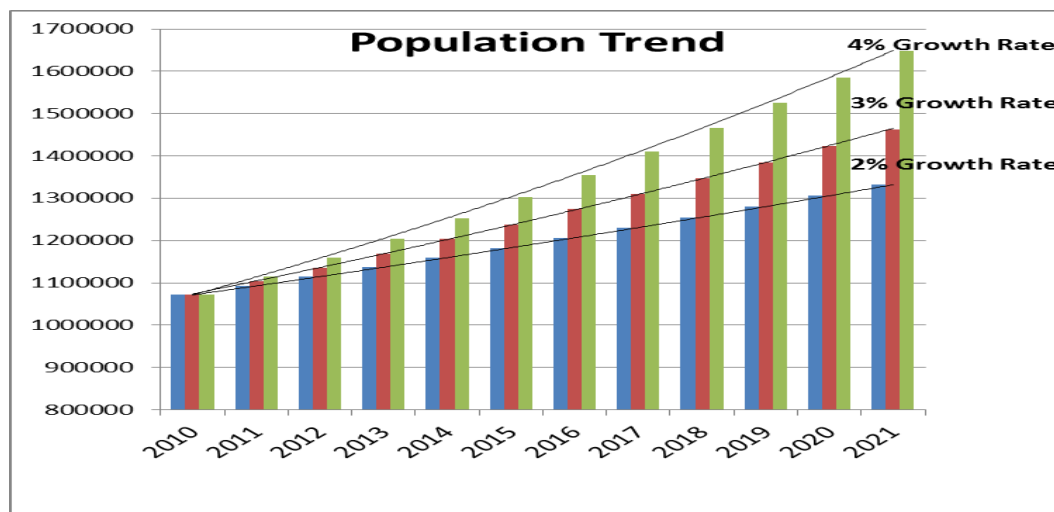


Source: National Committee for Democratic Development and Decentralization Battambang Province Data Book 2009

Figure 5 (above) shows that Battambang municipality has the highest population (151,656) followed by Thmar Koul (141,180), Moug Russey (116,644), and Sangkae (117,164) respectively, while Koas Krolor has the lowest population (27,497).

Over the next 10 years, the population of Battambang is projected to increase. Figure 3 shows the range of population projections based on three growth rate scenarios.

Figure 6: Population projection from 2010-2021



Source: Calculation based on *National Committee for Democratic Development and Decentralization Battambang Province Data Book 2010*

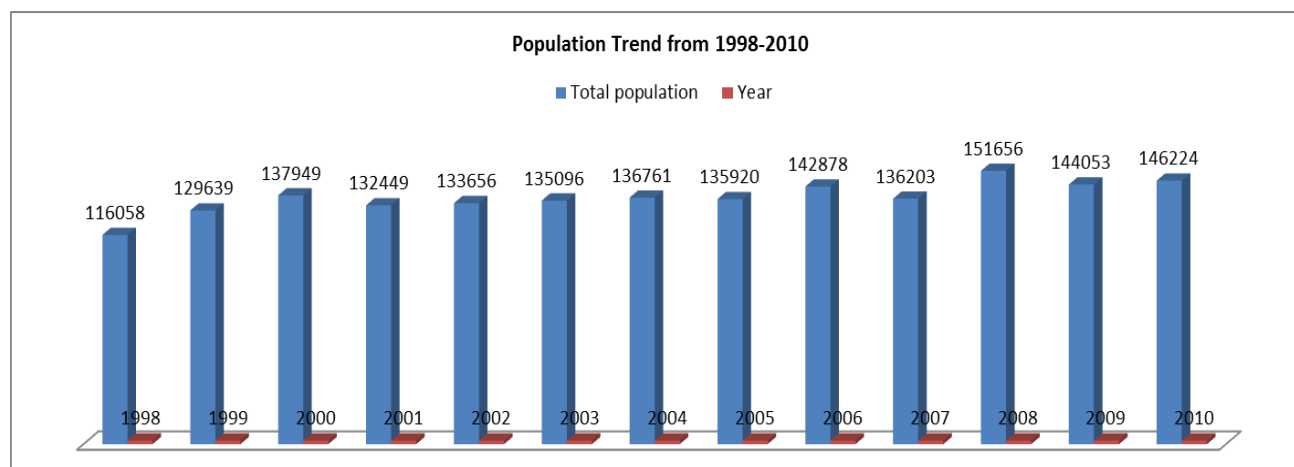
Population size in Battambang town

Battambang municipality is the central and provincial town of Battambang Province. The municipality covers an area of 115.44 km² of which 74% is agricultural land. The municipality consists of 10 sangka with 92 villages. The municipality is the center and the provincial town of Battambang province, which borders on the north with Thmoar Koul and Ek Phnom, on the east with Sangkae district, and with Banan district in the southwest.

The municipality's existing areas cover 115.44 km² of which more than 85.5 km² is agricultural land (about 74% of the municipality's territory). Among its 10 communes, there are three classified as rural (Kdol Doun Teav, O Mal, and Wat Kor), while other seven are currently classified as urban (Prek Preah Sdech, Svay Por, Toul Ta Ek, Rattanak, O Char, Chamar Smrong, and Slaket).

Based on demographic records prepared by the Master Plan Team of Municipality (2010), the population in the municipality significantly increased between 1999 and 2010.

Figure 7: Population trend of Battambang town



Source: Constructed by Thuon (2014)

Based on the three scenarios, it is anticipated that the average natural growth rate of approximately 1.72% between 2002 and 2006 will continue in the same way in the future, but will be supplemented by a further migration surplus of around 0.8% per year. Therefore, the projections and calculations of future population figures and for the estimated future demand for new settlement areas until 2020, will be based on Scenario 2 with an average annual population growth rate of 2.5%.

Table 7: Status of population of Battambang town in each sangkat, 2010

No	Sangkat	Total	Male	Female
1	Tuol Ta Ek	16,182	7,811	8,371
2	Preaek Preah Sdach	12,779	6,108	6,671
3	Rottanak	13,877	6,657	7,220
4	Chamkar Samraong	16,075	8,045	8,030
5	Sla Ket	6,713	3,289	3,424
6	Kdol Doun Teav	9,389	4,864	4,525
7	Ou Mal	10,398	5,129	5,269
8	Vaot Kor	18,232	8,983	9,249
9	Ou Char	21,475	11,455	10,020
10	Svay Pao	17,758	11,713	6,045
	Total	142,878	74,054	68,824

Source: Battambang Municipality Five-year Development Plan 2011

Table 8: Population density of each sangkat, Battambang Town

No	Sangkat	Total Land (km ²)	Population	Density/sq/km
1	Tuol Ta Ek	3.77	16,182	4,288

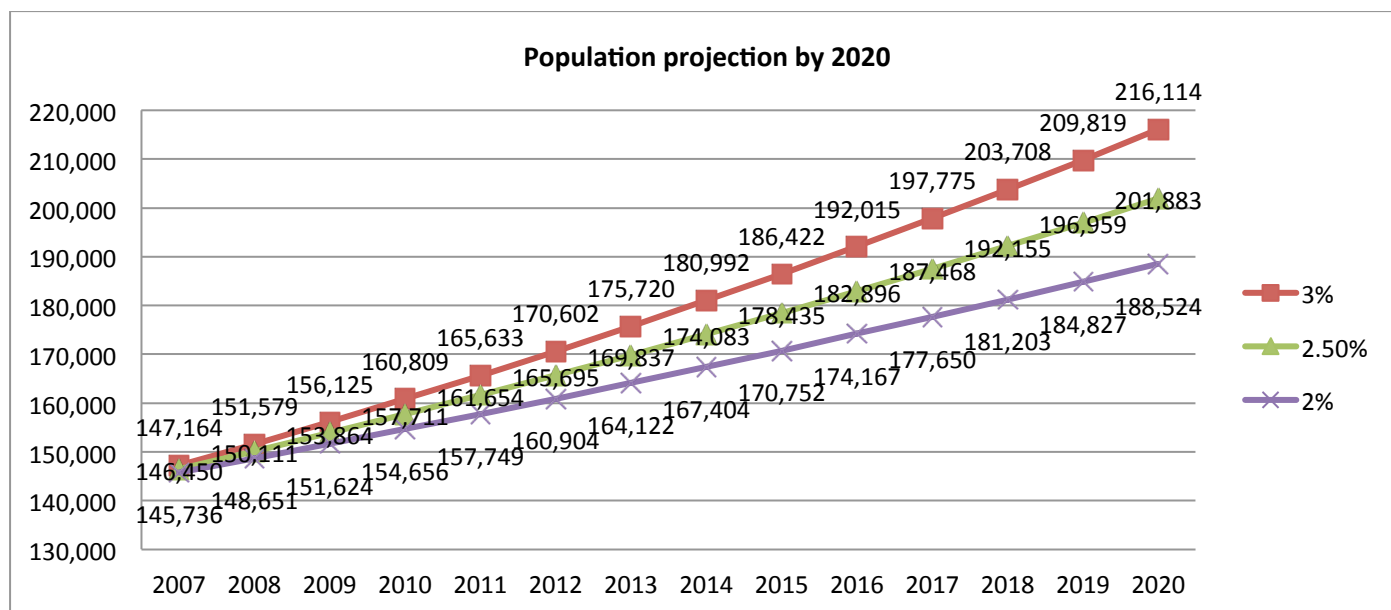
2	Preaek Preah Sdach	2.9	12,779	4,407
3	Rottanak	6.79	13,877	2,044
4	Chamkar Samraong	9.18	16,075	1,751
5	Sla Kaet	7.47	6,713	899
6	Kdol Doun Teav	9.06	9,389	1,037
7	Ou Mal	37.74	10,398	276
8	Vaot Kor	24.94	18,232	731
9	Ou Char	11.17	21,475	1,921
10	Svay Pao	2.42	17,758	7,304
Total:		573	142,878	

Source: Royal Government of Cambodia, Municipality of Battambang, 2010

Table 9: Estimated population by 2020 (3 Scenarios)

Municipal Population in 2002-2006			Estimated Municipal Population in 2020		
Population in 2002	Population in 2006	Average annual population growth	Scenario 1 (2%/year)	Scenario 2 (2,5%/year)	Scenario 3 (3%/year)
133,656	142,878	1.72%	188,524	201,883	216,114

Figure 8: Population projection for Battambang town from 2007-2020



Source: Adapted from Master Plan Team of Battambang Municipality (2009)

The projection above shows that by 2020, the population of Battambang municipality will reach 216,114 with 3% growth and 201,883 with 2.5% and down to 188,524 with 2% growth rate starting from 2007.

An ADB Technical Assistance feasibility study on wastewater treatment has projected up to 2030. The outcome of this projection is similar to a 3% growth rate by end of 2020 compare with 2030.

Table 10: Projected population growth from 2015-2030 for Battambang town

Projected Population Growth, 2015-2030, Municipality of Battambang						
	Sangkats/ Year	2010	2015	2020	2025	2030
	Total Population	142,878	157,749	174,167	192,295	212,309
	Tuol Ta Ek	16,182	17,866	19,726	21,779	24,046
	Rottanak	13,877	15,321	16,916	18,677	20,620
	Chamkar Samraong	16,075	17,748	19,595	21,635	23,887
	Ou Char	21,475	23,710	26,178	28,903	31,911
	Svay Pao	17,758	19,606	21,647	23,900	26,387
	Preaek Preah Sdach	12,799	14,109	15,577	17,198	18,989

Source: Asian Development Bank (2011)

3. Regional connections

In recent years, Battambang has reactivated its strategic location as an economic and trading centre, while the threat from climate change as well as a degraded natural environment is expected. Battambang is one of the strategic locations in, and part of, the ADB Greater Mekong Subregion southern corridor town development.

Pilot Program for Climate Resilience (PPCR)

In 2013, the Royal Government of Cambodia, with technical and financial support from the World Bank/ADB Climate Investment Fund, has approved the second phase of the Pilot Program for Climate Resilience (PPCR⁴); 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 include 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 is nearly US\$400 million.

Railway rehabilitation project

A loan agreement⁵ between Cambodia and the ADB (2010) railway rehabilitation will help to 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.

⁴The 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, from a transport corridor into a full-fledged economic corridor by improving priority infrastructure and building institutional capacity in selected towns.

⁵ Loan No.2288-CAM (SF): GMS: Rehabilitation of Agreement dated 2 March between the Kingdom of Cambodia (borrower) and the Asian Development Bank with total funds around US\$26,408,000.

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 and connects Phnom Penh to Poi Pet (going through Battambang and Sisophon) on the border with Thailand
- The southern line, which was built in the late 1960s and connects Phnom Penh with Cambodia's main seaport in Sihanoukville. To date, approximately 93% or 266 kilometers of the southern line have been rehabilitated, and trains are operating between Phnom Penh and Sihanoukville.

Benefits from the project will include reducing the number of heavy vehicles on the road by up to 50%, leading to:

- fewer road accidents (almost 1,800 people die in Cambodia each year in road accidents and thousands more are injured)
- savings (estimated at over \$US1 billion) in road and sea transport costs in the first 30 years of operations (trains require less than 20 per cent of the fuel used by commercial trucks). 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% reduction in costs
- lower CO₂ emissions
- savings in road maintenance costs of US\$39 million (one fully loaded truck causes as much wear and tear on roads as 7,000 passenger cars), and
- removal of dangerous or flammable cargo from roads to rail.

The railway project will directly affect 4,000 families, one quarter of whom will be resettled⁶. The government, with an ADB loan, will be 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).

Roads and bridges under strategic plan

Local authorities consider investment in urban road and drainage structures the mobilizing factor 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 to ensure sustainable local economic development and investment. Thus, urban road infrastructure requirements according to classifications are as follows:

- Improvement of 406.3 kilometres of the National Road (NR 5). NR 5 is the major road running through the urban centre of Battambang. Through investment, it will be improved and visually enhanced.

⁶ 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.

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 kilometers 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 bypass ring road system in the urban center of Battambang is intended to decongest traffic build up on the NR5 and 57. A possible funding source for this investment is the Japan International Cooperation Agency (JICA).
- Upgrading 22.3 kilometers of municipal roads or the urban interior roads.
- Improvement of the existing provincial road with a total length of 21.3 kilometers to be extended to a length of 105.3 kilometers, 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.

Irrigation and hydropower development

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 two sectors will contribute hugely to potential food security and food demand for both local and export-oriented markets, as well as to the need for energy for local urban residents and various business and enterprise developments within the municipality and the province.

Table 11: Potential water infrastructure development and investment

No	Irrigation Projects	Proposed irrigation areas (ha)	Existing irrigation systems (no)
1	Kong Hout Rehabilitation	12,773 ⁷	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	

Source: Japan International Cooperation Agency, Ministry of Water Resource Management, and Meteorology, Ministry of Agriculture, Forestry and Fisheries, 2007

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 socio-economic goals, the development vision for Battambang envisions a competitive town that becomes a regional economic center for trade and investments in agro-industrial goods and services along the Southern

⁷ Now with more than 60,000 ha from Chinese investment.

Economic Corridor. Over the 15-year period, Battambang is aiming to be a city of heritage and culture while sustaining its economic competitiveness for private sector investment.

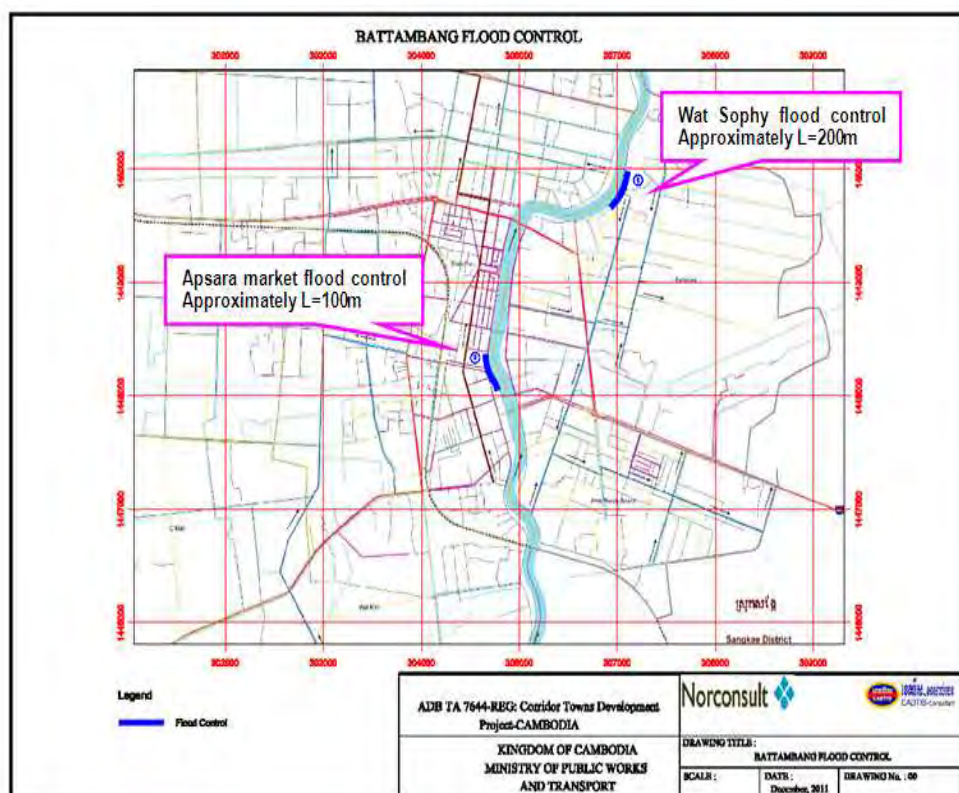
Battambang flood control

Based on an assessment of the current situation, the Battambang flood control sub-project 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 meters long and 30 meters 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 meters long and 30 meters wide.

The town of Battambang experiences flooding and periodic inundation during June to December, which is the 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 meters. In the town centre, flooding has become a nuisance to the local population, affecting the flow of traffic and the movement of people in the major thoroughfares while disrupting access to economic services.

Figure 8: Battambang flood control along Sangkae River



Source: GMS Corridor Town Development Project (TA 7944-REG) as cited in ADB (2012c)

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 centre, with 90% of the 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 consultation and criteria, the selected urban infrastructure for priority investment includes the following:

- **Improvement of waste water system and installation of treatment plant** includes 3 kilometers of open and close channel drainage structures along existing canals in the northern and eastern portion of Battambang. A five-hectare area has been identified as the plant site.
- **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 dump site. The sanitary landfill will address the perennial problem of waste collection and disposal and achieve the projected collection rate of 90% by 2020.

4. Background information availability

History of urbanization

The historical records (stone scripts and archeological evident) reveal that Battambang town has existed since the eleventh century during the Khmer Empire. Significant developments and records were founded in the following events:

From 1705 to 1907: the Lord of Governor

It was a small town with about 2,500 residents, stretching along the west bank of Sangker River with one road parallel to the river. People built their houses disorderly along both sides of this road. The site today known as **Psar Nath** (meaning new central Market) was just an open-air market⁸. At that time, dominant landmarks were numerous pagodas along both riverbanks and a Chinese temple. A rectangular fort called “Kampheng” was built in the late 1830s, with the palace of the “Lord Governor”, which is today the seat of the Provincial Governor (See Chhuong 1974).

From 1907 to 1953: French colony

In 1907, the French administration devised the city’s first urban development plan. They designed a significant grid pattern of well-defined streets, installed urban structures and built roads, a drainage canal, and a ring of open canals surrounding the area. Three main streets in town were built parallel to the Sangker River, which today are called street No. 1, 2 and 3. The west bank and the east bank were connected with two bridges in 1917 (an iron bridge and a concrete bridge). Many shop houses were built and separated into smaller blocks by crossing streets and back lanes between the three main streets, thus giving room for small scale commerce by Chinese-Khmer

⁸ It was also a major commercial hub with mixed ethnic groups: Khmer, Thai, Chinese, Vietnam, Laotian, Burmess (See Chhuong 1974).

traders. The French used the fort for military purposes and erected a prison inside the compound. A hospital was constructed on the northern edge of the town near French Indochina Bank warehouses.

From 1926, a second urban development plan was created. The railway was constructed to link Battambang to Phnom Penh and the urban structure was extended to the west of the town, featuring some important urban axes orienting on the railway station. Psar Nath market was built in 1936; a well-designed Art Déco structure on the location of an open-air market at the riverfront is now considered a significant land mark for Battambang city. Many outstanding buildings, including residential villas and significant public buildings, were constructed during the period, some of them contributing to the urban heritage and unique character of Battambang until today. Urban development of the city in the French colonial period was directed at making the town a business and administrative center of the colonial protectorate.

From 1953 to 1970: Sangkum Reastr Niyum

This period is known as “Golden Area”⁹ of Cambodian history when the urban layout of Battambang was enlarged to five times the size of the French colonial town. According to the third urban development plan for Battambang city, large extension areas were planned for the north (a well-planned residential area called “le quartier vert de Sangkum Reastr Niyum”), for the east, and for the south of the city. The aesthetically and technically planned urban layout of the time was courageous and reflected long-term thinking. It featured some significant urban axes corresponding to the existing urban layout from the former period. The area covered by this urban plan is still not completely developed or filled with settlements until today.

Battambang grew as a modern provincial capital, being the industrial and commercial center of the region. Several large infrastructures and public facilities were built under the modernization program of the Cambodian government of then-prince Sihanouk. Several provincial departments, the courthouse, and other public administration offices were set up on both sides of the river. Textile and garment factories were built by French and Chinese investors, the airport was set running, and a railway line was developed to reach Poipet. Numerous schools and a university were built. A sports center, museum, and an exhibition hall were constructed to serve the cultural needs of the growing population. The government filled in a number of open canals and converted some of them into sewage systems.

From 1970 to 1990¹⁰: Civil war

Like other cities in Cambodia, the town was emptied and abandoned during the Pol Pot regime. When the country fell into civil war, the city was held back from developing and was sometimes further abandoned.

In 1980, the cadastral division within the Provincial Department of Agriculture designed the fourth development plan for Battambang. It covered most of the area in Prek Preah Sdech commune surrounding the location of Psar Thmey in the southwest of the city. Since the end of the civil war, the city has been growing dynamically. The development of market places has continued and the town has expanded. Refugees from neighboring regions migrated into Battambang seeking jobs and new homes. The urban layout of Battambang from the Independence Period proved to be very robust and has changed little since then.

⁹ During this period, the province was well known for being the leading rice-producing province in the country.

¹⁰ From 1997-1990, Battambang was influenced by the Vietnamese. From the 1980s to present, there has been a Vietnamese consulate in Cambodia (Sovathana 2013)

From late 1990s to present: National development and regional integration

The development of Battambang Municipality has sped up since the late 1990s, primarily due to a booming agricultural trade, small-scale business sector, and the moderately growing tourism industry. Besides the abovementioned, the education sector with its fast development of state and private universities and high schools is of great importance for Battambang Municipality as a momentum for the local economy. Many new buildings have been constructed, mainly covering what was laid out in the urban structure plans of the Independence Period and from 1980. This includes hotels, markets, private schools, and private residences. The settlement area, though, has not dramatically increased beyond the borders of these last two urban development plans.

Resulting from unsatisfactory law enforcement and sometimes monotonous and unsuitable design, the recent urban development has been disorderly and faces problems including: severe changes and defacing of the unique character and beauty of the cityscape, poor or non-existent technical infrastructure, informal settlements, and limited access to basic supplies in some areas. The urban heritage of the city, state land, and state properties are endangered by modernization and privatization.

Still, Battambang is today the main hub of the northwest connecting the entire region with Phnom Penh and Thailand, and as such it is a vital link to Cambodia. The city is situated by the Sangke River, a tranquil, small body of water that winds its way through the city, providing a nice picturesque setting. The city has transformed itself from a group of small fishing village stretched along the banks of the Sangker River into a nineteenth-century Thai outpost, then to a European-style planned city and finally, after Cambodia's independence in the 1950s, into a major regional hub.

5. History of engagement

One of the team members has been involved with the Battambang municipality over the past 15 months as a member of a project focused on building climate resilience in cities.

6. Accessibility and affordability

- Good road connection from Phnom Penh.
- Transportation is diverse; it can be reached by bus or taxi.
- Accommodation is also diverse.

7. Local interest and political buy-in

Town development working groups in the city are receiving training provided by ADB on climate change adaptation and mitigation in the urban areas. Working group members are comprised of representatives from various departments with expatriates who serve as technical advisers for infrastructure investment.

The Ministry of Land Management, Urbanization, and Construction is promoting spatial planning, land use planning, and master place development of towns and cities. This means that they do need more technical capacity to support their staff at the national and sub-national levels.

Battambang is the first municipality to have a master plan of urbanization (2008-2022), with technical support from GIZ and Cities Development Initiative for Asia.

8. Replicability and transferability of knowledge or lessons

Battambang is clearly a demonstration site for GMS town developments that are resilient to climate change as well as a model town for development in Cambodia. It is expected that other towns surrounded Tonle Sap Lake and Mekong River will replicate Battambang's successes.

CONCLUSION

In conclusion, Battambang municipality represents a town worth exploring in terms of climate change, urbanization, regionalization, and poverty reduction. These issues are well perplexed and manifested in the recent developments of the town. The town has encountered rapid processes of economic growth and regionalization as a consequence of the overall development in the province, Cambodia, and the region. Further, the town had a long history of development event before the colonial time and is currently becoming a strategic location (as the regional business and trading hub) for the western provinces. Coupled with soaring urbanization and population growth, it will be interesting to examine how the city copes with increasing economic activity in light of climate change, and how this impacts poverty reduction.

There have been some studies on the issues of climate change, urbanization, regionalization, and economic development in Battambang province. These studies, however, tend to focus on the issues in a separate manner, without a holistic lens cementing their interface. It is thus value-added to delve into how Battambang town can become resilient and sustainable in the inter-woven realms of climate, urbanization, regionalization, and poverty reduction. This is crucial and timely since the town is rapidly developing while under threat from climate change and resource stresses. It is also of immense interest to the local government and development partners who are executing investments pertinent to many of the issues presented in this report.

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