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Royal University of Phnom Penh

Urban Climate Resilience in Southeast Asia Partnership (UCRSEA) Project

(Draft Working Paper)

Situation Analysis Report – Battambang City, Battambang Province, Cambodia

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1. 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 Greater Mekong Sub-region (GMS). This region is changing rapidly: from being a region characterized as largely agricultural to the process of urbanization in the scale that never seen before in certain areas. This process is set to intensify with the ASEAN Economic Community (AEC) coming into place in 2015 linking urban, commercial and industrial centers across the GMS. The process of urbanization represents a dramatic shift in ecological landscapes, and in demographics (Richard and MacClune 2013).

McKinnon (2011) defines urbanization as, "the increase in the number of people who live in places defined as urban, the increase in number of people engaged in non-agriculture, and the growth in the value of the non-agricultural production in an urban-rural spaces". He also provides three elements to analyses on urban growth: the natural increase of the people who already live in the city, the migration of people into the city from rural areas; and the expansion of the city such that populations formerly regarded as non-urban become urban.

Urbanization creates dependency on critical systems (food, water, energy) that are often beyond the control of city administrations. Failure in these systems can have enormous implications for people in urban areas, while businesses located in these areas, and those dependent on resources elsewhere are also at risk (Richard and MacClune 2013). In addition, the study shows that much of the urbanization that is occurring in the GMS is happening in places that are already in hazardous, particularly along rivers, coast, and deltas that re already vulnerable to flooding and extreme weather events. Richard and MacClune (2013) show that the expansion of urban areas is altering ecological landscapes; the conversion of agricultural land wetland areas creates new risks of flooding, affecting key critical economic assets that located in these flood prone areas.

Battambang is one of the GMS corridor towns and situated along sensitive flood plain connected by various tributaries, watersheds, national road No.5, No. 57 and railroad connecting Phnom Penh through the town to other provinces surrounded Tonle Sap Lake and Thailand. The corridor town approach is to maximize economic benefits of increased trade and traffic flows along the transport corridors by developing proper strategic local economic development plan, adequate infrastructure, essential services, and institutional capacity to guide and manage future development and investment by attracting public and private sector for urban sector development (ADB 2012a,b). The town is located along the Southern Economic Corridor (SEC) and positioned to boost trade and investments and stimulate economic growth. Its location as a market town along the transport corridor offers considerable opportunities as well as enormous economic and environmental challenges. Currently, the town is envisioned to be a competitive town becoming the regional economic centre for trade and investments for agri-industrial goods and services along the SEC.

1.1 Objectives

The objective of this Situation Analysis (SA) is:

- To review concept, framework and tool related to urban climate resilience
- To conduct situation analysis on key urban systemsits current status of climate resilience within the town development strategies. Key urban system services and government are highlight which include land use management and planning, waste, water and energy management and infrastructure development.

Key related issues of urban were also documented including urban slums and informal settlement and nature of their access to social services and social organization. The above issues and sectors are some of the critical elements of urbanization and development being identified in Battambang municipality.

1.2 Framework and methodology

A. The concept of urban resilience

Discussion on urban resilience is very common. It usually focuses on ecology, risk relating to hazards and disaster, economy, and governmental or institutional capacity to improve resilience. Francis and Chadwick (2013) show most works has focused on the social aspect of resilience, essentially looking at how social urban system may be better enabled to withstand stresses without highly detrimental impacts, and how quickly the system may return to normal after stress. O'Brien and O'Keefe (2014) argue that within human societies, resilience describes the capacity to anticipate and plan. Resilience, as a concept, has become part of the disaster management, sustainable development and climate change discourses. In disaster management, resilience is variously described as minimizing loses and damages, the ability to recoil from adversity, self-righting and learned resourcefulness and coping capacity, ability to react or effect recover.

As for resilience Alliance (2011) identified three characteristic of human-environment systems:

- the amount of change the system can undergo and still retain the same controls on function and structure;
- the degree to which the system is capable of self-organization; and
- the ability to build and increase the capacity for learning and adaptation

Based on the reviewed from 28 studies on resilience, O'Brien and O'Keefe (2014) come up with key focus on the physical, ecological system, social, community, system, individual, economic and city. Ecological system are dominant studies following by the community and individual with only one study focus on economic and city. This argument similar to what Francis and Chadwick's resilience and resistance within urban ecosystem alongside with socio-ecological system (Francis and Chadwick 2013).

Richard and MacClune (2013) shows urbanization creates dependency on critical systems (food, water, energy) that are often beyond the control of city administrations. Failure in these systems can have enormous implications for people in urban areas, while businesses located in these areas, and those dependent on resources elsewhere are also at risk. The authors suggested to focus on three components: the system, the agents and institutions. The approach is also being adopted by URCSEA program. Historically, this framework was developed by Tyler and Marcus

(2012): A framework for urban climate resilience. Building up from this framework, we learn that urban climate resilience covers three major components of interlinked: the system, agent and institutions that can be operationalized for local planning.

A1. The system

Cities requires high levels of infrastructure to deliver essential services. They are also linked across multiples scale to other systems, such as regional food production that relies on ecosystem to deliver provisioning services. At global scale, cities are connected through international trade and investment patterns, which can have direct effects on local employment and livelihoods as well as on supply ranging from pharmaceuticals to imported stable foods. Support system that enable networks of provision and exchange of urban populations are therefore an essential elements of urban resilience. They include physical infrastructure and ecosystem that provide key services such as food production, runoff management or flood control.

From the study of complex engineering and ecological system, resilience system follow the characteristic:

- *Flexible and diversity*: the ability to perform essential tasks under a wide range of conditions and to convert assets or modify structure in order to introduce new way of doing.
- *Redundancy, modularity*: spare capacity for contingency situations, buffer stock within system that can be compensated the impact and lost.
- *Safe failure:* ability to absorb sudden shocks (including those that exceed design thresholds) or the cumulative effects of slow-onset stress in ways that avoid catastrophic failure. Safe failure also refers to an interdependence of various systems, which support each other; failure in one structure or linkage being unlikely to result in cascading impacts across other system.

A2. The agent

The resilience in complex adaptive system also links social agent and institutions along with biophysical elements as components of socio-ecological system. This also refers to adaptive capacity of social organization and individuals (e.g., farmers, consumers), households (as unit for consumption, social reproduction, education, capital accumulation); and private and public sectors organizations (government department or beaus, private firms, civil society organization). They have identifiable but differentiated interests and are able to change behaviors based on strategy, experience and learning.

Many agent depend on urban systems and demand services but are not proactively involved in the creation, management or operation of those systems. Other agent are directly concerned with management of critical urban system such as water supply, water quality, regulatory agencies, private water utility, key water quality or regulatory organizations involved in water related advocacy. Agent and actors considered as resilience include:

- ***Responsiveness***: Capacity to organize and reorganized in an opportune fashion, ability to identify problems, anticipate, plan and prepare for a disruptive events or respond quickly in its aftermath.

- ***Resource fullness***: capacity to mobilize various assets and resources in order to take action. It also include ability to access to financial and other assets, including those of other agents and systems through collaboration.
- ***Capacity to learn***: ability to internalize past experiences, avoid repeated failures and innovated to improved performance, as well as learn new skills.

High capacity agent have the ability to anticipate and act in order to adjust to external changes and stress.

A3.The institutions

The concept of institutions in social sciences refers to the social rules or conventions that structure human behavior and exchange in social and economic interactions. Institution that enable or constrain individuals to organize or to engage in decision making determine whose interests are considered in political decisions making. Finally, pricing of urban structure services is an institution that influence access to infrastructure systems and the resilience he offs, particularly for thee urban poor. From studies of economic behavior, collective action, social marginalization and decision making, key aspects of institutions linking gents and systems that should be considered in assessing whether they enhance or constrains resilience appear to be those outline below:

- *Right and entitlements* linked to system access (key resource and access to urban system should be clear)
- *Decision making process*: in relation to urban development and urban systems management should follow widely accepted principal of good governances: transparency, accountability and responsiveness.
- *Information flow:* household, entrepreneur, community organization need for meaningful and creditable information flow to enable judgment about risks and vulnerability and to assess adaptive option
- *Application of new knowledge*: institution that facilitation the generation, exchange and application of new knowledge enhance resilience's.

The framework for urban climate resilience facilitates planning for climate adaptation in cities by reaching beyond a focus on climate impacts to integrate ecological, infrastructure, social and institutional resilience factors.

B. Methodology

This situation analysis (SA) was carried out by building up from previous work on city selection criteria for UCRSEA program with additional three periods of visits. The first visit took place from 1-3 December 2015, the second was taken place from March 27-30, 2016 and final visit was taken place 23-28 June 2016.

Additional literature reviews was conducted to support the key findings and data on urban development framework and investment. Key informants interview, group meeeting and site visit were carried out in each visit. The visit and interviewed was followed by the guideline of urban climate resilience by focusing on selected key urban systems. The framework of interview, key focus of discussion and key informants are listed in annex sections.

2. Key element of urban systems

2.1 Urban ecological system

Battambang is part of the greater natural landscape of the Cardamom region[1]. 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). The province used to be rice production centre in supporting the country.

The major physical feature of the Battambang is the Sangker River which flows through the town centre to Tonle Sap Lake, with 92 percent of the municipality lies on the west bank, including the main commercial and government establishments. There are shops and small restaurants that built along the riverbanks adjacent to the town centre. The Riverbank provides a scenic backdrop of the town centre particularly at sundown. Tonle Sap Lake supplies irrigation water for agricultural production particularly for the cultivation of rice paddies. It also provides water for domestic use by local household. The Lake is a major source of income and livelihood from fishing and fish farming. The lowland area of the Tonle Sap Lake is a rich fertile land for growing cash crops and vegetables.

Within the province territory, there are three protected areas associated with the Sangker river system[2]: Phnom Samkos Wildlife Sanctuary, Sam Lout Multiple Use Area, and Tonle Sap Multiple Use Area, totalling 710,000 ha**.** Both Phnom Samkos and Samlaut are located upstream where most irrigation systems existed and those system are also being renovated. Tonle Sap Multiple Use Area is situated downstream along Sangker River (JICA, MOWRAM, and MAFF 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 (JICA, MOWRAM, and MAFF 2007).

In an interview with an official working on the issues at sub-national showed economic land concession for large scale agriculture, the encroachment from both local community and outsiders have put more pressure on protected areas. The overall estimation reveal major loss of forest land as follow:

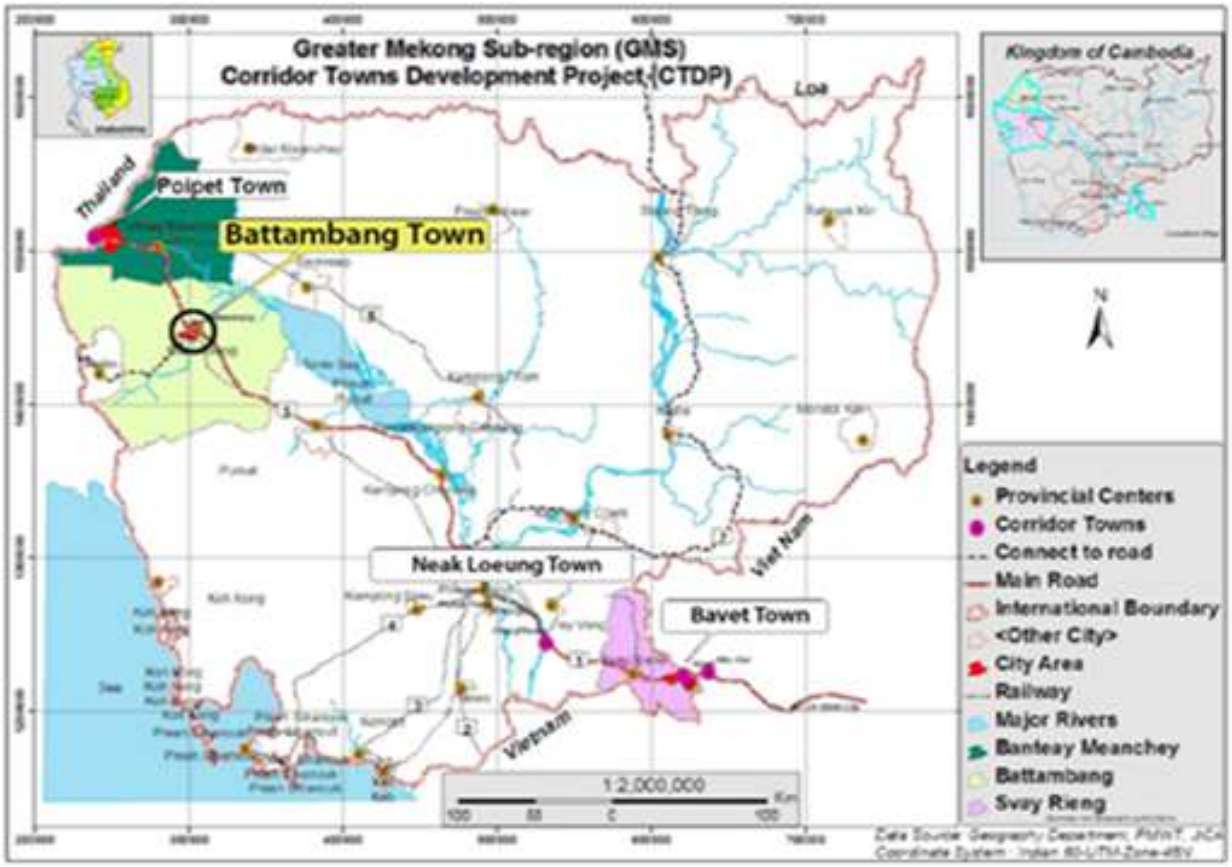
- Samkos wildlife sanctuary[3]: 14,000 ha of land has been taken by concession and additional 8,000 ha were provided to local community with legal title while additional 6,000 ha was in pending of titling to local farmers.
- Roneam Dounsar wildlife sanctuary: only 3,000 to 4,000 ha out of 70,000 or 80,000 ha are left.
- Samlout multiple use area: only 10,000 out of 40,000 ha are left.

[1] This region covers approximately one third of the country's land surface and spans 24 of its provinces, including Koh Kong, Pursat, Battambang, Pailin, Sihanouk, Kampong Speu, Kampong Chhnang, Kam Pot and Kep.
[2] Sometimes known as the Battambang River Basin
[3] This Samkos wildlife sanctuary covers three provinces: Battambang with 59,000 ha, Pursat with >200,000 ha, Koh Kong with >90,000 ha.

2.2 Urban Economic Infrastructure

Battambang is situated in the north western part of Cambodia which is about 300 kilometers via National Road No. 5 from the capital city of Phnom Penh. The town is located in the junction plain of Sangke River and National Road No.5, connecting to National Road No. 57 in the southern part. The inter-section portion of the national road emerged as a good junction for the traffic flow of people, goods and services to nearby provinces and neighboring counties, particularly Thailand (ADB 2012b).

Figure 1.Strategic location of Battambang within GMS-SEC



Source: Adopted from ADB TA7644-REG (2012)

The town of Battambang is a traditional agricultural trading center along the Southern Economic Corridor (SEC). This market town has high potential to be transformed into agro-industrial town given its vast agricultural lands and the growing interest of private sector in establishing small and medium enterprises and manufacturing industries in Battambang. The development have been constrained by an inadequate urban infrastructure and the institutional capacity of the local authorities to manage the urban sector (ADB 2012a, b).

The existing economic infrastructure in Battambang provide the facilities and utilities to further boost trade and traffic flows of people, goods and services. There are 5 big and 8 small markets

and trading centres that caters to local buyers, sellers and traders from neighbouring towns and provinces. Most of the market facilities however, are old while some of the structures are already dilapidated. Makeshift stalls are erected alongside of the road clogging the drainage structures and disrupting the flow of traffic. With increasing economic activities in trade and commerce, the market facilities have become inadequate and the market area is already congested with ambulant vendors and makeshift stalls.

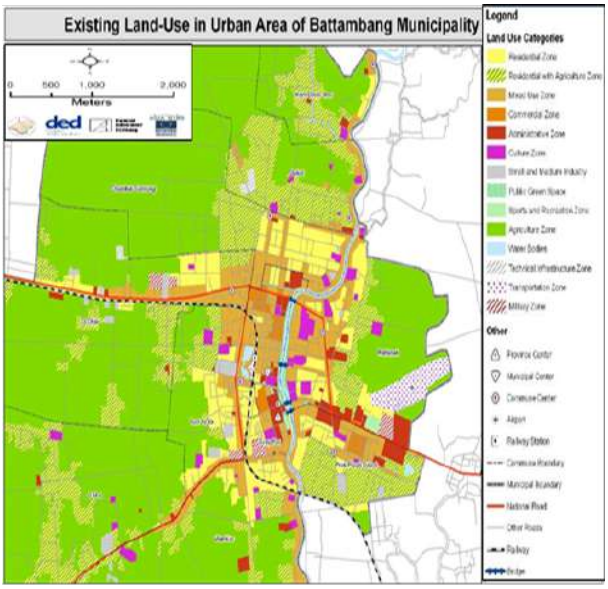
However, as ADB (2012b) point out, the key challenges facing the town of Battambang stem from inadequate urban infrastructure investments and the limited institutional capacities at provincial and district levels to manage urban sector development and provide essential urban services. The increasing population and rapid growth of the urban areas are creating considerable pressures on the part of the local authorities to provide urban infrastructure that would sustain the liveability and competitiveness of Battambang as the trade and investment centre. The present institutional capacity is limited in responding to the needs and requirements of a growing urban population and in-migrants in terms of the delivery of urban services and the provision of essential urban environment infrastructure. Its local level capacity is also inadequate in enforcing land use and management regulations due to insufficient funding support and adequate trained manpower.

2.3 Existing Land Use and Zoning

The land use pattern of the municipality of Battambang indicates 14 categories in terms of zonal delineation with corresponding area sizes.

Figure 2: Existing land use plan in Battambbang town

	Land Use category	**Ha**
1	Residential zone	456.7
2	Residential with Agriculture zone	1,379.6
3	Mixed Use Zone	584.5
4	Commercial Zone	42.1
5	Administration Zone	132.6
6	Culture Zone	104.4
7	Small and medium industry Zone	65.5
8	Public Green Space	17.6
9	Sports and Recreation Zone	9.1
10	Agriculture Zone	8,557.5
11	Water bodies	89.9
12	Technical Infrastructure Zone	10.5
13	Transportation Zone	64.2
14	Military Zone	29.6
Total Settlement Area		
Total Municipal Area		**11,544**



Source: Battambang Municipal Master Plan Team, 2009.

The major land use category is the agriculture zone which occupies more than 74 percent or 8,558 hectares of the total land area of the municipality. The residential zone and residential

areas with agricultural zone represent a combined area of more than 1,800 hectares or almost 16 percent. The residential spaces are concentrated within the urban area along medium and small roads. The residential areas with agriculture zones are situated within the sub-urban areas along small to medium roads close to the city border limits.

The mixed use zones in Battambang which include all settlement categories in urban, sub-urban and rural areas cover a total area of 584 hectares accounting for 5 percent of the municipal land area. These zones are found along the National Roads and main road networks surrounding the commercial centre. The small and medium industry zones which are within all settlement categories in urban and sub-urban areas, consist of a mix of small-scale enterprises for vehicle repair shops, construction companies, and small-scale factories, some of them causing disturbances due to air and noise pollution to surrounding residential and commercial areas.

Within the town center or the core urban area of the municipal are several commercial establishments such as markets, shopping stalls, hotels and restaurants including financial facilities such as banks and money changers. The town has several universities, colleges and vocational training institutions making it as the educational center of the province of Battambang.

As one of the oldest town in Cambodia established even before French colonial period, the town is also famous of its historical buildings that were built during the French protectorate in Cambodia. Local authorities are inclined to conserve and preserve these historical building and houses in order to retain the reputation of Battambang as the cultural centre of Cambodia.

The town center is also the location of government buildings and facilities such as the Provincial and Municipal administration buildings, district offices of provincial and district level departments, court houses and other public offices. The Sangker River remain the lifeblood of the town in term of water supply, life and livelihoods as well as industrial development.

2.4 The trend of land use change and speculation

There are at least two major trend of land use change: the vulnerability to climate change and the land speculation.

First, the review shows that the vulnerability of a city to climate change is not fixed and unmanageable predicament. Through the wise use of urban land, whatever vulnerability is present can be modified and, often, at least partly remedied. The remedies stem from an awareness of a city's natural setting, and understanding of how the design of urban from intentionally (or not) gives rise to the built environment, and an active effort to reduce the effects of Urban Heat, flood and drought. Solecki et al (2013) show that adapting to climate change through urban land management involves many moving parts: the legal and political systems, planning departments, zoning regulations, infrastructure and urban services, land markets and fiscal arrangement. Planning and managing an effective response to climate change is highly dependent on coordinating these parts: the more so because many metropolitan areas with seemingly common interests, are politically fragmented.

Secondly, the town master plan on land use has been drafted since 2009 and only by February 2015, this draft were official approved. Ideally, the master plan contains only land use categories, while regulation for construction and urban expansion was not clearly decided.

Our fieldwork from early 2015 to mid-2016 shows land speculation among urbanism remain strong. Except core urban areas where the land are already high values, the speculators have moved to periphery urban and rural-periphery areas dominant by agricultural production with seasonal flood. The town master plan technical team revealed that:

> During the cadastral survey for urban master plan, these area were natural habitats where more water bird and snake exists and there was no land buyer and sellers. Land start to have some values in 2006 with price range from 0.50 to US$1/m^2, from 2008-2009, price was a bit increase ranged from US$1-2/m^2 and from 2010 to 2015, land price was increasing from US$3/m^2 to US$70/m^2. The areas which used to be flooded with seasonal rice cultivation, were filled up with land, road construction, drainage and other infrastructure even though there are no clear study on ecological and environmental impact.

Real estate investment on housing in these areas are done by local businessmen such Rasmey Battambang company who is having more concrete plan with around 1,000 plots of land for house building. There are also more individual land ownership with land around 1 ha or less than this have also mapping out their land and divided into small plot for selling and some do build house for selling. New markets and entertainments service centers have also been expanded to these areas.

Most of the urban sprawl are being expanding to urban-periphery and rural- periphery close to current dump sites which is about 5 km from urban core. These areas cover large agricultural areas (mainly rice fields) with few rural type settlements/ villages surrounding the existing settlement area and are suitable for urban extension. A basic infrastructure provision/ service is given already during the visit in late 2014, 2015 and early 2016 with the existence of main roads. This developed practice reflecting an urban sprawl where development move faster than the plan.

2.5 Housing and informal settlement

Battambang is among the oldest town in Cambodia believed to have been established even before the arrival of the colonial power in early 19 century (Chhuong 1974). Buildings and houses in the town consisted of historical buildings that were built during and before the French protectorate in Cambodia. Local authorities are inclined to conserve and preserve these historical building and houses in order to retain the reputation of Battambang as the cultural center of Cambodia.

Flat units or apartments with multi-storeys were built mainly within the core town to serve as residence-cum-shops. Royal Government of Cambodia delegated the power to the municipality in order to approve on the architectural and engineering designs to conform to the building regulations and permission before construction. Wooden traditional buildings were built up in urban fringe for residences.

The first survey by technical working group of Battambang municipality in 2009 showed 24 informal settlements mainly scattered across the inner city. Some communities have been

residing in their current location on public land (e.g. on canals, road corridors, pagodas grounds and along the railway) for many years. The settlements are characterized by unsecured land tenure, lack of people's education, inadequate and unhealthy living conditions and insufficient basic amenities such as water supply, electricity and safe sanitation (Zillich 2016). Since 2013, more and more houses were built in ecological sensitive in wetland areas, expanding both inner cities to sub-urban areas and rural settlement areas. Meanwhile, more and more informal settlement (urban slum) have increased. In 2013, the initial survey by municipality office shows 2,167 families living in 64 urban slums. By February 2016, the number increased to 2,486 families living in 51 communities. Currently about 90 communities were identified as living as informal settlement with overall estimation around 4,000 families, more than 10% of total families. Some of these people are war migration returnee in early 1990s, rural migrant and internal migrants for economic and social reasons.

Some potential areas for reallocation for urban informal settlement have been complexes beyond the state rule. Most of the time land allocation often involved with elite groups, or high ranking official intervention while land allocation are not often reach equity among those entitled. Recent interviewed with commune chief of Prek Preah Sdach and village chief, Au Takoam 1 of Tuol Taek commune revealed some of those who have received recognized letter for land tenure also sold their land to outsiders or other , creating more complex issues when policy on social land allocation take place. This issues is partially the delay in approval and the inequality of land distribution and power elites involves in the sites.

3. Water and waste water management

3.1 Water production and management

By 2016, there is prolong drought and increase temperature. Irrigation schemes could support with more than 24% of total cultivated areas in wet season and 15% in dry season. The interviewed with PDOWRAM representative (28 March 2016) shows a series of water infrastructure development plan are taken place which include:

- Kong Hort flood control upstream to regulate flood water, and provide supplementary irrigation to up 70,000 ha in wet season with loan from China. At downstream, there is another plan to build spillway (renovated) to control water in Sangker River and plan to irrigate 20,000 ha as well.
- Sek Lork scheme: could store water around 200 million m^3 and could irrigate more than 10,000. Most of the water will be released to the city and Battambang town will need only around 50 million m^3.
- Kamping Pouy schemes: 14,000 ha in wet season and 10,000 in dry season if there if full water store in the reservoir. This year, we need to save water that can irrigate 6,000 ha but farmers move up to 10,000 ha exceeding the capacity of water supply (1 ha consume water up to 12,000 m^3).
- Sala Taorn dam: Situates in lower part, along the Sangker River (it used to be Pol Pot system). With China loan of US$30 million starting from 2017-2020 and expect to provide supplementary irrigation of 20,000 ha. There is also EIA study, but we assume with less impact compare to benefit we expect to earn. Fish is considered as major

impact, but we wish to store and keep more water to support the city growth and food production, instead of natural fish.

- Stung Tasak (Basac) with expected to irrigate 20,000 ha and US$ 20 million. PDOWRAM does not plan to build complete system, but will include reservoir, main canals and secondary canals that can survive wet rice (3 to 4 tons/ha).
- Ream Kun reservoir: the project also contained loan US$10 million to renovate 8,000-9,000 ha.

It is estimated that about 15,000 ha are under irrigation in dry season, mostly in Bovel, Thmor Koul, Kamping Pouy and Moung districts and 255,000 ha in wet season.

Overall, the aim of water management is build flood control gates across the Sangker River and store water and regulate water uses. At Sek Sork, upstream, the government also build reservoirs that could store 200 million m^3, around 80% of them could be used to supply the town. They also build hydropower at the reservoirs with 13 MW in wet season only. The scheme is done with the loan from China and expect to be ready by 2017 for operation.

There are current two main actors involved with water management. Provincial department of water resource and meteorology is in charge of flood controlling, dike, reservoir and irrigation construction including multipurpose dams, while water supply under ministry of commerce and industry is in charge of supplying clean water to all urban resident in the town and other districts in the provinces.

Overall, the water coordinating between PDOWRAM and water supply unit did not get on well, but thing has been improved during the last visit in March.

3.2 Water and sanitation services

Providing water and sanitation services (WSS) to the urban areas in developing countries is a daunting task as more people come to live in urban areas than the rural. However, thee WSS provision using conventional, networked approaches requires financing not only for individual connections, but also for extending the primary distribution networks- since unserved communities usually lie at the periphery of cities, physically far from the bulk of water supply network. Furthermore, informal communities are often situated on marginal lands, steep hillsides, where construction is complicated and expensive (Trémolet, Rachel and Catarina 2013).

Many studies shows different source of funding in order to recover WSS which include (i) Tariffs: including payments from customers to service providers, as well as households' own investments, (ii) Taxes: allocations from domestic government budgets and (iii) transfers from external development agencies and philanthropic organizations (Trémolet, Rachel and Catarina 2013).

User fees are the main financing source for WSS, either through fees for network services or through users' own investment in sanitation (latrines and septic tanks). User fees are often not enough to finance capital expenditure required to extend network services to (poorer) unserved areas. Notably, contributions are typically inequitable: better-off users pay less for high quality

piped water, whereas poor users pay higher tariffs for poor-quality water sold form street vendors.

In Battambang town, water supply is done by state own cooperation manages to water system. Up to present, about 45% of households connected to urban water system, while 97% of these use the system as their main source of drinking water and other 3% draw their supply from existing wells (ADB 2012a)

Interviewed with deputy director of Batttambang Water Supply Unit, it revealed that up to early 2016, not all urban communes do have full access to clean water, except Svay Por commune who serve as core urban area and the most developed one. Up to February 2016, there 12,074 household[4] connecting to the system.

It is expected current population in the town by 2015 is around 150,000 while actual one might be higher to about 178,435 and 201,883 by 2020.

Figure 3: Population trends and projection by 2020

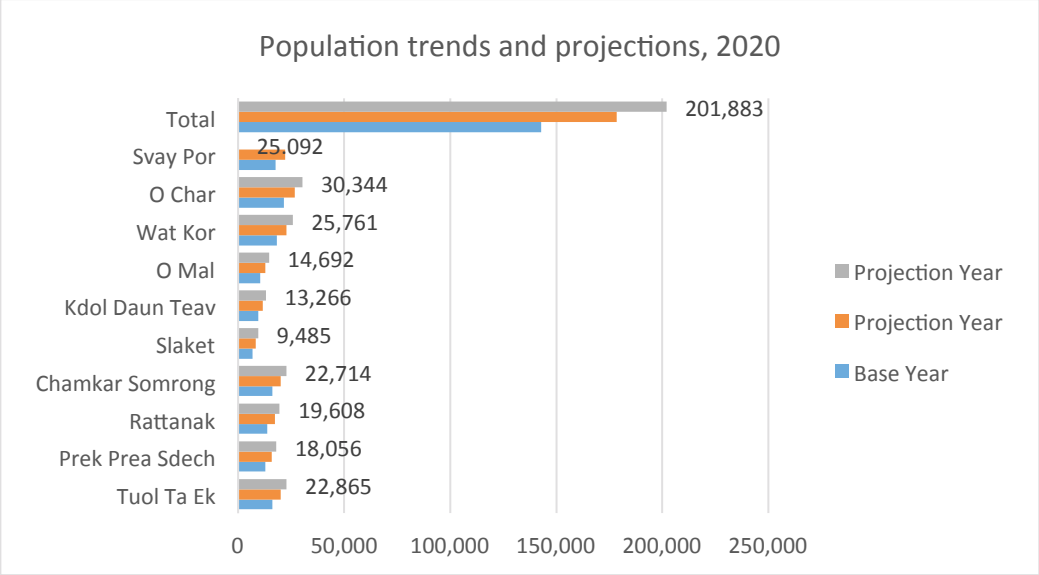
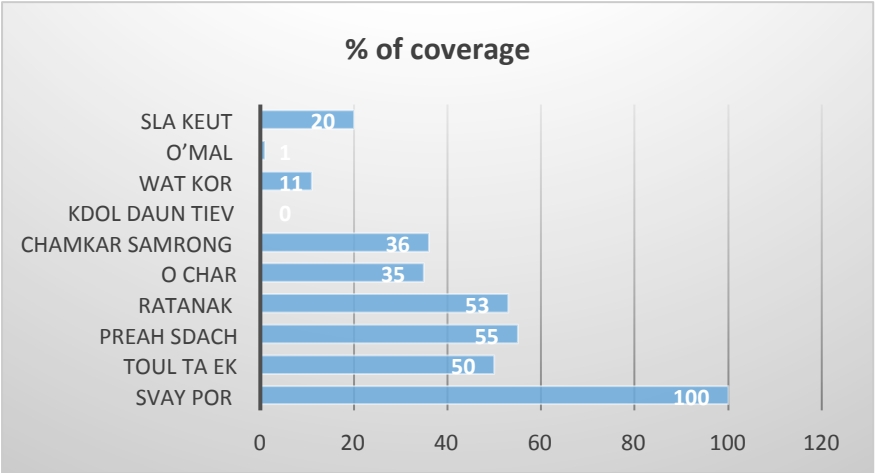


Figure 4: Current coverage provided by Battambang Water Supply Unit, 2016

[4] More than 28,000 families in town recorded in 2015. This figure shows less than 50% of all families' access to pipe system provided by the state company.



Source: Interviewed with provincial water supply, March 29, 2016

Water supply is also being extended to newly urbanized areas in other districts, in particular in Teuk Vil commune with 11% and Nor Rear with 49% in Sangker district.

The current water supply is being run by a loan project which could generate 11,520 m^3/day with potential support 70% of its capacity. The current JICA scheme support with capacity to produce clean water up to 22,000 m3/day and this will be able to supply most other areas in the town.

Water abstraction from Sangker River has been in competing claim over scarcity. Interviewed with water supply unit[5] showed that there is water shortage every year during dry season. Not enough water from the stream to pump up to required quantity. For instance, the system could pump up to 100 m^3/hour but only 80m^3/hour. The water supply unit also try to build small block to raise water up but sometimes PDOWRAM release water from dam without informing and the dike was broken. The release of water from upstream dams are irregular.

In March 2016, they managed to pump up to 1,100 m^3 /day as there is too little water released from water gates upstream. Peak demand for clean water starting from October to March and April while from May to September, it is a rainy season with enough from the river to pump as well.

JICA technical adviser who worked this water supply suggested that the new water supply system could not supply all the need in town even though we do have enough water in the river pump for the station with maximum up to 85% of the total need.

There is also cooperation between provincial department of water resource and meteorology and water supply facility such as the need of water to release from dams. However, PDOWRAM do need exact figure of the water supply used and sell per day. They told us with 10,000 m3/day but they do not tell the truth. It is only 55%-56% of water are being supplied in the city.

The real price of clean water supply is 1,600 riel but by adding with wastewater management and other services, the actual price move up to 2,000 riel/cm^3 equals US$0.50/$cm^3$.

[5] Currently, there are 65 staff working on water supply unit in five different sectors.

3.3 Floods control and its impacts

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

Table 1: Flood record and frequency

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
2008	12.14	569			
2009	12.08	552			
2010	11.12	337			
2011	13.95	1235			
Average	**12.66**	**760**			

Source: CDIA and ADB (2010) and PDOWRAM 2013

Flooding has been recorded in every Sangkat (communes) of Battambang municipality during the rainy season from June to December. In 2013, flood even more serious affecting the whole provinces (flooding occurred mostly in October to December). The highest level of flooding occurred in Sangkats Svay Por and Prek Preak Sdach, with water depth ranging from 1 to 2 meters.

Table 2: Extend of floods in each urban commune

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	6,466	10	1	<3

Samrong				
Sla Ket	6,059	5	3	<2

Source: CDIA and ADB (2010)

Table 2 shows 7 out 10 Sangkats experienced flood 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.

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.

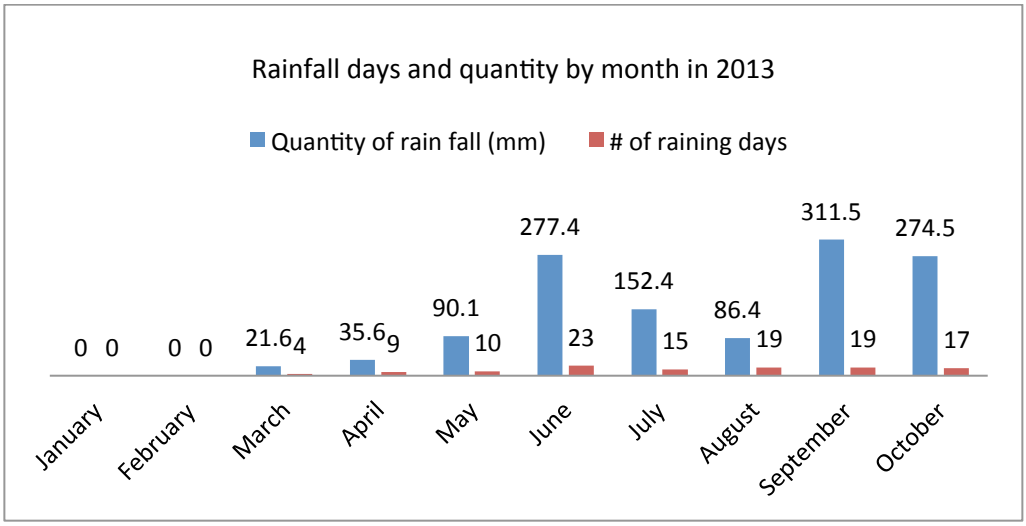
Flood in 2013

Official records from various documents shows that in 2011 (with water levels up to 13.95 m) floods affected 31,458 people (7111 households in 31 communes in 9 districts), inundated 52,503 ha, and destroyed 36.266 ha of rice fields. Flood in in 2013 is even more serious as water level is the highest in history that is 14.2 m high along Sangker River (normally 12.5 meters, water start to overflow from river to the town and areas in lowland or wetland).

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

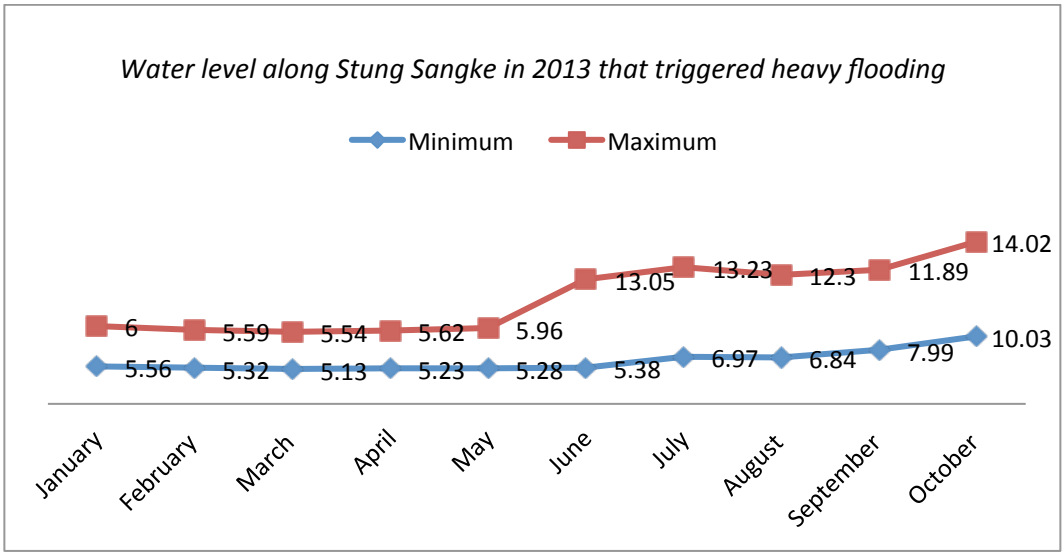
Currently large-scale infrastructure works are being built by the Chinese across the Sangker River, for flood control and water diversion for irrigation (potential irrigation area of 70,000 ha) and domestic use, also faced problems the late 2013 flooding. Investment for this project was US$100 million,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

Figure 5: Total monthly rainfall in 2013



Source: Provincial department of Water Resource and Meteorology, 2013

Figure 6: Level of water level in Sangker River, 2013



Source: PDOWRAM (2013)

Significant impacts of 2013 flood

- Flood started in early October and lasted around 7 to 10 days while in some areas, flooded lasted longer, around 20 days.
- Among provinces affected, Battambang and Battey Meanchey were the worst affected in terms of numbers of households affected and infrastructure affected (social sector, agriculture, and infrastructure value). See Table 20 below.

Table 3: Social sector 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)

4. Waste management

There are two type of waste management in town: the solid and waste water management.

4.1 Solid Waste Management

The solid waste collection and disposal is contracted by a private company, CINTRI, per a 24 years contract with provincial government. The contract began on July 1, 2010 and will be terminated in 2034. In contract, the company has to provide services on waste collection and transport and street sweeping. Therefore the company has served the two main services, and of which its operations waste on collection and transport from household, public and private market, hotel and commercial area so on, and waste sweeping at some curb side roads and commercial areas (ADB 2012a).

By 2011, approximately 80% of total households in the urban areas of 7 Sangkats receive the collection services. The services generally serve along the main roads, where the trucks can have access to. The waste collection fees are different for the flat house, business house, guest house and hotel. The fees vary from 0.5 to 2 US Dollars per month per household. Meanwhile, there were only 7 trucks, including six compactor trucks and one large truck and one bulldozer, for operations of its services in the municipality. There are complained that the waste flew around the dump site area which was located at the Sangkat Sla Kaet and into rice fields and open spaces, negatively affecting the rice crops and general aesthetics.

Table 4: Baseline of solid waste generation by 2010

Household waste production	**Units**	
Population in study area x 0.35 kg/day	38	Tons/day
Population in all municipality x 0.35 kg/day	51	Tons/day
Non-household Waste Production		
Pro-data for all study Area	19	Tons/day
Pro-data for all municipality	25	Tons/day
Total Waste Arising (HH & Non-HH)		
Battambang study area	21,069	Tons/year
All area of municipality	27,670	Tons/day

Source: Asian Development Bank (2012a, b)

Interviewed with Cintri program manager based in Battambang (28 June 2016) shows two more trucks increased with total 9 trucks, total 66 staffs with full cover all urban communes with an extended services to other districts: Sangke district (Anlong Vil commune), Ek Phnom district: Prek Kanchreng commune and Thmor Koal district: Thmor Koal market.

From 2012 up to 2014, waste quantify had increased from 70-80tons/day and by 2016 total waste collected per days are 102 tones.

The dump site and its impact

The current dump site covers 8 ha around 5 km from urban core. It has been complained with poor technical consideration and no environmental assessment. It was reported that ucollected solid wasted attracts animals and insects, all of which are potential carriers of enteric pathogens and diseases. Flies spread flood related disease such as salmonella, while mosquitoes can carry encephalitis, dengue fever ad malaria. Rodents can spread rabies, rat-bite fevers, leptospirosis, typhus and bubonic plagues (CDIA 2009).

During the last visit in March 2016, the current dump sites with 8 ha consists of 7 ha for dumping sites managed by **Cintri** while one ha being managed by COMPETE for waste recycle and processing. It was reported that CINTRI has around 20 workers while COMPETE[6] has no more workers due to health issues.

There is little awareness raising to local residents the waste management in the dump site was not good and in property as all waste dump which include the chemical waste and uncontrolled burning. In addition, dump site is situated in lowland, surrounded by farmer paddy and it is now close to urban core. During the visit, there are more flies, workers face with dry coughing, and headache while working as waste collectors in the site.

Interviewed with representative from department of environment revealed that

> The dump sites is now so close to the urban core and it should be reallocated to more rural areas, around 20 or 40 km from core urban. Now, the urban expansion is so fast and most of them are building surrounded or areas close to the dump site. Cintri has 6 car, and sometimes could not collect in time and some areas, they come to collect every three days.

There is also concern impact on ground water (10 meter down) and there is also report impacts to nearby communes in other district such as O'Taki and Peam Ek of Ek Phnom are seriously impact on water The current pond constructed to store waste is lack of hygiene and standard. It was suggested to use geotextile to protect pond bed and capture methane but in practice none of these have been applied. In addition, the pond construction have also erode nearly farmers paddy as well impact of polluted water to their paddy (in crease arsenic, and iron in thee rice crop).

[6] COMPETE: during the last visit has no more staff working as there are concern on health impact. Most of the staffs were reported to be seriously ill and could not tolerance to the areas. This organization received fund from Germany, Japan and Ministry of Environment.

Cintri did also acknowledge the impact as the dump site was bought with promised technical and financial support from ADB that is sanitary land fill for dump site. Key impact they acknowledge include human health as the result of fire on waste, the lack of labor and the poor salary for the workers. Flood is another issues for truck to collect waste.

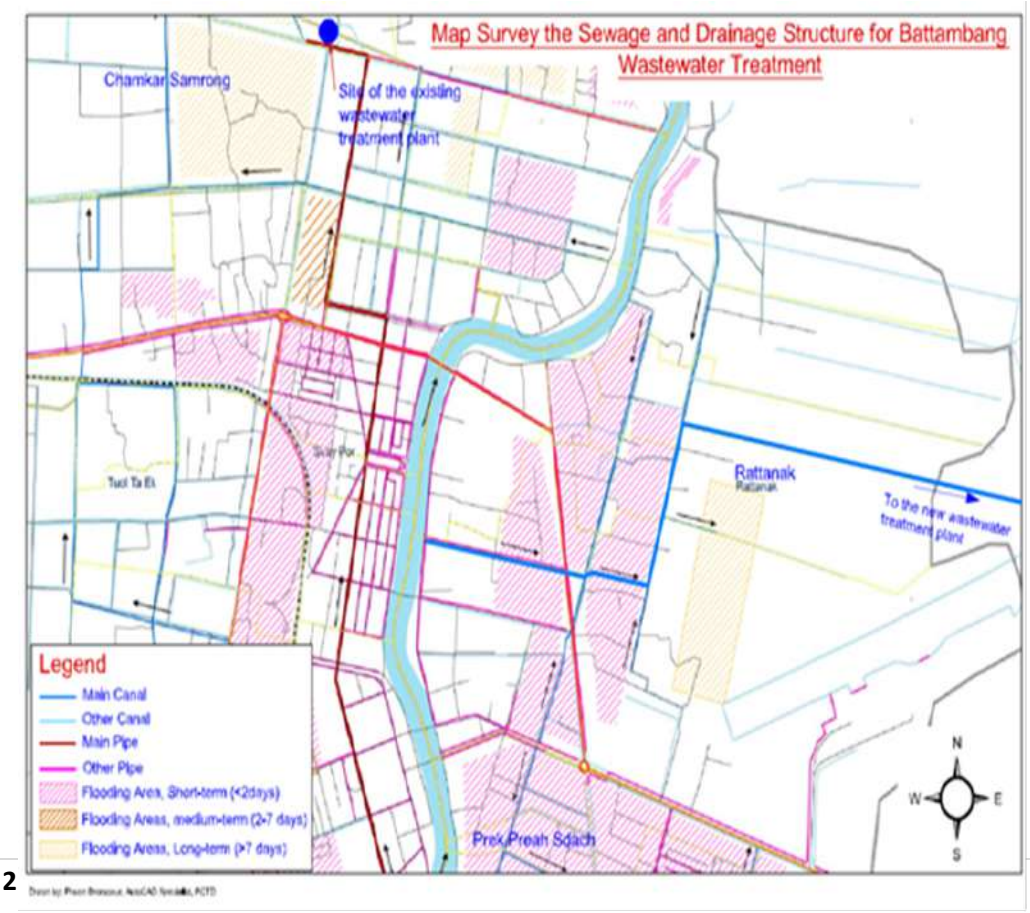
4.2 Wastewater management

Most of the current drainage systems were built since the French period and it is too bad now as it is too old and still remain in poor conditions and not functioning wells. There is small water treatment station which could store water around 10,000 to 12,000 m^3 and 2015 with increased 14,000 to 15,000 m^3 before releasing to river system.

In 2009, CDIA reported 46 per cent of the town' population is covered by the combined drainage and sewerage system with only 20 per cent of households in 7 Sangkats connected to the system. In Sangkat Svay Pao, the combined sewers which were constructed in the 1970's serve only about 10 per cent of the households. The study also showed 64 per cent of households have toilet facilities and about 40 per cent have septic tanks for waste disposal.

At present, there is no wastewater treatment facility on the eastern side of Battambang which covers Rottanak and Prek Preah Sdach Sangkats. Although there are some areas with existing combined canals for wastewater and storm water, the wastewater are disposed in open canals and are drained out to open farm lands without any treatment.

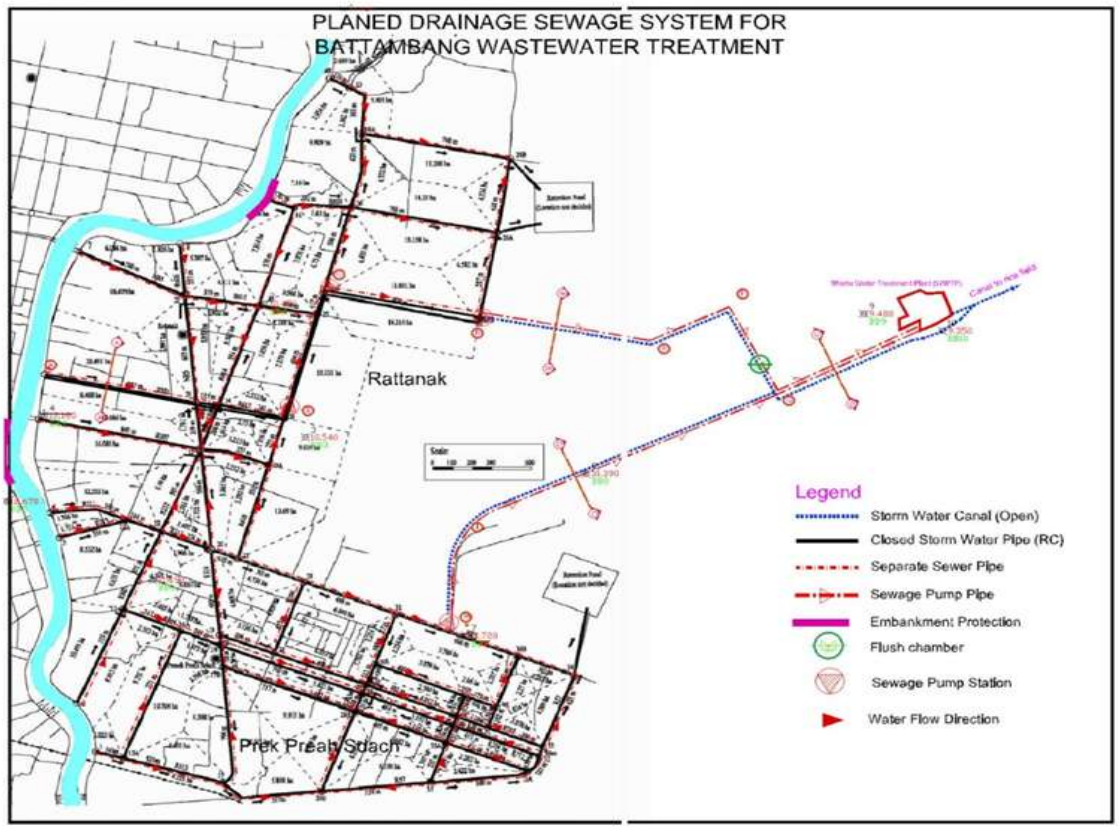
Figure 7: Existing wastewater treatment system (source: ADB TA7644-REG 2012)



The service areas of the Battambang Wastewater Treatment cover the residential areas and commercial establishments in Chamkar Samraong Sangkat, which is located in the western side of the town center and in Rottanak and Preak Preah Sdach Sangkats in the eastern side of town.

The existing service area of the wastewater and sewerage system in Battambang is limited to only about 10% of the town center which is the Svay Pao Sangkat located on the western side of the Sangker River.

Figure 8: Current plan for wastewater treatment system (source: ADB TA7644-REG 2012)



The current plan for Battambang Wastewater Treatment project includes the construction of a separate system for sewage pipelines and drainage networks for wastewater disposal leading to the wastewater treatment plants. Total investment cost[7] of the Battambang Wastewater Treatment Subproject amounts to $18.05 million. This will defray the direct cost for civil works, structures and facilities and equipment amounting to $12.62 million and the indirect cost for detailed engineering design, construction supervision and price contingencies amounting to $5.44 million. The new proposed site cover an area of 10 ha with projection of increased population up to 2020.

Some issues and challenges reported by the department of public work and transportation include:

> First, there is lack of staff. There is only one remain and there is a need to have at least 5 more contract staffs with regular salary rather than hiring them when it is needed with 20,000 riel/day. Working on wastewater is very dirty work which could not be done by white color people even though they are paid US$80 or US$100/day. Second, when it is needed, they also busy with other work. If we pay them salary, this might cost around US$100/month only. (Interviewed with deputy director of public work and transportation, March 28, 2016).

It was acknowledged that those who work on the wastewater controlling, management through laboratory work could not stay long as they faced with water born disease and low paid work.
Also, the current cost of drainage system maintenance and operation are also lows and could not paid off the overall expense and social services for wastewater workers.

5. Energy

Power plants are often located along the bodies of water, hence are susceptible to flooding and drought. As for hydropower, the projected changes in intensity and frequency of precipitation will increase the variability in both quantity and timing of the water available for conversion to energy. These interruptions of service will have negative effects both on local health and the local economy. Climate change will generally reduce energy demand in cooler seasons, and it will increase demand in warmers seasons- but overall impact will depend on the balance of seasonal effects.

For Battambang, energy sources come from both local diesel generators, the power grid connection from Thailand and the plan for replacement of transmission line from recent hydropower plan from both Koh Kong and Pursat provinces. Energy demand is projected to be increased from 15-20%. Source of energy include Thailand through 115 Kwh, Phnom Penh with 230 Kwh and standby generator with 2 MW. There is national transition line from Pursat province.

Total energy used and demand in 2015 are 6.26 MW with minimum and 34.35 MW maximum.

[7] The funding sources for the subproject are: $10.65 million from ADF, $4.71 million from PPCR and $2.70 million from the Government. The results of the economic and financial analysis indicate that the Subproject is viable with an EIRR of 30.7% and ENPV of $2.74 million. For the financial analysis, FIRR is 4.22% and FNPV is $4.37 million. Poverty impact ratio is 42%.

Staff: 262 (women 34). Energy projection, budget allocation and planning was done from national level while at provincial level is only implementation. Detail information on this sector seems a bit sensitive on its sources and how it is operated, in particular link to services fee and distributions.

Overall, the electricity distribution are strongly encouraged to extend to other urban areas and the investment from private sector.

6. Conclusions

This situation analysis reflects current status and trend of core element and urban structure in place. It examines the ecological setting of the town, the core element of production, key infrastructure and actors involved in urban development participation.

It is critical that urban sectors and services such as water, sanitation services, energy, food production, waste management and transportation are key critical role in adapting to climate change. Beside this system, there is limited role and capacity of the citizen to influence the system and development intervention has been foreseen in the process, in particular the key agent and institutions that ensure adaptive capacity and flexibility of the system.

Based on our review, the approach to urbanization highlights the ways in which social relations, and livelihoods change (Richard and McClune 2013). Many urban people are involved in complex livelihood strategies, involving both informal (and irregular) employment, insecure access to housing and key systems and services, and limited voice in how decisions about the city are made. To sustain this livelihood system, key system within urban areas such as water, land management, waste management and energy need to be addressed.

For water, maintaining supplies of fresh drinking water, managing excess water from flooding, controlling water and sewerage flow remain problem in Battambang. Climate change will put all this systems under great stress. Both the quantity and quality of the water supply will be significantly affected by the projected increases in both floods and drought. Long term planning for the impacts of climate change on the formal and informal water-supply and wastewater-treatment sectors in cities is required, and plans should be monitored, reassessed and revised every five to ten years as climate science progresses and data improve.

Other consequences of impact poor water supply might include serious health risk from climate change. Since a large and high-density population amplifies the potential for negative outcomes. Cities with limited existing water services are also at greater risk of drought and vector-related diseases. Other critical health related issues can surface with increased flooding and drought.

For urban land and land use, we learn that adapting to climate change through urban land management involves many moving parts: the legal and political systems, planning departments, zoning regulations, infrastructure and urban services, land markets and fiscal arrangement. Planning and managing an effective response to climate change is highly dependent on coordinating these parts: the more so because many metropolitan areas with seemingly common interests, are politically fragmented.

Over the past years, solid waste management has been poorly managed. The service provider has involved with wide rank of power relations among elites group from national level beyond the mandate of municipal level who often received various complaints from local residents including those farmers whose paddy field have been impacted by the dump site. In this regards, there are need full stakeholder coordination: the service providers, local residents, local authorities and line agency to work together both services provision and law enforcement.

For energy sector, adaptation and mitigation strategies often overlap, and it is critical to emphasize both to help reduce the inevitable impacts of climate change. Programs for managing demand to cut peak load blend elements of both adaptation and migration. So do project for updating power plants and energy distribution networks, which aim to increase resilience to flooding, wind storms and extremes of temperature.

In conclusion, climate change is just one of many issues. Uncontrolled urban sprawl, the push for regionalization and economic integration, the need for better land use planning, implementation, better water and sanitation services, the waste system managed and operations are strongly encouraged which need to be overcome by local government, its people and institutions.

For next step, we can build from this SA toward self-government assessment tools with combining with urban climate resilience framework and then apply with local stakeholders which include town officials, technical team, urban commune and village chiefs, civil society to conduct the participatory assessment, joint in technical reporting, write shop so that they will have more sense of ownership of the production and feel more comfortable in participating any upcoming dialogues and public debates.

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Annexes

Urban Climate Resilience in Southeast Asia Partnership (UCRSEA)

Tentative schedule for Batttambang town situation analysis
Date: 27-30 March 2016

Country lead partner:
Royal University of Phnom Penh (RUPP)
Ministry of Environment (MOE)

Objectives

- To update information for municipal situation analysis report related to urban climate resilience issues.
- To collect additional data and information on land use management and planning, waste, water and energy management and infrastructure development.
- Visiting related to urban slums, identification nature of access to social services, and social organization.

Participants (from project)

- Thuon Try, PhD student and project researcher
- Graduate Student from Master Program in Development Studies (RUPP)
- Dr. Ngin Chanrith, RUPP?

Key interview guideline for UCRSEA situation analysis for Battambang

Note: parts of this document were adapted from Richard Friend's brainstorming document after the Battambang trip December 2015, the content of which, was derived from the post-field visit meeting held at RUPP.

Theoretical approach
UCRSEA approaches the problem of urbanization and climate change as a challenge of governance – looking at urbanization as a contested process of transformation bringing together competing interests, values and worldviews.
Stemming from this, there are three key elements for consideration:

1. ***Political Economy – issues of power, knowledge and differentiation:*** for urbanization, this entails looking at patterns of political and economic investment in urbanization, land speculation and transformation, how power is shaped and recreated by competing forces.

2. ***Complex Social-Ecological-Technological-Systems:*** from the perspective of complex social-ecological (technological systems) with critical systems and services (water, energy, food, transport, waste) shaped by and delivered by a combination of infrastructure, technology and ecosystems that stretch across ecological and administrative boundaries, and that are beyond the ability of individual actors to influence.

3. ***Actor-oriented approaches:*** how the wellbeing and vulnerability of individuals and groups is shaped by these complex systems and broader political economy, but also in people's agency in shaping their own future, and changing current circumstances.

Approach to situation analysis in considering vulnerability:

- The fragility and potential failure of urban systems (e.g. water, energy, food, transport, waste) – and how climate change creates additional pressures.
- The ways in which different people access, control and gain benefits from these systems, and how they are impacted and respond to failures in these systems (e.g. institutional, environmental).

Battambang

Land

The land use plan (LUP) for Battambang was developed in 2005 but only recently approved.
Areas for further investigation in the situation analysis include:

- Analyzing the LUP and see to what extent it is based on broad ecological considerations. For example, by comparing the 2005 land use plan with satellite images of the growth of the city and changes in land use.
- How do investors select areas for investment? What criteria are being used?
    - Where is the investment coming from? (e.g. China, Korea, Japan, local)
- Analysis of land price trends over time (e.g. past ten years)
- Access to residential services: how do new residential areas get access to water and other systems such as waste?

Waste

Growing urban population is outpacing capacity (physical infrastructure and technology) of the waste management system and services which are having adverse effects on ecological and the wellbeing of people and communities.
Areas for further investigation in the situation analysis include:

- What are the ecological impacts of inadequate waste management?
- What are the governance issues associated with current waste management given the limited influence of citizens and potentially local government officials?
- What is the influence of the private sector (i.e. waste management company) on the local (or even national) government?
- Public awareness: to what extent is the public aware of proper disposal practices? How rampant is littering and illegal dumping?
- Case study of Centri waste management company

Water

Currently, some (if not all) of the infrastructure is outdated, either from the colonial period of Khmer rouge era and is poorly designed and maintained or for purposes that no longer match present needs (e.g. irrigation).
Areas for further investigation in the situation analysis include:

- Conduct an overview of the water management system for Battambang and projected water demand in the future.
- Assess water treatment systems (if present) and the challenges associated with water provision, treatment, etc. Is the system or parts of the system vulnerable to environmental risks?
- What is the drainage infrastructure like in the city and what are the future plans for improving drainage?
- How is sewage handled, treated (if applicable) and disposed? What potential environmental and social risks does the current sewage system present (if there is one

present)? How has increase population been factored into waste water treatment planning?
- What kind of flood control and flood management practices are in place? What are some identified problems with the system?
- To what extent are investments in water and waste systems guided by concerns of climate change or take climate change into account?
- How did the city deal with the 2013 flood? How did the flood affect the various systems of the city?
- What are the current status and future clean water supply in Battambang in responding to the growing need and demand for the urbanization and industrialization?
- What are the current status of water for food (irrigation and agricultural production)?

Energy

Demand is expected to increase with increasing development and economic activity.

Areas for further investigation in the situation analysis include:

- Conduct an overview of the energy generation, transmission and availability in the city
- What is/are the source(s) of energy?
- How has increased demand been taken into account?
- Has there been consideration of environmental impacts from the energy sources (e.g. hydropower)
- To what extent have climate change and climate-related events been considered in terms of their impacts on energy infrastructure?

Koh Kong

Land

Visiting Koh Kong town, it is evident that there are many plots of land for sale along with increasing development along the main strip (e.g. the current 38,000 ha resort development by Union Development Group)

Areas for further investigation in the situation analysis include:

- Analyzing the LUP and see to what extent it is based on broad ecological considerations. e.g comparing the land use plan with satellite images of the growth of the city and changes in land use
- How has the economic zone at the Cambodia-Thai border shaped demand and price for land? Analysis of land price trends over time (e.g. past ten years)
- Access to residential services: how do new residential areas get access to water and other systems such as waste?

Waste

Due to population growth and increasing economic activity, waste has increased accordingly to 20 tons/day, which is disposed of in an open dumpsite.

Areas for further investigation in the situation analysis include:

- What are the ecological impacts of inadequate waste management?
- What are the governance issues associated with current waste management given the limited influence of citizens and potentially local government officials?
- Public awareness: to what extent is the public aware of proper disposal practices? How rampant is littering and illegal dumping?

Water

It is unclear what the state of the infrastructure is for water-related systems. This will need to be ascertained as part of the situation analysis during meetings with key city officials.

Areas for further investigation in the situation analysis include:

- Conduct an overview of the water management system for Koh Kong
- Assess water treatment systems (if present) and the challenges associated with water provision, treatment, etc. Is the system or parts of the system vulnerable to environmental risks?
- What is the drainage infrastructure like in the city and what are the future plans for improving drainage?
- How is sewage handled, treated (if applicable) and disposed? What potential environmental and social risks does the current sewage system present (if there is one present)? How has increase population been factored into waste water treatment planning?
- What kind of flood control and flood management practices are in place? What are some identified problems with the system?
- To what extent are investments in water and waste systems guided by concerns of climate change or take climate change into account?
- How did the city deal with the 2013 flood? How did the flood affect the various systems of the city?

Energy

Hydropower development has been under way in the province in recent years, with supply connecting to nearby Pursat and Battambang provinces. Demand is expected to increase with increasing development and economic activity.

Areas for further investigation in the situation analysis include:

- Conduct an overview of the energy generation, transmission and availability in the city
- What is/are the source(s) of energy?
- How has increased demand been taken into account?
- Has there been consideration of environmental impacts from the energy sources (e.g. hydropower)
- To what extent have climate change and climate-related events been considered in terms of their impacts on energy infrastructure?

Proposed schedule & activities

Date/time	**Activity**
27th March: Travelling and visiting urban slum	
Morning	Travelling to Battambang from Phnom Penh
Afternoon	Visiting urban slum
28th March: Battambang town	
9:00-10:30 am	Proposed meeting with Battambang Municipal Master Plan Team (land use, waste management)
10:30-12:00 am	Department of Public Work and Transportation
12:00-13:30 pm	Lunch and break
14:00-15:30 pm	Provincial office of Investment and International cooperation
16:00-17:30 pm	Provincial Department of Water Resource
29th March: Battambang town	
9:00-10:30 am	Provincial Water Supply , Battambang

11:00-12:00 am	Electricity du Cambodge, Battambang
12:00-13:30 pm	Break, lunch
14:00-15:30 pm	Department of Environment
16:00-17:00	Meeting with NGO working on waste management (CAMPET)
30th March: Visiting dumping site (Management and safeguarding)	
8:00-11:00 am	Visiting dumping site, interviewing local people, waste collectors
12:13:30 pm	Break and lunch
14:00 pm	Return back to Phnom Penh

Summary key persons/places met and visited
23-28 June 2016

Dates	Activities: meetings, place vistied
23 June 2016	• Travelling from Phnom Penh to Battambang (morning) • Afternoon: visiting key green space and public space of Battambang
24 June 2016	• Visiting Battambang municipal office and master plan office • Talking with finance office chief of Battambang Municipality • Meeting officer in charge of public work from master plan • Meeting with GIZ Staff who used to work on urban slum and later on moved to urban mappings.
25 June 2016	Visiting Toul Ta Koam village of Toul Taek Village, talking about urban slum, villager's livelihoods, and issue of resettlements (morning) Afternoon: • Reviewing some documents • Meeting NGOs working integrated rural development • Talking with former manager of COMPET NGO on urban slum waste recycled.
26 June 2016	Morning: • Visiting dump site (waste dumped site) • Follow up land speculation around dump sites, talking with local farmers and observing the current trend of development around dump site. • Observing waste collection at dump sites • Visiting ancient house (wooden house style and status). 102 years old. Afternoon: • Talking with village chief of Toul Taek north sites who stayed inside railway station land surrounded the lake. • Visiting ancient house built over last 120 years at Wat Kor commune and talking with house owners (the 3rd, 4th and 5th generation) who are currently living in the house.
27 June 2016	**Morning:** Meeting with Sangkat Chief of Prek Preah Sdach commune. **Afternoon** (lunch with former COMPET managers and GIZ technical

	staffs). Ask him about land use planning in each Sangkat: mostly what it is displayed on the wall (what about 11 slums communities recently established and all 8 villages in Prek Preah Sdach is effected by newly urbanization). Guideline on construction in each block.
28 June 2016	**Morning:** Meeting Cintri company (waste collection)