Doctoral Dissertation

Mainstreaming Climate Change Adaptation for Sustainable Urban Development in Developing Countries in Asia

アジアの開発途上国における持続可能な都市開発のための気候変動適応の主流化

March 2014

Major in Environmental and Functional Sciences

Graduate School of Science and Engineering

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Abstract

Rapid urbanization in developing countries in Asia is creating a number of challenges. Many of these cities are facing difficulties in providing basic infrastructure and services even to their current inhabitants, when urban population is growing. Climate change is added as a new challenge, with higher temperature, more intense and frequent rainfall, and sea-level rise, among others. Thus, in order to make development achievements effective and sustained, developing country cities need to adapt to climate change. This requires integration of climate change adaptation into development processes, which is commonly referred to as 'mainstreaming,' defined as integrating climate change adaptation into development planning, policies, strategies, and projects.

Despite a general agreement on the need for mainstreaming climate adaptation, there is limited research on how successful developing countries and their cities are in mainstreaming and why. This research, therefore, intends to answer four key questions: (i) to what extent are the developing countries in South and Southeast Asia successful in mainstreaming, by developing an analytical framework including factors affecting the success of mainstreaming; (ii) what is the progress of mainstreaming at city level, and what are the key factors in promoting mainstreaming; (iii) how is mainstreaming at project level taking place, and what considerations are needed to make the proposed adaptation measures robust under uncertainties; and (iv) what is the status of mainstreaming in a particular city; and how can the city make its development projects more effective and sustainable through mainstreaming? As to the last research question, flood management systems in Bangkok, Thailand, are analyzed in depth.

Based on a review of literature and characteristics of adaptation, an analytical framework, comprising six factors and two perspectives, for evaluating mainstreaming at country level, is proposed and applied to six least developed countries (LDCs) in South and Southeast Asia, namely Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic (PDR), Maldives, and Nepal. The analysis reveals that these countries have different levels of climate adaptation mainstreaming. Bangladesh is considered successful in mainstreaming, with their adaptation priorities well integrated into development plans, and the development priorities being discussed in the context of climate change adaptation. The level of mainstreaming in other countries is still limited (Lao PDR, Maldives, and Nepal) or minimal (Bhutan and Cambodia). Out of the proposed six factors that would determine the success of mainstreaming, the analysis reveals that four factors are closely associated with the overall level of mainstreaming: (i) coordination among relevant agencies, particularly between the environment ministry, and finance and/or planning ministries; (ii) recognition of the need for mainstreaming; (iii) monitoring and evaluation, and (iv) time compatibility between development plans and adaptation plans.

At city level, no comprehensive data are available to enable comparative analysis on the level of mainstreaming, particularly for developing country cities, but the relevant literature is rapidly growing. Some pioneer cities such as Durban, South Africa, initiated adaptation planning and implementation on their own, but many others, some of which are being

supported by development partners, are still in an early stage of planning or implementation of climate change adaptation. Review of the literature identified important determinants to advance mainstreaming, which include (i) a solid knowledge base on climate impact and vulnerability; (ii) leadership and championship; (iii) good governance of local governments; (iv) internal collaboration; and (v) existing problems linked with climate. There is high overall coherence among key factors affecting mainstreaming at country and city levels, accentuated by different approaches and priorities due to scales in question.

Mainstreaming at project level is often termed 'climate-proofing,' referring to the explicit consideration and internalization of climate change to deliver intended services of a proposed intervention at acceptable levels over the expected life of the intervention. Climate-proofing does not only mean adjustments in the infrastructure design, but also includes non-structural measures such as institutional and social interventions to ensure long-term service delivery. The review of the seven studies of climate-proofing in developing countries in Asia confirms that quantitative assessments based on downscaled climate projections and impact assessments could help identify adaptation measures with quantitative information on costs and benefits which would be useful for decision-making. Among the four criteria of effectiveness, efficiency, equity, and legitimacy proposed by Adger et al (2005) to evaluate successful adaptation, effectiveness and efficiency have been addressed well in the seven cases, while the assessments are generally weak in terms of consideration to equity and legitimacy. Moreover, the optimal engineering design derived from the assessment may not be robust to deep uncertainties, so an additional analysis becomes necessary.

To further verify effectiveness among the four criteria, another set of four criteria is derived from Hallegatte (2009): (i) no-regret, (ii) reversible and flexible, (iii) safety margins, and (iv) synergies among options. The proposed adaptation options for the improvement of water supply and urban drainage systems in Khulna, Bangladesh (two cases among the seven) are further analyzed to see if they meet these four criteria. While each adaptation option does not always meet all four criteria, consolidated measures as a whole meet all the criteria and are evaluated as robust to uncertainty. This highlights the need to review not only each option individually, but compatibility between options. Institutional arrangements to ensure collaboration among agencies concerned, with strong leadership and championship, would be a key to make mainstreaming happen in Khulna.

Bangkok, Thailand is studied for the last research question. Mainstreaming in Thailand is considered to be limited, by applying the above country-level framework. The level of mainstreaming in Bangkok is also found to be still limited. However, Bangkok Metropolitan Administration (BMA) initiated the process for developing a climate change master plan. Applying the five key factors for adaptation mainstreaming to Bangkok's status, the following aspects will need further attention: (i) preparing a risk assessment by integrating hazard, exposure, and vulnerability assessments to serve as a solid knowledge base; (ii) involving the public in consultations to solicit public support, ensure equity, and enhance legitimacy in the output; (iii) establish an effective internal collaboration system; and (iv) top-level support and commitment to climate change adaptation. If these issues are addressed adequately, the

development of a master plan could be a game changer in promoting mainstreaming in Bangkok.

An assessment of Bangkok's flood management systems, which is the biggest challenge in climate change adaptation in Bangkok, reveals that BMA is implementing key flood risk mitigation measures, and flood management and drainage infrastructure improvement intends to be strengthened to manage a flood equivalent to the devastating 2011 floods. However, no measures explicitly consider climate change, so there is a need to identify and carry out increments to each measure through climate-proofing. Too much focus on structural options needs to be balanced by putting in place more non-structural options that are compatible, such as land-use planning, building codes, and early warning systems, to make overall measures more robust under uncertainty. Institutional arrangements will require transformational adaptation, by establishing a collaborative mechanism among relevant departments in BMA under strong leadership.

The findings of the research will provide important insights on approaches and specific measures to be adopted by the governments of developing countries, their cities, as well as development partners in promoting and supporting the mainstreaming of climate change adaptation.

論文要旨

アジアの開発途上国における急速な都市化は、いくつもの問題をもたらしている。これらの多くの都市は現人口に対してさえ基礎的なインフラ･サービスを供給できていないが、これに加え、気温の上昇、より頻繁な豪雨、海面上昇等の気候変動による影響が新たな問題を作り出している。開発の成果･便益を効果的かつ持続的なものとするためには、途上国の都市は気候変動に適応(adaptation)する必要があり、そのためには、気候変動への考慮を開発の過程に統合する「主流化」(mainstreaming)が求められる。主流化は、気候変動への適応を、開発の計画、政策、戦略、プロジェクトに統合すること、と定義される。

気候変動への適応を主流化する必要性は広く認識されているが、開発途上国及びこれらの都市がどの程度主流化に成功しており、またその理由は何であるかについての研究はこれまで限られている。そのため、本論文は、以下の４つの問いに答えることを目的とした。(1)開発途上国では気候変動適応の主流化にどの程度成功しているか。分析方法を提案、適用することによって、主流化に重要な要因(factor)を導き出す。(2)都市レベルでの主流化の進捗状況はどうなっているか。主流化を進展させる上で重要な要因は何か。(3)プロジェクトレベルの主流化には、どのようなメリット、限界があるか。提案された適応策を、不確実性の下でより強固な(robust)ものにするためにはどのような配慮が必要か。(4)特定の都市及び開発プロジェクトにおける主流化の現状をケーススタディーとして取り上げ、主流化を通じ開発プロジェクトを更に効果的、持続可能なものとするために何が必要か。ケーススタディーでは、タイのバンコクにおける洪水管理システムについて詳細な検討を行う。

国レベルの主流化については、まず、既往の研究や各国政府の報告書等を幅広く分析し、気候変動への適応の特性を踏まえ主流化実現に重要な６つの要素と２つの評価の視点を抽出した。それに基づく分析方法を提案し、南アジア及び東南アジアの６つの低所得国（LDCs）（バングラデシュ、ブータン、カンボジア、ラオス、モルディブ、ネパール）に適用した。分析の結果、主流化の程度には大きな違いがあることが明らかになった。バングラデシュは主流化に成功し、適応の優先分野は開発計画に適切に取り込まれており、開発の優先分野は気候変動の適応の観点から議論されている。他方、他の国では主流化の程度は限定的（ラオス、モルディブ、ネパール）または低い（ブータン、カンボジア）と判断された。提案した６つの要素のなかでは、(1)関係機関間の協調、特に環境関連省庁と計画省/財務省との協調、(2)主流化の必要性の明示的認識、(3)実施状況のモニタリング･評価、(4)開発計画と適応計画との時間的整合性（作成のタイミング及び計画の対象期間）が重要であることを見い出した。

都市レベルの主流化については、特に途上国の都市に係るデータは限定されるが、本分野の文献は急速に増加している。そのため、既往文献のレビューにより現状を分析した。南アフリカのダーバンのように自ら適応計画の策定と実施に取り組んだ都市もあるが、多くの都市は援助ドナーの財政的、技術的支援を受けつつも、気候変動への適応の取り組みはまだ初期段階である。さらに、都市レベルの適応の主流化に重要な要因として、(1)気候変動の影響及び脆弱性(vulnerability)に関する十分な知見、(2)リーダーまたはチャンピオンの存在、(3)都市行政府によるよい統治(good governance)、(4)都市行政府内部の協力、(5)気候影響と関連する問題の存在、

が抽出された。これは、国と都市というスケールの違い、国レベルでは開発計画と適応計画が別途策定されているのに対し、途上国の都市レベルでは両者を統合した（適応を主流化した）計画策定の機会があるという状況の違いはあるものの、関係機関間の協力･協調の重要性、リーダーシップの必要性等の点で、国レベルで検討された要素とよく整合している。

プロジェクトレベルでの主流化は、通常クライメート・プルーフ(climate-proofing)と称され、「プロジェクトが、想定されるサービス供用期間に、受容可能なレベルのサービスを提供できるよう、気候変動の影響を明示的に内部化すること」と定義される。これは、長期的なサービスの提供を確実にするために、単にインフラの設計の修正にとどまらず、制度的、社会的等の非施設的な施策（ソフト施策）をも含むものである。アジアの開発途上国における７つのクライメート･プルーフの実例をレビューしたところ、気候予測及び影響評価に基づく評価により、具体的な適応策が定量的な費用や便益と共に明らかとなり、円滑な意思決定を支援しうることを確認した。Adger ら(2005)により提唱されている適応策を評価するための４つのクライテリアである効果(effectiveness)、効率(efficiency)、公平性(equity)、正当性(legitimacy)の観点から７つの実例を評価したところ、効果と効率についてはよく検討されているが、公平性、正当性については、これらの調査の主眼ではないこととも関連するが十分な検討は行われていなかった。さらに、検討の結果最適とされる工学的設計は、不確実性の下では必ずしも最適とは限らないため、追加的な分析が必要であることを示した。

４つのクライテリアのうち特に効果についての更なる検証のために、Hallegatte (2009)が提唱するクライテリアを踏まえ、４つのクライテリア、(1) 後悔しないこと(no-regret)、(2) 可逆性(reversible)、柔軟性(flexible)、(3)安全のための余裕(safety margin)、(4)適応策間のシナジー(synergies among options)、を選定し、(7 つの実例のうちの２つである)バングラデシュのクルナ市における上水と都市排水システムの改善のための適応策が、これらのクライテリアを満たしているかの検討を行った。この結果、個別の適応策は必ずしも４つのすべてを満たさないものの、適応策を統合的に実施すればすべてのクライテリアは満たされ、不確実性に対して柔軟に対応可能であると判断される。これは、適応策を個別に捉えるのではなく、適応策間の両立性を確認することの重要性を意味している。クルナ市では、適応策の実施を担当する関係機関間の協調のための実施体制の整備と、強いリーダーシップが、主流化を実際に達成するための鍵である。

最後に、都市レベルのケーススタディーとしてタイのバンコクにおける気候変動の主流化を検討した。国レベルの主流化については、上述した分析方法を適用し、タイにおける主流化は限定的であることを明らかにした。バンコクについても、主流化はまだ限定的であると判断された。しかし、バンコク都（BMA）は気候変動マスタープランの作成に着手しており、都市レベルの主流化に重要な５つの要因に照らして分析したところ、(1)ハザードや脆弱性に基づくリスク評価の実施、(2)市民からのサポート、公平性及び正当性を確保するためのコンサルテーションの実施、(3)効果的な内部協調の体制作り、(4)トップレベルの気候変動適応へのコミットメント、が十分に考慮されれば、マスタープラン作成は、主流化を前進させるための大きな変革につながると考えられる。

さらに、バンコクにおける気候変動適応の重要課題である洪水管理システムを分析したところ、BMA では、2011 年の大洪水と同程度の洪水に対処するための主要な対策を講じているものの、施策は気候変動への影響を明示的に考慮しておらず、各担当局が別個に関連なく実施していることが判明した。排水能力の向上等の構造物の施策（ハード施策）に重点が置かれすぎており、これらと両立するソフト施策、具体的には土地利用計画や建築基準、予警報システムの整備等とバランスさせることが、不確実性の下で全般的な対策を強固なものとするために必要である。組織体制については、変革的な適応(transformational adaptation)により、強いリーダーシップの下で、関係機関が協力するためのメカニズムを設定することが求められる。

以上を通して、当初掲げた研究目的を達成した。この成果は、開発途上国政府、都市行政府及び開発援助機関が気候変動への適応の主流化を促進及び支援する上でのアプローチや具体的施策に対し、重要な示唆を与えると考えられる。

List of Acronyms

ADB: Asian Development Bank

BCCSAP: Bangladesh Climate Change Strategy and Action Plan

BMA: Bangkok Metropolitan Administration

CBA: cost-benefit analysis

CIF: Climate Investment Fund

CLUP: comprehensive land use plan (Bangkok)

CoP: Conference of the Parties (of the UNFCCC)

DDS: Department of Drainage and Sewerage (BMA)

DoE: Department of Environment (BMA)

DSD: Department of Social Development (BMA)

GEF: Global Environment Facility

IPCC: Intergovernmental Panel on Climate Change

JICA: Japan International Cooperation Agency

LDC: Least Developed Country

LDCF: Least Developed Country Fund

LICs: low-income communities

M&E: monitoring and evaluation

NAPA: National Adaptation Programme of Action

NCCC: National Committee on Climate Change (Thailand)

NESDB: National Economic and Social Development Board (Thailand)

NESDP: National Economic and Social Development Plan (Thailand)

NSAPR: National Strategy for Accelerated Poverty Reduction (Bangladesh)

NSCCM: National Strategy on Climate Change Management (Thailand)

NSDP: National Strategic Development Plan (Cambodia)

ODA: Official Development Assistance

OECD: Organization for Economic Cooperation and Development

ONEP: Office of Natural Resources and Environmental Policy and Planning (Thailand)

PPCR: Pilot Program for Climate Resilience

PRSP: poverty reduction strategy paper

SFYP: Sixth Five Year Plan (Bangladesh)

SNDP: Seventh National Development Plan (Maldives)

SNSEDP: Seventh National Socio-Economic Development Plan (Lao PDR)

SPCR: Strategic Program for Climate Resilience

TFYP: Tenth Five Year Plan (Bhutan)

TYP: Three Year Plan (Nepal)

UN: United Nations

UNDP: United Nations Development Programme

UNFCCC: United Nations Framework Convention on Climate Change

UN-HABITAT: United Nations Human Settlements Programme

UNISDR: United Nations Office for Disaster Risk Reduction

Chapter 1: Introduction

1.1 Urbanization, and its challenges and opportunities

In 2008, for the first time in human history, more than half the world's population lived in urban areas (UN 2012). The proportion living in urban areas continues to grow, and is projected to reach 59.9% in 2030 and 67.2% in 2050. Nearly three quarters of the world's urban population lived in less developed regions in 2010, and Asia alone accounted for 51.9% of the total urban population in 2010. More than 90% of the world's urban population growth is currently taking place in developing countries. Among the regions, urban population growth in Asia is the second fastest after Africa in terms of growth rate, and by far the largest in absolute numbers. This rapid urbanization in developing countries, coupled with the increased intensity and frequency of adverse weather events, will have devastating effects on these countries, which also have lower capacities to deal with the consequences of climate change.

While the cause of urban-rural migration differs from country to country, better employment and education opportunities available in urban areas are often a major factor. Rapid urbanization in Asia is creating both opportunities and challenges. Key opportunities associated with large population and the concentration of people, buildings, and economic activities include economy of scale in providing basic infrastructure and services at a lower unit cost, investments in labor-intensive industry, and growth in the service industry. Urban areas also have a better potential in achieving more efficient economy although greenhouse gas (GHG) emissions from urban areas are estimated to be as high as 60-70% on a consumption basis (UN-HABITAT 2011).

On the other hand, urbanization in cities in low- and middle-income countries is creating serious challenges. First, many of these cities are facing difficulties in providing basic services such as water supply and sanitation, drainage systems, solid waste management, and transport, even to their current inhabitants. Very large deficits in infrastructure and services are further aggravated by increasing population. As the demand for housing, infrastructure, and services grows much faster than supply, development is forced in hazardous areas with inadequate construction materials and techniques. The rapid growth also often leads to urban slum expansion due to lack of adequate affordable housing, which may encroach upon natural flood and storm buffers. This will increase both the risk of and damages from disasters in urban areas: more people are exposed to a range of possible urban hazards such as flooding due to lack of hazard-removing infrastructure such as drainage systems; limited availability and poor quality of other infrastructure such as water supply and sanitation will aggravate their recovery from disasters; there is less state provision to help them cope, along with less legal and insurance protection; on the other hand, such settlements may block waterways, thereby reducing drainage capacity in other areas. Concentration of economic and industrial activities is also causing traffic congestion, urban heat islands, and local air, water, and noise pollution, which exacerbates public health risks.

Then a new challenge is climate change. Most cities in low-and middle-income countries face adaptation deficit; i.e., basic infrastructure and services are inadequate even under current climate conditions (Burton 2004; Parry et al. 2009). Higher temperature, more intense rainfall, sea-level rise (particularly relevant to coastal cities which are many in Asia), and a longer dry period, which will appear as a result of climate change and variability, will exacerbate deficits in basic infrastructure and services.

1.2 Cities' vulnerability to climate change

Vulnerability is defined as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC 2007). Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. In a recent publication of the Intergovernmental Panel on Climate Change (IPCC), it is simply defined as "the propensity or predisposition to be adversely affected" (IPCC 2012). In this paper, the old definition is used as it is more specific. There are three components to understand vulnerability: exposure, sensitivity, and adaptive capacity. Each term is further defined by IPCC (2007) as follows: Exposure is "the nature and degree to which a system is exposed to significant climatic variations"; sensitivity is "the degree to which a system is affected, either adversely or beneficially, by climate-related *stimuli*. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature), or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise)"; Adaptive capacity is "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."

While generalization of cities in developing countries in Asia is difficult, many cities are considered highly vulnerable to climate change: First, many large cities are located in coastal areas and exposed to impacts from sea–level rise and associated saline water intrusion. Many are also prone to extreme climate events such as cyclones and typhoons. More frequent and intense flooding is projected in many cities due to sea-level rise and/or increase in frequency and intensity of rainfall events. Moreover, in developing country cities, a large section of the urban population is living in informal housing, not regulated by land use controls and building standards. Smit and Wandel (2006) argue that exposure and sensitivity are almost inseparable properties of a system, and are dependent on the interaction between the characteristics of the system and on the attributes of the climate stimulus. Therefore, cities are faced with both high exposure and sensitivity. Hanson et al (2011) estimated the exposure of the world's large port cities (with populations greater than 1 million in 2005) to coastal flooding due to sea-level rise, storm surge, and land subsidence now and in the 2070s, taking scenarios of socio-economic and climate changes into account. In this analysis, many large cities in South and Southeast Asia are ranked high. Ten cities out of the top 20 are located in South or Southeast Asia, including the top three cities of Kolkata, India; Mumbai, India; and Dhaka, Bangladesh. Table 1-1 below presents the ranking of large cities in these regions in their analysis.

Table 1-1: List of large cities in South and Southeast Asia, and their salient features in relation to climate change[1]

City	Country	Population in 2010 (million)	Coastal city	Vulnerability factors	Major climate-related risks	Exposure ranking in Hanson et al (2011) (population exposed to coastal flooding in the 2070s)[2]
Bangkok	Thailand	6.97	X	Land subsidence	Sea-level rise Storm surge Floods	7
Chittagong	Bangladesh	4.96	X	Poor solid waste management Large slum population	Sea-level rise Floods Storm surge Landslides Cyclones	18
Delhi	India	22.16		Water scarcity Large slum population	Drought Floods Heat waves	--
Dhaka	Bangladesh	14.65	X	Land subsidence Large slum population	Floods	3
Ho Chi Minh City	Vietnam	6.17	X		Sea-level rise Floods Cyclones	5
Jakarta	Indonesia	9.21	X	Land subsidence	Sea-level rise Storm surge Floods	20
Karachi	Pakistan	13.13	X	Large slum population	Sea-level rise Floods Droughts Heat waves	--
Kolkata	India	15.55	X	Land subsidence Large slum population	Sea-level rise Floods Storm surge Cyclones	1
Manila	Philippines	11.63	X	Land subsidence	Floods	--
Mumbai	India	20.04	X	Large slum population	Sea-level rise Floods Cyclones	2
Yangon	Myanmar	4.35	X	N.A.	Sea-level rise	8

[1] All cities with a population of more than 4 million in the region are presented, except for India, where only the top three cities are presented.

[2] Two more cities in these regions are included in the top 20 ranking: Hai Phong, Vietnam ranked 10th, and Khulna, Bangladesh ranked 13th.

Source) Ahammad (2011); Alam and Rabbani (2007); Anwar (2012); de Sherbinin (2007), Firman et al (2011); Chapter 4, UN-HABITAT (2011); Hanson et al (2011); Haque et al (2012); Heinricks et al (2011); Storch and Downes (2011); Tanner et al (2009); World Bank (2011); modified by author
N.A. = not available.

Adaptive capacity is context- and area-specific, and dynamic (can change over time). At the local level, Smit and Wandel (2006) find that the adaptive capacity can be influenced by such factors as managerial ability, access to financial, technological, and information resources, infrastructure, the institutional environment within which adaptations occur, political influence, kinship networks, etc., by reviewing the various literature on the topic. Although quantification is not easy, most cities in developing countries in Asia generally have low managerial ability, limited access to financial, technological, and information resources, limited access to quality infrastructure, an undeveloped institutional setting, and poor enforcement of rules and regulations, which illustrate limited adaptation capacity. Adger and Vincent (2005) highlight the issue of uncertainty in determining adaptive capacity at different scales, and caution the use of an approach for measuring vulnerability through a single aggregate index. In short, adaptive capacity is generally low in these cities.

While there can be wide differences among developing country cities in South and Southeast Asia, it is reasonable to conclude that these cities are highly vulnerable to climate change because of high exposure and sensitivity, and low adaptive capacity. The degree of disparity between high- and low-income groups is an additional variability factor for cities, as the poorest are typically the hardest hit by natural disasters and least able to cope with a range of climate change impacts (UN-HABITAT 2011). Land subsidence has been noted in several megacities in these regions, caused by overexploitation of groundwater resources. This also negatively impacts cities from climate change, as this could damage pipelines and other infrastructure, and create similar effects as sea-level rise in low-lying cities. These vulnerable factors and climate-related risk of major cities are also summarized in Table 1-1 above.

1.3 Adaptation and resilience

In order to reduce vulnerability to climate change discussed above, cities need to adapt to climate change. Adaptation is defined by IPCC (2007) as “adjustment in natural or human systems in response to actual or expected climatic *stimuli* or their effects, which moderates harm or exploits beneficial opportunities.” Various types of adaptation can be distinguished, including anticipatory or proactive adaptation, referring to adaptation that takes place before impacts of climate change are observed; autonomous or spontaneous adaptation, meaning adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems; planned adaptation, which is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state; and reactive adaptation, referring to adaptation that takes place after impacts of climate change have been observed. Adapting to climate change requires strengthening resilience. Although it is usually considered to be the opposite of vulnerability,

resilience is defined by the IPCC (2012) as “the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.” Brown et al (2012) define resilience as “the capacity of an individual, community, or institution to dynamically and effectively respond to shifting climate circumstances while continuing to function at an acceptable level.” The concept of resilience includes the ability to resist, reduce, or withstand impacts as well as the ability to cope with the impacts and recover or bounce back, and if possible to ‘bounce forward’ to a more resilient state.

How to increase resilience and enhance sustainability in urban areas has become a central research topic and policy consideration, beyond the discussion of resilience to climate change alone. Leichenko (2011) broadly sort literatures on urban resilience into four categories: (i) urban ecological resilience, which draws upon traditional notions of ecosystem resilience and defines urban resilience as the ability of a city to absorb disturbance while retaining identity, structure, and key processes; (ii) urban hazards and disaster risk reduction, which focuses on enhancing the capacity of cities, infrastructure systems, and urban built environments to quickly and effectively recover from both natural and human-made hazards; (iii) resilience of urban and regional economies, which emphasizes the evolution of urban and regional economic and industrial systems; and (iv) promotion of resilience through urban governance, focusing on questions of how different types of institutional arrangements affect the resilience of local environments. He concludes that cities need to become resilient to a wider range of shock and stresses including climate change, and that diversity, flexibility, adaptive governance, and capacity for leaning and innovation are the key characteristics of resilient cities. He recommends that efforts to promote urban resilience need to be bundled with broader development policies and plans. This last point, often termed ‘mainstreaming,’ is particularly important in the context of developing countries, and is the main theme of this paper, as further discussed below.

1.4 Need for mainstreaming climate change adaptation

Governments in developing counties, at both national and local levels, have been making significant efforts in reducing poverty, improving education and health, and ensuring environmental sustainability under their own development plans, poverty reduction programs, and the Millennium Development Goals (MDGs) which were adopted by all United Nations Member States in 2000. Despite substantial progress made in many of these areas, the pursuit of providing better basic infrastructure and services such as water supply and sanitation, solid waste management, and drainage, continues to be the most important agenda for almost all the major developing country cities. The new agenda of adapting to climate change, or strengthening climate resilience, is, therefore, secondary in terms of their priority, unless specific considerations are made.

Increasing attention is being paid to the relationship between these two – poverty reduction and development through better infrastructure and services, and climate resilience: on

one hand, better infrastructure and services, better health and education of individuals, and higher financial resources available for individuals, communities, and governments, all generally contribute to higher resilience to climate change; however, if climate change impacts are not addressed properly, development efforts such as improved infrastructure and services may make these cities more vulnerable and less resilient, often termed 'maladaptation.' Maladaptation is defined as "any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead." It refers to development measures that deliver short-term benefits or economic gains but lead to greater vulnerability in the medium to long-term, such as the construction of hard infrastructure that may reduce flexibility and the range of future adaptation options. An example is improvement of storm-water drainage systems by building higher embankments, which leads to development of flood-prone areas, however they should be kept as flood plains to cope with more intense rainfall events caused by climate change and variability. Such interventions may make downstream population more vulnerable. Adaptation efforts aimed at armoring the coastline may result in coastal erosion elsewhere. Barnett and O'Neil (2010) identified five distinct types or pathways through which maladaptation arises; namely actions that relative to alternatives: (i) increase emissions of greenhouse gases, (ii) disproportionately burden the most vulnerable, (iii) have high opportunity costs, (iv) reduce incentives to adapt, and (v) set paths that limit the choices available to future generations, by using a case of a desalination plant to improve water supply in Melbourne, Australia. Another risk is that climate change may make development interventions less effective and unsustainable: when the lifespan of a decision, policy, or measure including infrastructure development, has implications for multiple decades, intended benefits may be cut short by climate change. For example, sanitation facilities constructed in a low-lying area without considering climate change may become unusable due to waterlogging before its intended service life expires. Roads constructed in accordance with current design standards may deteriorate quickly due to high temperature, and more intense and frequent rainfall caused by climate change.

In order not to undermine hard-earned development achievements and ensure sustainable development, it is essential to take adaptation to climate change into account. This requires integration of climate adaptation into development processes. It is commonly referred to as 'mainstreaming,' defined as **integrating climate change adaptation into development planning, policies, strategies, and projects** (based on UNFCCC 2002; OECD 2006; Lasco et al 2009). At the planning level, for example, "mainstreaming refers to the integration of objectives, policies, strategies or measures in an adaptation plan such that they become part and parcel of national and regional development policies, processes, and budgets at all levels and at all stages, and such that they complement or advance the broader objectives of poverty reduction and sustainable development" (UNFCCC 2002).

A question may be raised as to the relative merits of approaches that develop stand-alone urban climate change plans for adaptation or strengthening climate resilience, and those that seek to promote mainstreaming and integrating climate change issues into a broader range of urban planning mechanisms (Romero-Lankao and Dodman 2011). Stand-alone urban adaptation policies and/or strategies have been prepared in a number of cities in developed

countries, as represented by New York and London (Hunt and Watkiss 2011). However, there is general consensus that the latter approach – mainstreaming climate considerations into development planning systems – is more effective particularly in developing countries (e.g., Kithiia and Dowling 2010, UN-HABITAT 2011, UNDP and UNEP 2011, Sharma and Tomar 2010). This is because of large development deficits, often termed 'adaptation deficits,' meaning that the current infrastructure and systems are not well adapted to the risks posed by the current climate in developing country cities. In these cities, adaptation itself is not regarded as a major agenda for both local governments and communities. The overall development and poverty reduction programs are and should be the center of concerns. Therefore, without mainstreaming, adaptation will remain a peripheral exercise and will not be effectively implemented.

1.5 Research objectives

Mainstreaming climate change adaptation into development planning, policies, and projects is essential for sustainable development in developing countries which are rapidly urbanizing. Despite a general agreement on the need for mainstreaming adaptation to climate change, there is limited research on how successful developing countries and their cities are in mainstreaming, and what factors are affecting the level of success. Therefore, the research analyzes the degree of mainstreaming at three levels; country, city, and project. The research intends to answer the following four key research questions with regard to mainstreaming of climate change adaptation in developing countries in South and Southeast Asia:

(1) To what extent are these countries successful in mainstreaming? What framework is appropriate to measure the success of mainstreaming, and what are the key factors that affect the level of mainstreaming? (Chapter 2)

(2) What is the progress of mainstreaming at city level? What are the key factors in promoting mainstreaming? What are the commonalities and differences between the key factors at country level and those at city level? (Chapter 3)

(3) How is mainstreaming at project level taking place? What are the advantages and challenges of mainstreaming at project level? What considerations are needed to make the proposed adaptation measures robust under uncertainties? (Chapter 4)

(4) What is the level of mainstreaming in a particular city in this region? Is adaptation to climate change taken into account in development planning and design of development projects? If so, are the proposed measures and designs appropriate? How can the city make its development projects more effective and sustainable through mainstreaming? (Chapter 5)

1.6 Research methodology

A flowchart of the research is presented in Figure 1-1, and the methodology adopted in each Chapter is summarized in Table 1-2, followed by details.

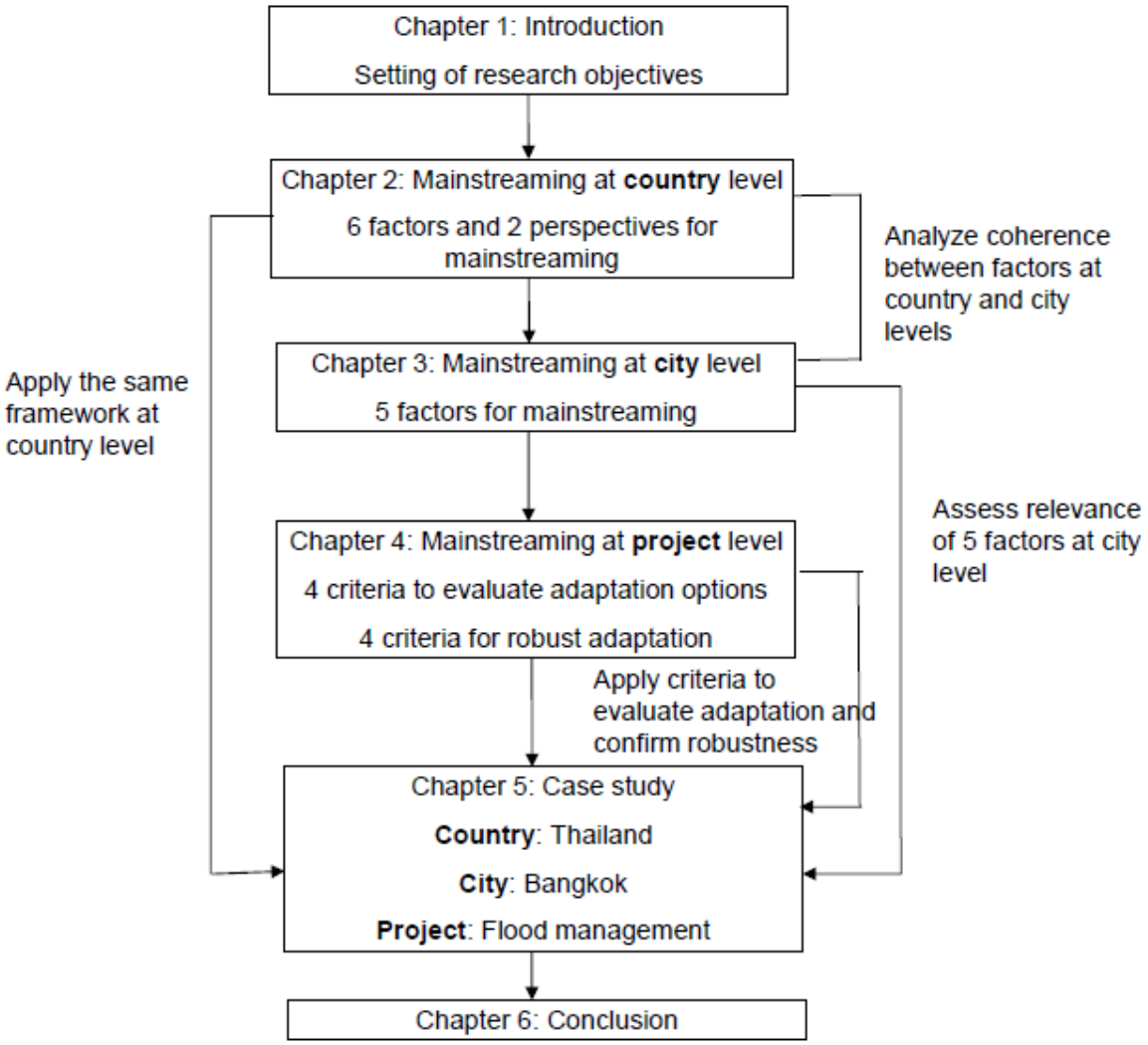

Figure 1-1: Research Flow

Table 1-2: Methodology

C	Key issues	Framework	Methodology	Key features
2	Mainstreaming at country level	1. Develop an analytical framework (six factors and two perspectives) for rating 2. Apply the framework and evaluate the level of mainstreaming	• Analysis of documents endorsed by governments by using a rating method • Literature review • Interviews with government officials	Review of core documents: NAPAs, SPCRs, and development plans
3	Mainstreaming	1. Develop key factors	Literature review	Review of

	at city level			literature cited in the reference
4	Mainstreaming at project level	1. Apply the criteria proposed by Adger et al (2005) to see advantages and challenges of climate-proofing 2. Apply the criteria deriving from Hallegatte (2009) to see robustness under uncertainty	• Review of literature/documents • Interviews with relevant agencies and field observations	Field assessment and observations in Khulna in 2009-2011*
5	Case study	1. Apply the framework developed in C.2 to assess Thailand's mainstreaming 2. Apply the key factors developed in C.3 to assess Bangkok's mainstreaming 3. Identify key flood management measures in Bangkok 4. Apply the criteria used in C.4 to flood management in Bangkok	• Analysis of documents endorsed by the central government by using a rating method • Review of documents issued by the local government • Literature review • Interviews with government officials and resource personnel	Interviews held in June 2012, September 2012, June 2013, and December 2013

* Through implementing a technical assistance project of the Asian Development Bank (ADB), which includes discussion of adaptation options with various government agencies.
C = Chapter, NAPA = National Adaptation Programme of Action, SPCR = Strategic Program for Climate Resilience.

First, in Chapter 2, the research assesses the level of mainstreaming at country level, and analyzes factors that affect the level of mainstreaming by reviewing both development and adaptation plans in six least developed countries (LDCs) in South and Southeast Asia: Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic (PDR), the Maldives, and Nepal. The reason for selecting LDCs is because LDCs have been given an opportunity to develop a National Adaptation Programme of Action (NAPA) due to their limited ability to adapt to the adverse effects of climate change. NAPAs provide a process for them to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change. The United Nations Framework Convention on Climate Change (UNFCCC) funds the preparation and implementation of NAPAs through its LDC Fund. Therefore, the LDCs have a formal document on climate change adaptation endorsed by the government and submitted to the UNFCCC secretariat, which enables an effective comparative analysis. The analysis focuses on South and Southeast Asia because of high vulnerability of the countries in the region to climate change, data availability, and the author's familiarity and understanding of the region.

Much of the literature stresses the need to address 'mainstreaming' or 'integrating' climate change adaptation into development plans, policies, and projects, but how the developing countries have advanced in their efforts in mainstreaming has not been well analyzed. Since no framework exists in making such an assessment, an analytical framework for evaluation, comprising six factors and two perspectives, is first developed. As detailed in Section 2.4, the six factors that could influence the level of mainstreaming are identified by reviewing salient features of adaptation and the literature, and then applied to the above six

countries. This demonstrates which factors among the six are closely associated with the level of success in mainstreaming in the six countries. The level of mainstreaming is likely different from country to country, and identifying factors that affect the level of mainstreaming will provide important insights on how they should further mainstreaming.

Three documents are the focus of the analysis in this Chapter, namely, NAPAs, development plans, and the Strategic Program for Climate Resilience (SPCR). First, as mentioned above, a NAPA is the most important document on climate change adaptation in LDCs. It is developed through inclusive and participatory processes, and driven and formally approved by the government. "Annotated guidelines for the preparation of NAPAs" (hereinafter referred to as the "Guidelines") (UNFCCC 2002) have been prepared by the LDC Expert Group under the UNFCCC, which specify the objectives, characteristics, process for development, and structure of NAPA documents, among others.[3] Second, these countries have established a system for formulating national development plans, which are the key guiding document for the country's medium-term development. Third, the SPCR is developed under the Pilot Program for Climate Resilience (PPCR) of the Strategic Climate Fund established as part of the Multi-donor Climate Investment Funds (CIF). While NAPAs are intended to identify urgent and priority adaptation projects, the PPCR was created in consideration of a need to integrate climate resilience into development planning and financing. The PPCR is designed to be country-led and country-driven (just like NAPA), to build upon national development plans, NAPA, and other relevant country studies and strategies, and help countries move beyond the project stage to the programmatic level (CIF 2009). The SPCR, which includes an underlying investment program, is the output of the first phase of the PPCR; the PPCR's second phase is to support the implementation of the SPCR. Nine countries and two sub-regions (the Pacific and Caribbean) have been selected under the PPCR, which includes Bangladesh, Cambodia, and Nepal from South and Southeast Asia. Therefore, these three documents are the most important documents to analyze climate adaptation mainstreaming at the country level. The analysis is augmented by a literature review and interviews with government officials in these countries.

Second, in Chapter 3, the research identifies five key factors in promoting climate adaptation mainstreaming at city level. A city-level analysis on mainstreaming is limited to date, particularly for developing country cities, due to paucity of climate adaptation plans or development plans that have incorporated climate adaptation considerations. However, adaptation in cities or urban areas is an emerging policy domain and the literature is rapidly growing. This Chapter is based on a review of the literature. Discussion is made of commonalities and differences between the factors affecting the level of mainstreaming at country level and those at city level.

Third, in Chapter 4, examples of mainstreaming at project level are reviewed to assess effectiveness and robustness of adaptation options. Considering the existing infrastructure deficits in most developing country cities, there is an urgent need to improve basic infrastructure

[3] The structure of a NAPA document comprises (i) introduction and setting, (ii) framework for adaptation program, (iii) identification of key adaptation needs, (iv) criteria for selecting priority activities, (v) list of priority projects, and (vi) NAPA preparation process.

and services. In order to ensure that the long-term investment effectively generates benefits over its service life, it is imperative that these projects take account of future climate impacts in their design, usually called 'climate-proofing.' The definition of climate-proofing and methodologies for application are discussed before reviewing seven cases in the region (urban floods in Bangkok, Thailand; urban floods in Ho Chi Minh City, Vietnam; urban floods in Manila, Philippines; urban floods and water supply in Khulna, Bangladesh; inland monsoon floods and cyclones in Bangladesh). Then, advantages, challenges and limitations of these cases are assessed by using the four criteria proposed by Adger et al (2005): effectiveness, efficiency, equity, and legitimacy. As one key weakness of the approach is inadequate consideration to the issue of deep uncertainty associated with climate change, further analyses are conducted to see the robustness of proposed adaptation options for urban floods and water supply systems in Khulna. Another set of four criteria, derived from Hallegatte (2009), is used to assess robustness, which is a key element of effectiveness. While the Chapter is largely based on the literature review, the author's hands-on knowledge and experience in Khulna supplement the assessment.

In Chapter 5, Bangkok, Thailand, is selected for a case study of a specific city in this region. Although each city varies with different background and progress for mainstreaming, Bangkok is considered a representative coastal megacity in the region with large and growing population. Lessons and experience learned from Bangkok will likely be highly relevant to other megacities in the region. Data availability, augmented by the author's long-term experience and relationship with the city government and understanding of the local language (Thai), enables a detailed analysis in Bangkok. Progress of climate adaptation mainstreaming in Thailand is first reviewed by applying the same evaluation framework proposed in Chapter 2. Status of mainstreaming in Bangkok is then analyzed, based on the key factors identified in Chapter 3. As flooding is the most serious climate-related risk in Bangkok, an analysis is made to see whether climate adaptation is mainstreamed in the flood management measures. The assessment further discusses whether such measures are effective and robust, adopting the review framework from Chapter 4. This reveals strengths and weaknesses of climate adaptation in Bangkok. Based on the assessment, discussion will be made as to how to strengthen flood management systems through adaptation mainstreaming. For Chapter 5, interviews with officials of central and local governments, experts working on climate change adaptation in Bangkok (such as academia), and development partners, were conducted in 2012-2013 to cross-check the findings and recommendations of the literature and other authorized documents, as well as fine-tune and strengthen the analysis and conclusion of the research.

In the concluding chapter, Chapter 6, key findings to these research questions are summarized, and key policy recommendations are given for promoting climate adaptation mainstreaming in developing countries and their cities as well as development partners.

1.7 Concepts and terminology related to adaptation

Various concepts and terminology are summarized below, which would be useful to avoid misunderstanding in subsequent discussions.

Although there is no consensus, a categorization often used is structural and non-structural adaptation options. They are also called hard and soft measures. Structural options can be further classified into engineering, technological, ecosystem-based adaptation, and services. Non-structural measures have two sub-categories: institutional and social. These are presented in Table 1-3 below.

Table 1-3: Categories and examples of adaptation options

Category	Sub-category		Examples of options
Structural	Engineering		Flood walls, water storage, improved drainage, beach nourishment, flood shelters, infrastructure upgrading
	Technological		New crop varieties, efficient irrigation , adjusted planting, home insulation
	Ecosystem-based		Wetland re-establishment, mangrove reforestation
	Services		Cleaning drains, mosquito nets, insecticide sprays
Non-structural	Institutional	Economic	Taxes and subsidies, insurance
		Laws and regulations	Land use plans, zoning regulations, building standards
		Policies and programs	Groundwater management, emergency planning
	Social	Educational	Awareness raising
		Informational	Early warning systems
		Behavioral	Water conservation, evacuation planning

Source) Carmin et al. forthcoming, modified by author

Another classification of adaptation options is by nature or characteristics. No- or low-regret options are often recommended in the selection of adaptation options, which draw on measures that minimize costs and support existing or complementary goals that would create benefits even if climate change impacts are not as significant as projected. Co-benefits or win-win options refer to measures that both reduce climate risks and provide other social, economic, or environmental benefits. No-regret options usually bring co-benefits, because 'no-regret' implies other benefits irrespective of future climate change. Other characteristics of adaptation measures include reversible and flexible options, and options with safety margin, referring to applying additional free board to the design of the option. These will be further clarified in Chapter 4.

In terms of strategies for implementing adaptation options, adaptive management refers to a strategy that places emphasis on taking action incrementally, by taking the lessons learned and additional information obtained through monitoring into account, and thus enables us to make better-informed decisions in the face of uncertainty. Transformative or transformational adaptation has recently come to the fore, as incremental adaptation may not be sufficient due to large vulnerability and severe climate change that overwhelms the existing human systems. Transformation refers to changes in the fundamental attributes of a system, often based on

altered paradigms, goals, or values. Transformations can occur in technological or biological systems, financial structures, and regulatory, legislative, or administrative regimes.

Actors in adaptation include (i) international organizations, (ii) national governments, (iii) regional/state governments, (iv) local governments, (v) civil society organizations (CSOs) and nongovernment organizations (NGOs), (vi) local communities, (vii) households, and (viii) the private sector. Among them, local governments play a critical role in adaptation, as climate change affects service delivery at the local level. Generally speaking, as discussed further in Chapter 3, governmental engagement in planning and implementation is higher in developed countries. Local governments in developing countries, on the other hand, are faced with numerous challenges that limit their capacity to act on adaptation, because of financial constraints and lack of qualified officials. This makes engagement of CSOs and NGOs, communities, and households more important in developing countries. Community-based adaptation is often characterized by the engagement of local residents to identify and implement measures that can reduce vulnerability and strengthen resilience, while building local adaptation capacity. It is important to note, however, that community-based adaptation, a bottom-up approach, does not negate or create conflict with adaptation by local governments, a top-down approach, and that synergies between the two need to be sought.

It is in this context that this paper analyzes adaptation mainstreaming at three layers. National governments are the highest body to drive and act on mainstreaming on their own (Chapter 2). International organizations may guide, catalyze, and support mainstreaming of other bodies, but are not a party to execute and implement mainstreaming. Local governments, as discussed above, are a key player in adapting to climate change, as impacts are felt and actions need to be taken at the local level (Chapter 3). City governments are the focus of the study, due to the importance of urban areas arising from rapid urbanization and their central role in a country's development, as outlined in this Chapter. Sustainable urban development will not be possible without adaptation mainstreaming in city governments. Actions by city governments are normally implemented in the form of projects, which makes mainstreaming at the project level all the more important (Chapters 4 and 5). Successful mainstreaming at the three layers is expected to significantly contribute to sustainable urban development, by making policy, planning, and project interventions more effective, resilient, and robust. There are other important agents in adaptation, including communities and CSOs/NGOs. But their adaptation initiatives, in particular community-based adaptation, are widely and intensively discussed in the literature, and not analyzed further in this paper.

Chapter 2: Climate adaptation mainstreaming at country level: least developed countries in Southeast and South Asia

2.1 Introduction

It has been increasingly recognized that climate change will adversely affect development and poverty reduction efforts being made by developing countries, and that strengthening resilience through adaptation measures is essential to ensure that development achievements are not compromised or negated by climate change. Adaptation means "adjustment in natural or human systems in response to actual or expected climatic *stimuli* or their effects, which moderates harm or exploits beneficial opportunities" according to the IPCC (IPCC 2007). Adaptation to climate change needs to be integrated properly into national development plans, or in other words, 'mainstreamed', to be meaningful and effective.

The annotated guidelines (the "Guidelines") for the preparation of National Adaptation Programmes of Action (NAPAs) (UNFCCC 2002) stress the importance of mainstreaming NAPAs, and state that "mainstreaming refers to the integration of objectives, policies, strategies or measures outlined within a NAPA such that they become part and parcel of national and regional development policies, processes and budgets at all levels and at all stages, and such that they complement or advance the broader objectives of poverty reduction and sustainable development." In this research, the word 'mainstreaming' is defined as above, while it is used interchangeably with 'integration.'

The objective of this Chapter is to assess the level of mainstreaming and analyze factors that affect the level of mainstreaming in least developed countries (LDCs) in South and Southeast Asia: while there are eight LDCs in these regions, all six countries where relevant information is available for a meaningful assessment are selected for the study; namely, Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic (PDR), the Maldives, and Nepal.[4] All these countries successfully developed NAPAs in 2005-2010. Bangladesh, Cambodia, and Nepal have been selected for the Pilot Program for Climate Resilience (PPCR), and they developed the Strategic Programs for Climate Resilience (SPCRs) in 2010-2011.[5] Since there is no established framework to measure the level of mainstreaming, the research proposes an analytical framework that comprises six factors that could affect the advancement of mainstreaming, and two perspectives demonstrating the success of mainstreaming. Application of this framework to the six countries provides insights on the usability of the framework, and reveals which factors are more important than others in mainstreaming. The analysis further shows us how NAPAs can be strengthened in facilitating mainstreaming.

[4] The two LDCs that are not covered in this paper are Afghanistan and Myanmar. Afghanistan is still in the process of its national building, while Myanmar just resumed engagement with the international community. Nevertheless, Afghanistan developed its NAPA in 2009, and Myanmar submitted its NAPA in May 2013 to UNFCCC.

[5] The PPCR is directly linked with large-scale funding under the CIF; the range of funding agreed for a single country pilot program is $40-50 million in grant resources and 75% of the grant amount in concessional loans, both depending upon availability of resources.

2.2 State of mainstreaming and research gaps

Much of the literature stresses the need to address 'mainstreaming' or 'integrating' climate change adaptation into development policies (e.g., Kok and de Coninck 2007; Lasco et al. 2009; Richardson et al. 2011). The Guidelines stress that "if a NAPA is not relevant to a country's immediate development priorities, there is a higher probability that it will remain a peripheral exercise and that its results will not be given serious consideration during national development planning processes." The Guidelines acknowledge the challenge of mainstreaming, and call for efforts in the fields of (i) engaging other development sectors, particularly ministries and agencies responsible for national development such as planning and/or finance ministries; (ii) raising awareness from a scientific and socioeconomic perspective of the implications of climate change; and (iii) developing the capacity of government agencies and civil society organizations to implement adaptation efforts.

However, the progress of mainstreaming in developing countries has been limited to date (Chuku 2010; Hardee and Mutunga 2009; Huq et al. 2003; Lasco et al. 2009; Persson 2008; Prowse et al. 2009; UNDP 2009). The status of linkage between climate change adaptation and national development plans is well documented in Hardee and Mutunga (2009). Their review of 41 NAPAs reveals that NAPAs and national development plans are not well aligned. The authors point out that all the documents have a section on the link between the two, but a clear link is not actually demonstrated in 76% of NAPAs reviewed. They stress that a consensus is emerging on the disconnect between national development plans or poverty reduction strategies and NAPAs, and that the disconnect is due to (i) the difference in time-scale between development plans and NAPAs, with the former taking a longer-term perspective and the latter being more action-oriented and short-term; and (ii) the leadership of different ministries in formulating the development plans and NAPAs, with the former led by ministries of finance or planning, and the latter led by the environment ministry. Similarly, focus on short-term actions and lack of a strategic approach is cited as one of the main shortcomings of NAPAs in the Human Development Report of the United Nations Development Programme (UNDP 2008).

Another analysis made by the UNDP (2009) similarly concludes that the link between NAPAs and national development strategies or poverty reduction strategy papers (PRSPs) often holds very little content, by reviewing 38 NAPAs completed up to November 2008. It points out that a challenge of building the technical, analytical, and institutional capacity that is needed for integrating climate change risks and opportunities into national development planning is not well recognized in NAPAs. Prowse et al (2009) also conclude that most PRSPs and national development strategies (NDSs) ignore climate change issues almost entirely by reviewing 15 PRSPs/NDSs and 11 climate change adaptation policy frameworks. Bangladesh, however, was identified as a clear outlier to the above conclusion, and cited as the one clear success story in integrating climate change in its PRSP. While most studies did not focus on Asia, Lasco et al (2009) assessed progress in the Philippines and conclude that there is no mainstreaming there.

The need for mainstreaming climate change adaptation in development assistance is also increasingly recognized (Sietz et al. 2011), as manifested in the 2006 Organization for Economic Cooperation and Development (OECD) Declaration on Integrating Climate Change

Adaptation into Development Cooperation (OECD 2006). Following the declaration, OECD (2009) issued policy guidance on identifying appropriate approaches for integrating climate adaptation into development policies.

NAPAs have been prepared for all the 50 LDCs by November 2013, out of which 33 countries are in Africa. Therefore, review of NAPAs is generally skewed towards practices and trends in Africa (e.g., Osman-Elasha and Downing 2007). Moreover, the past studies entailed a review of either a large number (more than 10) of countries or only one country, without undertaking a cross-country comparison in the level of mainstreaming based on an in-depth review. The SPCRs were invented to address weaknesses of NAPAs, by adopting a medium-term programmatic approach and strengthening the link with external funding, but the experience of developing SPCRs has not been reviewed to date. In short, there is still limited research on the level of mainstreaming and the factors that promote successful mainstreaming in developing countries (Lasco et al. 2009). This paper attempts to address the research gaps above, by (i) focusing on LDCs in South and Southeast Asia; (ii) undertaking an in-depth analysis for cross-country comparison; (iii) reviewing both NAPAs and SPCRs where available; and (iv) analyzing the level of mainstreaming by developing and applying an analytical framework that includes factors that may affect the level of mainstreaming.

2.3 Methodology

An assessment was undertaken for six LDCs in South and Southeast Asia. Both the NAPAs and national development plans, as well as the SPCRs of three countries (Bangladesh, Cambodia, and Nepal), were reviewed to see the extent to which adaptation priorities have been integrated in the development plan of the country. Table 2-1 shows the key documents reviewed in the assessment.

Table 2-1 Key documents reviewed in the assessment

Country	NAPA Month/year of publication	National development plan		SPCR and other key documents reviewed and their publication Month/year
		Title	Month/year of publication	
Bangladesh	November 2005 (updated in August 2009)	National Strategy for Accelerated Poverty Reduction II (FY 2009-2011); Sixth Five Year Plan (2011-2015)	October 2008 July 2011	SPCR (November 2010) BCCSAP (2008) (updated in 2009)
Bhutan	May 2006	Tenth Five Year Plan (2008-2013)	2008	N.A.
Cambodia	October 2006	National Strategic Development Plan Update (2009-2013) Rectangular Strategy for Growth, Employment, Equity and Efficiency Phase II	November 2009 September 2008	SPCR (June 2011)
Lao PDR	April 2009	Sixth National Socio-Economic Development Plan (2006-2010);	October 2006	Strategy on Climate Change (2010)

		Seventh National Socio-Economic Development Plan (2011-2015)	October 2011	
Maldives	March 2008 (completed in end 2006)	Seventh National Development Plan (2006-2010)	2007	N.A.
Nepal	September 2010	Three Year Plan Approach Paper (2010/11-2012/13)	August 2010	SPCR (June 2011) Climate Change Policy (January 2011)

BCCSAP = Bangladesh Climate Change Strategy and Action Plan, FY = fiscal year, N.A. = not applicable, NAPA = National Adaptation Programme of Action, PDR = People's Democratic Republic, SPCR = Strategic Program for Climate Resilience.

In undertaking the assessment, relevant documents with respect to mainstreaming and adaptation actions of the six countries were reviewed to supplement and triangulate the information provided in these key documents, which was supplemented by a few interviews with officials of the environment ministry. Due to the nature of the study, which mostly relied on the documentation that is publicly available, several limitations surfaced. First, the documentation and the real situation on the ground could be significantly different. For example, coordination and the recognition of the need for mainstreaming may be stressed in the documents, even if no meaningful actions are actually taken. Secondly, the analysis did not take account of the capacity of key stakeholders to effectively implement the plans. Even when the same plans are prepared, the progress of implementation would be significantly different from one country to another due to the implementation capacity. The third constraint is the frequency of updating adaptation plans and national development plans. They are usually updated only once every 3-5 years, so the analysis may be outdated for some countries, and would tend to favor countries that develop these plans more recently. Lastly, although an intensive literature search and supplementary interviews were made, important facts that would affect the rating and overall judgment might have been missed out.

2.4 Analytical framework to evaluate mainstreaming

To date, no assessment framework is available for measuring the success of mainstreaming. Although different factors are highlighted in different research articles (as reviewed in Section 2.2 above), there is no standard set of factors that are considered most important in affecting the success of mainstreaming. Therefore, it is important first to identify factors which could determine the success of mainstreaming efforts, by reviewing the literature and assessing characteristics of climate change adaptation. How the factors are derived is presented in Figure 2-1 and explained below.

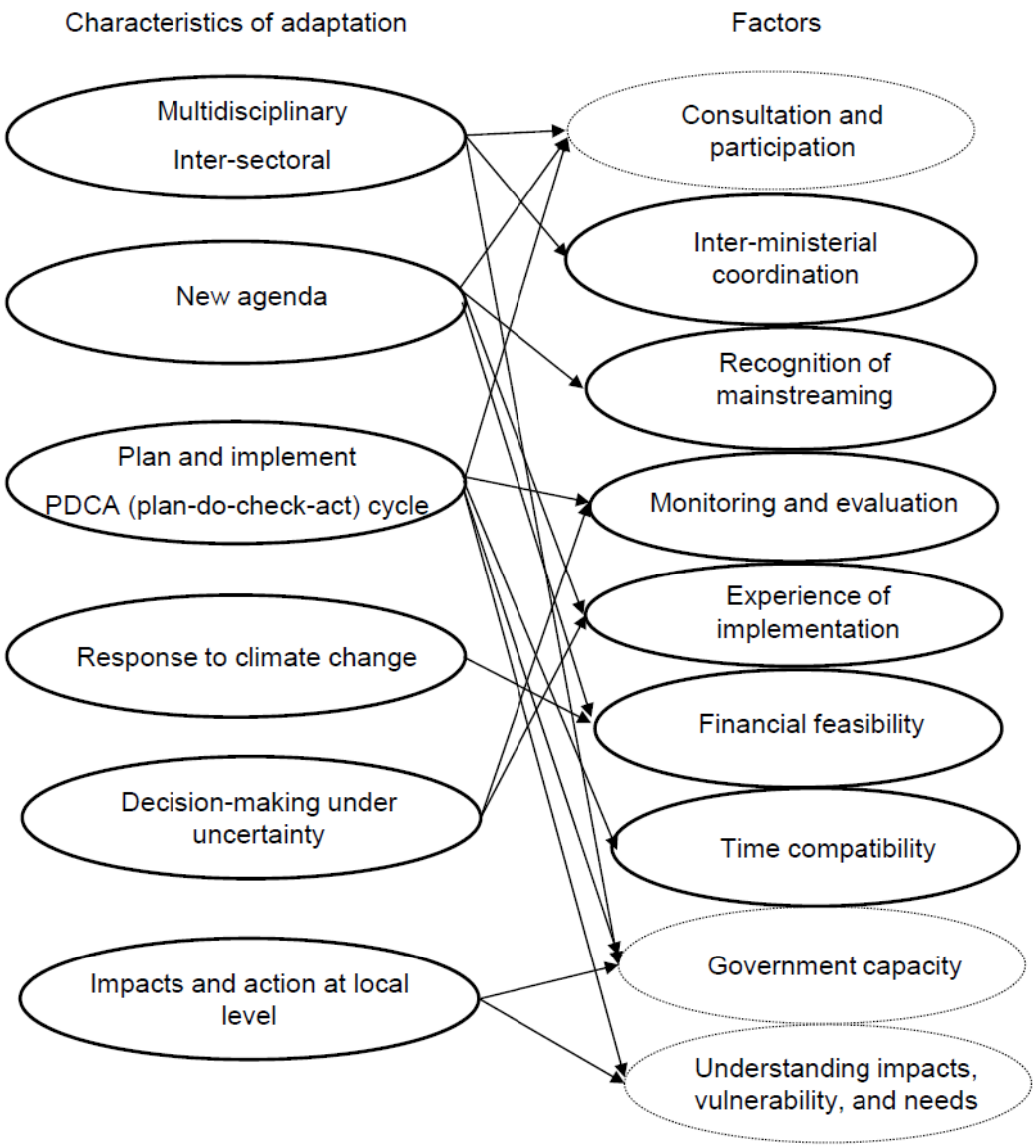

Figure 2-1: Characteristics of adaptation and important factors (six factors are shown in bold lines)

Characteristics and main features of climate change adaptation are discussed in a number of documents, including UNFCCC (2002), Adger et al (2005), Adger et al (2007), OECD (2009), and UN-HABITAT (2011), among others. Based on the literature, six main characteristics are considered particularly important, which are: (i) climate change adaptation is multidisciplinary, (ii) it is a new development agenda, (iii) it needs good planning followed by implementation, (iv) it is a response to climate change, (v) it requires decision-making under uncertainty, and (vi) its impacts are observed and actions are required at local level. From these characteristics, relevant factors that would affect the level of mainstreaming can be derived.

Adapting to climate change is cross-sectoral and multidisciplinary, going beyond responsibilities of any single conventional ministry or government agency. This requires inter-ministerial coordination supported by the highest levels of government, shortly termed

coordination (first factor). As cited in much of the literature on adaptation (OECD 2009; Sietz et al. 2011; UNFCCC 2002), it is critical to involve key ministries for national development, such as the finance and/or planning ministries, in adaptation planning so that adaptation is recognized as a country's priority. Support from the highest levels of government, or political will, is also an important factor to ensure adaptation is institutionally mainstreamed and adaptation activities receive necessary budgets (Kalame et al. 2011). In the assessment, the level of coordination among ministries and departments, involvement of key ministries, and engagement of government's top leaders are inferred from the approved documents.

Adapting to climate change is a new policy agenda. This requires the recognition of mainstreaming in the government's development agenda (second factor). Without explicitly recognizing the need, mainstreaming would remain a challenge because the government is preoccupied with other pressing development needs such as poverty reduction. Countries tend to continue business-as-usual practices unless the need for mainstreaming is prioritized. This is assessed if a national development plan, NAPA, or SPCR explicitly prioritizes mainstreaming. Being a new agenda, countries need to learn from piloting. NAPAs are new to any country, and lesson-learning through implementation, or leaning-by-doing, would help promote mainstreaming (third factor). Although adaptation in the context of developing countries is not fundamentally different from development, as reviewed in Chapter 1, adaptation requires a shift in priority setting. An adaptation lens provides an opportunity to revisit development interventions to focus more on climate-vulnerable poor (Ayers and Huq 2013). Experience of implementation is measured by the duration of NAPA implementation, as well as demonstrated by evidence of project/program implementation.

Another feature of adaptation, through a NAPA, is that the implementation follows the standard development planning and implementation processes. Therefore, it needs to have a solid institutional framework of monitoring and evaluation (M&E) (fourth factor). The planning process itself was supported by the LDC Fund under the UNFCCC, but the M&E is an important element to ensure implementation of the plan, without which poor implementation could go unnoticed. Importance of an implementation framework and M&E is recognized in past studies (Kalame et al. 2011; UNDP 2009, Lamhauge et al 2012). The evaluation is made by reviewing the M&E arrangements elaborated in relevant documents, supplemented by information provided through interviews. Since NAPAs were prepared separately from the national development plans, it is important to check 'time compatibility' between the two documents (and SPCR if prepared) which comprises (i) compatibility of time frame between a development plan and an adaptation plan, and (ii) the timing of formulation of these plans (fifth factor). Countries' planning and budget allocation usually follows a medium-term framework (3-5 years), which is often consistent with the election cycle. Therefore if the time horizon of adaptation plans is too short or too long, the priority projects may not be easily accommodated in the budget framework. If these plans are developed at the same time under the same political leadership, it is more likely that mainstreaming (if intended) will be successful. The difference in time-scale was one major factor of the disconnect between the two plans as reviewed in Section 2.2 above.

Adaptation to climate change has become necessary as a response to climate change. IPCC (2013) concludes that it is extremely likely that more than half of the observed increase in

global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas (GHG) concentrations and other anthropogenic forcings together. As developed countries are largely attributable to the historic emissions of anthropogenic GHG, many developing countries demand financial support from developed countries. Therefore, another important factor is financial feasibility (sixth factor), as NAPA implementation depends upon the likelihood of obtaining external funding for implementation. Being a new issue, funding for adaptation may not be readily available in financially-constrained developing countries. Most LDCs, if not all, will not be capable of mobilizing internal financial resources to fulfill all the needs identified in NAPAs. This is measured by financial resource requirements of NAPA vis-à-vis the level of official development assistance (ODA) the country receives annually. This does not imply that NAPAs will be financed by the existing ODA, but the current level of ODA indicates the probable level of financing the country may be able to receive in addition to existing ODA commitments.[6]

Other factors are also identified from the nature of adaptation. First, impacts of climate change are location-specific, so adequate understanding of impacts and vulnerability is an essential factor for good planning. Second, the capacity of the government, particularly local governments, is another important factor as reviewed in Chapter 1. Government capacity is also critical for effective planning and implementation. Thirdly, since adaptation is a new and multidisciplinary issue, the success of mainstreaming efforts would also depend upon the depth and breadth of consultation and participation in preparing adaptation plans. However, these three factors are not included in the following analysis. Understanding impacts and vulnerability is not included because a vulnerability assessment was undertaken in accordance with the Guidelines during the NAPA process with external support, and it is expected to be difficult to detect a qualitative difference through a review of the documents. The importance of the capacity of the government ministries working on climate adaptation is cited in the literature (UNDP 2009; UNFCCC 2002), but due to the lack of relevant data in objectively measuring the capacity, this factor is not included. The issue of government capacity would be more prominent at city level. Similarly, consultation and participation is not included because of the difficulty in assessing the quality in an objective and comparative manner. These factors are discussed again when reviewing key factors at city level in Chapter 3.

To validate the completeness of the above factors, the relationship among the factors is presented in Figure 2-2 under the national-level planning processes. Since NAPA and national development plans are developed separately, plans should be reviewed if they have time compatibility and recognize the need for mainstreaming. Inter-ministerial coordination is a process to guide and support mainstreaming. M&E mechanism works if the plans are implemented and results are achieved as intended. Implementation experience, though similar to M&E to some extent, is important for a new development challenge like climate change. Government capacity and financial feasibility are essential in planning and implementation. Consultation and participation adds legitimacy to the process. Therefore, these factors,

[6] Net ODA receipts of the average of the most recent three years (2007-2009) available on the website of the Development Assistance Committee of OECD were used for this purpose (OECD 2011). Although it is more appropriate to use gross ODA receipts to see the level of ODA inflows to the country, such data are not readily available.

including three factors that are not included in the evaluation, cover each step of planning, as well as procedural, institutional, and financial aspects of planning and implementation.

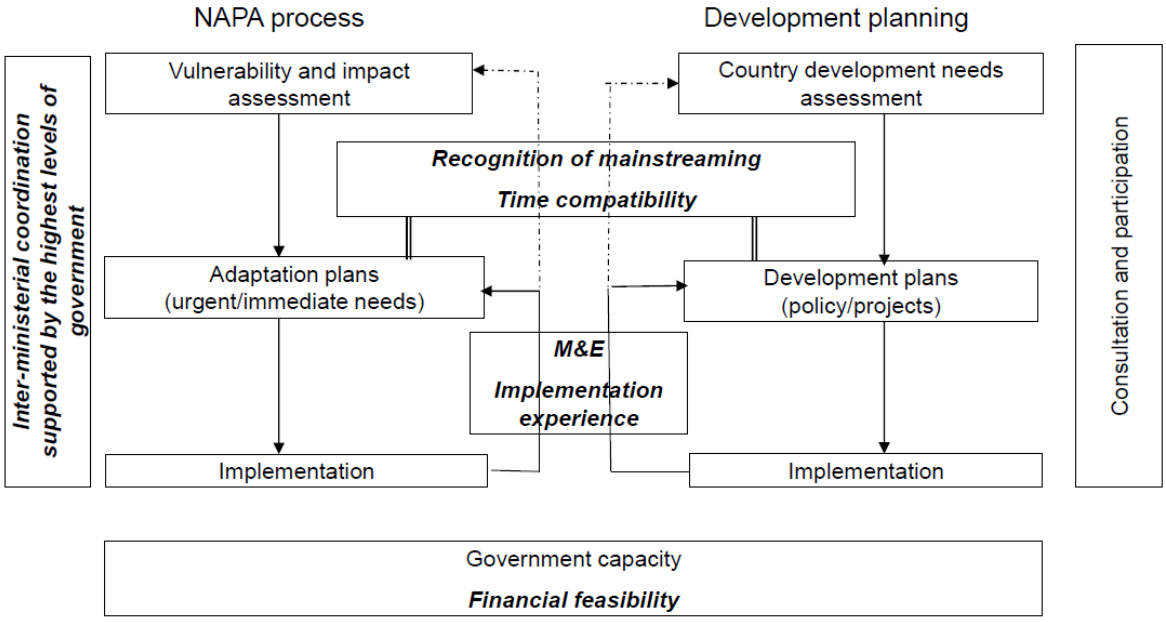

Figure 2-2: Relationship among factors in the development planning process (six factors are in bold and Italic)

A rating method is adopted in reviewing the key documents endorsed by respective governments,. For each of the six factors, one out of three ratings is assigned as described in Table 2-2, with "++" indicating the highest and "-" indicating the lowest. Criteria for rating are also specifically provided to ensure objective and uniform evaluation. The appropriateness of the six factors is also reviewed in Section 2.6 when discussing the level of mainstreaming across the study countries.

Table 2-2 Factors that determine the success of mainstreaming efforts

	Factor	Aspects reviewed and rating
1	Coordination	Aspects: (i) High involvement of planning and/or finance ministry, (ii) prime minister (or president)'s commitment, and (iii) existence of a highly functional coordination committee Rating: ++ (good) At least two of the three including (i) are satisfied. + (fair) Only one is satisfied, or only (ii) and (iii) are satisfied. - (weak) None of the above is satisfied.
2	Recognition	Aspect: Mainstreaming is explicitly recognized as a priority in NAPA/SPCR and development plans. Rating: ++ (high) Mainstreaming is recognized in both NAPA/SPCR and development plans. + (fair) Mainstreaming is recognized only in NAPA or SPCR. - (poor) Mainstreaming is not recognized as a priority in the document.
3	Monitoring and evaluation	Aspects: Institutional arrangement of M&E and clarity of its mandates and scope Rating: ++ (good) A clear and streamlined M&E arrangement exists with clearly

		defined mandates and scope. + (fair) A clear M&E arrangement exists without clearly defined scope. - (weak) An M&E arrangement is not clear or does not exist.
4	Financial feasibility	Aspect: Financial resource requirements in NAPA compared to average annual net ODA receipts Rating: ++ (high) Requirements in NAPA are less than 10% of net ODA receipts. + (medium) Requirements in NAPA are less than 30% of net ODA receipts. - (low) Requirements in NAPA are not less than 30% of net ODA receipts.
5	Experience of implementation	Aspects: Years of NAPA implementation after its formulation and experience of adaptation programs/projects within or outside NAPA (the evaluation was made as of early 2012) Rating: ++ (adequate) NAPA has been implemented for 3 years or longer, and clear evidence of implementation of specific programs/projects is observed. + (fair) Some evidence of implementation of specific programs/projects is observed, with 3 years or longer implementation of NAPA, or clear evidence of implementation of specific programs/projects is observed with less than 3 years of implementation of NAPA. - (limited) Only limited implementation is observed.
6	Time compatibility	Aspect: Time frame and timing of development plans and that of NAPA/SPCR Rating: ++ (high) Both the time horizon (duration) and timing match well. + (medium) Either the time horizon or timing matches. - (low) Neither the time horizon nor timing matches.

Then, it is necessary to identify indicators to measure the level of mainstreaming, or in other words, an outcome of mainstreaming efforts that the above factors would influence. First, if mainstreaming goes well, adaptation programs will be aligned with the priority issues of the country. Therefore, the relevance of adaptation priorities to those of national development plans is proposed as the first perspective. If these two are not aligned with each other, it is less likely that the adaptation priorities will be implemented under the country's development projects and programs. However, the match between priorities does not guarantee mainstreaming. Thus, the analysis further includes whether the priority sectors of national development plans take into consideration climate change impacts and vulnerability in their planning.

The success of mainstreaming will also likely lead to a country's own initiatives for climate change adaptation, particularly those involving budget allocation and beyond the jurisdiction of a technical ministry such as the Ministry of Environment. This clearly indicates whether the country's key ministries recognize the importance of adaptation to climate change.

These two perspectives, i.e., integration of climate change adaptation considerations in the priority development sectors and the country's own initiatives, are considered key determinants in the overall evaluation on the level of mainstreaming. In other words, if a country is successful in integrating adaptation considerations in development priorities and in developing its own initiatives for climate adaptation, it is possible to conclude that the country has progressed in mainstreaming. A numerical rating method is used with a scale of 0 to 2, indicating 0 for the lowest and 2 for the highest. Then the level of mainstreaming is evaluated as ''minimal' to 'advanced'. The two perspectives to measure the level of mainstreaming and rating system are summarized in Table 2-3. Again, rating criteria are made specific to support objective evaluation.

Table 2-3 Perspectives to measure the level of mainstreaming

	Perspective	Aspects reviewed and rating
1	Relevance:	(i) Aspect: Alignment between adaptation priorities and those of national development Rating: ++ (highly relevant) Adaptation priorities are closely aligned with development priorities. + (partially relevant) Some adaptation priorities are aligned with development priorities. - (not relevant) Most adaptation priorities are different from development priorities. (ii) Aspect: Consideration of climate change adaptation in the development priority sectors Rating: ++ (well considered) Climate change adaptation is taken into account in most development priority sectors (score of 2). + (partially considered) Climate change adaptation is taken into account in some development priority sectors (score of 1). - (not considered) Climate change adaptation is not taken into account in most development priority sectors (score of 0).
2	Country's own initiatives	Aspects: (i) Budget allocation to adaptation activities and (ii) development of policy and/or strategy on climate change adaptation other than NAPA, or relevant initiatives Rating: ++ (highly demonstrated) Both of the above actions are taken (score of 2). + (partially demonstrated) One of the above actions is taken (score of 1). - (not demonstrated) None of the above actions is taken (score of 0).
	Overall evaluation	Total score of 4: advanced; 3: medium; 2: limited; 0-1: minimal.

2.5 Country-specific analysis on mainstreaming

The structure of NAPA is similar among different countries. The key features of NAPAs of six countries are presented in Table 2-4. Commonalities are found in the areas of (i) NAPA priority sectors such as food security, water and coastal resources, public health, and disaster risk management; (ii) the lead agency being the environment ministry; and (iii) lack of recognition of mainstreaming (except Bangladesh), while differences are large in the level of resource requirements and the time lag between preparation of NAPA and that of the national development plan.

The national development plans are reviewed to see whether the priority sectors and issues identified in the NAPAs have been integrated. SPCRs are reviewed to assess what developments have been made from NAPAs. Based on the review, the policy development process and key features of these plans are summarized by country. Then, the success of mainstreaming is analyzed by using the six factors and two perspectives explained above. The analysis is summarized in Table 2-5, and discussed in detail below.

Table 2-4 Key features of NAPAs of six countries

	Bangladesh	Bhutan	Cambodia	Lao PDR	Maldives	Nepal
NAPA priorities	18 projects (27 combined with original NAPA): food security, disaster management, infrastructure, mainstreaming, capacity building, and natural resources management	9 projects: disaster risk management such as GLOF and early warning system	20 projects: infrastructure relating to water and water resources, food security, public health	12 projects: water resources and food security	12 projects: water and coastal resources, food security, infrastructure, public health	9 projects: disaster risk management, water resources, ecosystem management, public health
Approval authority of NAPA	Steering committee headed by Secretary, Ministry of Environment and Forests (MOEF)	National Environment Commission (NEC) headed by minister	Council of ministers	National Environment Committee chaired by deputy prime minister	Highest level of government	Climate change council headed by prime minister
Recognition of mainstreaming	Mainstreaming is one priority in the updated NAPA.	Not stated	Not stated	Not stated	Not stated	Not stated
Monitoring and evaluation (M&E)	Not stated	Not stated	Not stated	Very briefly stated; sector agency responsible for M&E	A special interagency implementation task force	Ministry of Environment (MOE) will administer M&E.
Resource requirements	$4 billion ($74 million in the original NAPA)	$7.5 million	$129 million	$24 million	$108.3 million	$350 million
Time difference between NAPA and national development plan	Previous national development plan was developed 3 years after original NAPA; Latest national development plan was developed 2 years after NAPA update.	National development plan was developed about 2 years after NAPA.	National development plan was developed about 3 years after NAPA.	National development plan was developed about 2 years after NAPA.	Two documents were prepared in parallel.	Two documents were prepared in parallel.
Lead agency	MOEF	NEC	Ministry of Environment	Water Resources and Environment Administration	Ministry of Environment, Energy and Water	MOE

GLOF = glacier lake outburst floods, NAPA = National Adaptation Programme of Action.

Table 2-5 Mainstreaming analysis of six countries

Factors	Rating criteria	Bangladesh	Bhutan	Cambodia	Lao PDR	Maldives	Nepal
Coordination	++ good + fair -weak	++	-	+	+	+	+
Recognition	++ high + fair - poor	++	-	+	-	-	+
Monitoring and evaluation	++ good + fair - weak	++	-	-	-	-	++
Financial feasibility	++ high + medium - low	-*	++	+	++	-	-
Experience of implementation	++ adequate + fair - limited	++	+	+	-	+	-
Time compatibility	++ high + fair - low	++	-	+	-	+	++
Level							
Relevance: (i) Alignment (ii) Consideration of climate adaptation	++ highly relevant + partially relevant -not relevant ++ well considered + partially considered -- not considered	++ ++ (2)	+ - (0)	++ -(0)	++ +(1)	++ +(1)	+ +(1)
Country's own initiative	++ highly demonstrated + partially demonstrated -not demonstrated	++(2)	-(0)	-(0)	+(1)	+(1)	+(1)
Mainstreaming scores	4: advanced 3: medium 2: limited 0-1: minimal	4	0	0	2	2	2
Overall evaluation		advanced	minimal	minimal	limited	limited	limited

* Under the NAPA update.

2.5.1 Bangladesh

2.5.1.1 Policy development process and key features

The National Strategy for Accelerated Poverty Reduction II (NSAPR II) for 2009-2011 was developed in October 2008, about three years after the development of the original NAPA. While the NSAPR II covers a wide range of issues and sectors relevant to a country's development and poverty reduction, the NAPA is well integrated in the document. After the change in government in 2009, the new government formulated, in 2011, the Sixth Five Year Plan (SFYP) for 2011-2015. In the SFYP, climate change continues to be recognized as a key challenge for the country's efforts in poverty reduction.

The NAPA is not discussed directly in the SFYP, while the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) is. The BCCSAP was first developed in 2008 as the main basis of the country's efforts to combat climate change over the next 10 years. The new government revised it in 2009 to ensure conformity with the priorities of the country's economic, social, and human development. The BCCSAP candidly admits that "past activities on climate change had been somewhat ad hoc, lacked coordination, and remained a parallel entity outside the normal development process and activities of the government." The BCCSAP evolved from the NAPA, as it is more comprehensive with a medium-term time horizon, is more closely aligned with the government development plan, and builds upon the lessons of NAPA. NAPA was updated in 2009 in parallel with the BCCSAP update. Major themes are identical between BCCSAP and the updated NAPA, the only major difference being mitigation and low carbon development constituting one theme in BCCSAP, as it covers both mitigation and adaptation. Among the priority projects in the NAPA, only one project of coastal afforestation is being implemented, and an expansion of this program to different areas is being planned under the LDC Fund (LDCF) as of September 2013 (UNFCCC 2013).[7]

The BCCSAP 'bridges' NAPA and SPCR. As the NAPA and BCCSAP were updated in 2009, developing the PPCR was made possible in a relatively short period.[8] Because of the substantial financial requirements of Bangladesh for climate adaptation, the limited PPCR resources are focused on two broad areas: capacity-strengthening of the government for planning, coordinating, implementing, and monitoring climate change-related activities in a sustainable manner; and interventions for the improvement and development of climate-resilient infrastructure in coastal districts, which suffer the most from climate-related events. Among the proposed activities, one technical assistance grant, one project preparation grant for an investment project, and an investment project ($30 million) were approved by September 2013 (Climate Investment Funds 2013).

2.5.1.2 Analysis of mainstreaming

Coordination. The vulnerability assessment and identification of priority adaptation activities were not confined to a practice of the environment ministry, the Ministry of Environment and Forests (MOEF). Adaptation has been well recognized in the Ministry of Finance (MOF) and Ministry of Planning. For example, the government that came into power in 2009 formed a cabinet review committee under the chairmanship of the Minister for Planning to review the

[7] From the information available on the UNFCCC website. Other priority projects may have been financed by sources other than LDCF. The same applies to other countries.
[8] Bangladesh did not request grant financing for SPCR preparation, and was one of the first countries (together with Niger and Tajikistan) to seek endorsement of its SPCR from the PPCR sub-committee.

BCCSAP; the national focal point of SPCR is the Economic Relations Division of the MOF; integration of BCCSAP in the SFYP was led by the Planning Commission; and the SFYP calls for the need for mainstreaming the poverty-environment-climate nexus in key institutions such as the Planning Commission, Ministry of Planning, MOEF, and MOF. Although lack of coordination among various departments and agencies is still an issue (Rawlani and Sovacool 2011), inter-ministerial coordination in Bangladesh is "good" overall, which could be attributed to the Prime Minister's commitment to the issue.

Recognition. Bangladesh well recognizes the need for mainstreaming. Mainstreaming and strengthening climate change adaptation across various sectors is stated in the cover message of the NSAPR II. The NSAPR II claims that the integration of NAPA into NSAPR II will be a step forward in the establishment of an institutional process to incorporate climate change into national policies. Both NAPA and BCCSAP prioritize mainstreaming adaptation to climate change into national and sectoral development programs and policies. Mainstreaming is one of the priority actions in the original NAPA, but is raised to one of the six thematic areas in the updated NAPA, indicating the country's increased awareness for promoting mainstreaming. Under the climate change sub-theme in the SFYP, the second priority is given to mainstreaming climate change issues of adaptation, mitigation, and capacity-building. The SPCR also includes capacity development technical assistance for mainstreaming. Overall, recognition is "high" in Bangladesh.

M&E. Although there is no inter-ministerial monitoring mechanism for the overall implementation of the NAPA, the NAPA is monitored by the MOEF.[9] On the other hand, the BCCSAP elaborates on the implementation arrangements of the action plan: climate change focal points in line ministries, climate change unit in MOEF, national steering committee on climate change chaired by the Minister of Environment and Forests, and the National Environment Committee chaired by the Prime Minister. The Climate Change Trust Fund (CCTF), a national fund, is financing activities under the BCCSAP, and the MOEF is taking the lead in undertaking monthly monitoring of projects financed by the CCTF with input from implementing agencies. The M&E is "good."

Financial feasibility. Bangladesh estimated the resource requirements for implementing the priority adaptation actions identified in the original NAPA to be $74 million. This is about 5% of the net ODA the country receives annually. However, the medium-term resource requirements under the updated NAPA jumped to about $4 billion, much higher than the country's annual net ODA receipts. The feasibility is "low" for the updated NAPA.

Experience. Bangladesh has a comparatively long experience in adaptation. Its NAPA was developed in 2005, the earliest among the six countries studied. Even among all the NAPAs prepared to date (a total of 50 countries), Bangladesh's NAPA was formulated as the second earliest after Mauritania.[10] This demonstrates the country's high awareness that climate change could be a serious threat to economic growth and poverty reduction, its commitment to taking actions for climate change, and the international community's willingness to support it.

[9] Based on an interview with an MOEF official made in 2012.
[10] Based on the date of NAPA posted on the UNFCCC website.

However, contrary to the expectation that NAPA would directly lead to implementation of priority activities with funding from development partners, only one out of 15 activities was initially funded by UNDP. Before the formulation of the BCCSAP in 2008, the government was not satisfied with the progress of NAPA implementation.[11] Against this background, the government made further efforts for mainstreaming NAPA into its development plans as well as developing the BCCSAP and updating the NAPA itself. Such trial and error processes provided important lessons on how priority adaptation actions could be actually and more effectively implemented. Existing literature also demonstrates sufficient implementation of adaptation projects in Bangladesh (Anik and Khan 2012; Huq and Rabbani 2011; Sovacool et al. 2012). Experience of implementation is rated "adequate."

Time compatibility. The BCCSAP, updated NAPA, and SPCR all have a medium-term time horizon, same as the SFYP. The SFYP and SPCR have been discussed in parallel and finalized with a time lag of less than a year. Therefore, both the time horizon and timing match between the two plans, leading to a "high" rating.

2.5.1.3 Level of mainstreaming

Relevance. The priority issues in NAPA and BCCSAP, which address food security, disaster risk management, climate-resilient infrastructure, mainstreaming, capacity development, and strategic natural resources management, are relevant to the priorities of national development plans. The SFYP elaborates on implications of climate change in Bangladesh, followed by the climate change action plan. It highlights the six pillars of BCCSAP developed in 2009. "Environment, climate change, and disaster management for sustained development" is one of the four key themes in the SFYP, and under the climate change sub-theme, the SFYP places first priority on the repair and maintenance of coastal polders and defenses which were washed away first by Sidr and then by Aila, two major cyclones that hit the country in November 2007 and May 2009 respectively.

As a country prone to natural disasters, Bangladesh has developed a variety of formal and informal coping strategies and mechanisms at both national and local levels. Reducing and managing risks of natural disasters, such as cyclones, floods, and storm surges, has been high on the development agenda of the country for decades, which led to the construction of more than 2,000 cyclone shelters in the coastal areas, about 200 flood shelters, and nearly 4,000 km of coastal embankments, as stated in the updated NAPA. These measures were effective in reducing loss of life and damage to property over the years. Therefore, adapting to climate-induced disasters will largely strengthen the past and ongoing efforts of the country. Even the salinity intrusion which is expected as a result of rise in sea level has already been observed in the coastal zone, and necessary actions are being taken. This has made the mainstreaming work in Bangladesh rather straightforward. Thus, the assessment is "highly relevant", and adaptation is "well-considered."

Country's own initiative. A key initiative the government took, other than developing the BCCSAP, was establishment of the CCTF with a total allocation of about $300 million in 2009-

[11] Based on an interview with an MOEF official made in 2008.

2011 from its own budget (Huq and Rabbani 2011). The CCTF is being used for various projects under the BCCSAP to strengthen resilience to climate change, clearly demonstrating that climate change adaptation is a priority of the country, not just that of one line ministry. This is despite the common view of most developing countries, including Bangladesh itself, that adaptation efforts by LDCs which are highly vulnerable to the impacts of climate change due to low adaptive capacity, should be fully financed by grants from industrialized countries. The country's initiatives are "highly demonstrated."

Bangladesh is advanced in mainstreaming climate adaptation. However, mainstreaming can be further enhanced by translating plans into actions, such as revision or preparation of sectoral policies and guidelines to incorporate climate change adaptation.

2.5.2 Bhutan

2.5.2.1 Policy development process and key features

The Tenth Five Year Plan (TFYP) was developed in 2008, about two years after the formulation of NAPA. Although its NAPA stresses the link with the government's policies, programs, and activities, including the National Vision launched in 1999, Millennium Development Goals, and the Bhutan Poverty Reductions Strategy Paper, no specific content was presented. Moreover, TFYP is silent on NAPA. The TFYP just addresses, as a major concern, the country's high vulnerability to climate change such as proneness to flash floods, glacial lake outburst floods (GLOF) and landslides without any indication of projects or programs, except that the early warning system for GLOF hazard mitigation is relevant to the priority actions identified in NAPA. Three priority projects (artificial lowering of Thorthomi lake, GLOF hazard zoning, and installation of early warning systems) in the NAPA are consolidated into one project for reducing climate change risks and vulnerabilities from GLOF, which is being implemented under the LDCF. This was the first NAPA priority project financed by the LDCF amongst all the LDCs. Another project for addressing the risk of climate-induced disasters is being considered as of September 2013. Bhutan updated its NAPA in 2012, following the decision of the 16th Conference of the Parties (COP) of the UNFCCC in 2010 (National Environment Commission 2012).

2.5.2.2 Analysis of mainstreaming

Coordination. NAPA was formulated by the National Environment Commission (NEC), which is also the National Climate Change Committee, chaired by a minister-level official, while the TFYP was formulated by the Gross National Happiness Commission, chaired by the Prime Minister. The link between these two plans is not clear from the documents, and no evidence is found on inter-ministerial coordination including the involvement of MOF. Coordination is considered "weak" in Bhutan.

Recognition. This is not found either in NAPA or TFYP. Thus recognition is "poor."

M&E. This is not stated in the NAPA. An interview with an NEC official clarified that an overall M&E framework for implementation of the NAPA does not exist, while project-level monitoring is being carried out. The M&E is "weak."

Financial feasibility. Resource requirements of priority activities in NAPA amount to $7.5 million, about 7.5% of the annual net ODA inflow to the country. Thus the financial feasibility is rated "high."

Experience. Bhutan's NAPA was finalized in 2006, which gave about two years' lead time before the formulation of TFYP. Although the TFYP and its mid-term review report prepared in 2011 do not indicate the status of NAPA, implementation of three projects among NAPA priorities makes the rating "fair." However, implementation is facing a challenge in terms of institutional capacity, coordination between institutions, and community awareness (Meenawat and Sovacool 2011).

Time compatibility. The NAPA addresses only urgent and immediate needs (in accordance with the Guidelines), whereas the TFYP is a five-year plan. The TFYP was formulated more than a year later after the publication of the NAPA. Therefore, neither the time horizon nor timing matches between the two plans. Time compatibility is "low."

2.5.2.3 Level of mainstreaming

Relevance. In Bhutan, national development priorities are not very much associated with disaster risk reduction and management, while the NAPA priority projects primarily consist of developing systems for disaster warning and prevention. Although the TFYP acknowledges the increased risks of flash floods, GLOF, and landslides, aligned with adaptation priorities, measures for coping with these risks have not been translated into priority activities of the TFYP, nor have taken the impacts of climate change into account. Adaptation priorities are "partially relevant" to those of development plans, and adaptation is "not considered."

Country's own initiative. Specific initiatives are yet to be observed. After update of the NAPA is complete, the government intends to develop a climate change strategy.[12]

The level of mainstreaming is thus far minimal in Bhutan. The NAPA update may be a starting point to facilitate mainstreaming.

2.5.3 Cambodia

2.5.3.1 Policy development process and key features

Cambodia established its NAPA in 2006 (preparation was completed in March 2005). The Rectangular Strategy for Growth, Employment, Equity and Efficiency (Rectangular Strategy) and National Strategic Development Plan (NSDP) were updated to the Rectangular Strategy II and NSDP Update 2009-2013 respectively in 2008, almost three years after the formulation of NAPA. However, neither the Rectangular Strategy II nor NSDP Update touches upon NAPA. Climate change is referred to as a challenge that the country faces, and the

[12] Based on an interview with an NEC official made in 2012. An update of project and profiles, as an addendum to the original NAPA, was developed in 2012. This is because other climate risks and vulnerabilities (e.g., windstorms and cyclones) that were not identified have emerged since the preparation of the NAPA in 2006. Moreover, given that the NAPA was prepared more than five years ago, there was a need to review the implementation status and update estimated costs of the remaining priority projects of the 2006 NAPA. Eight priority projects are identified. Climate strategy is, however, not yet available as of September 2013.

government is committed to mobilizing resources, support, and financing to participate in global efforts to address challenges of climate change. No specific projects or programs are identified, however, to implement activities for climate change adaptation. Among the priorities in NAPA, one project for promoting climate-resilient agricultural practices is being implemented (D'Agostino and Sovacool 2011), and two more for micro watershed management and strengthening climate information and early warning systems are planned with funding from the LDCF as of September 2013. Another project for coastal adaptation and resilience planning is also ongoing.[13]

Cambodia developed the SPCR in 2011 nearly five years after the preparation of NAPA. It built upon the NAPA and other relevant country studies and strategies to mainstream climate resilience into national and sub-national development policies, plans, and projects. The SPCR noted, in line with the NAPA, that agriculture and water resources are the most important sectors to the economy but are highly vulnerable to climate change impacts. This leads to the proposal of two investment components under SPCR – strengthening climate resilience of these two sectors mainly through improving (climate-proofing) related infrastructure. Another investment component is also for improving climate-resilient infrastructure, focusing on roads and urban environmental infrastructure such as water supply and sanitation. Unlike NAPA, the health sector is not highlighted in the SPCR.[14]

Capacity-strengthening to mainstream climate resilience into development planning, including updating of NAPA, is a soft component under the SPCR. This is a major difference from the NAPA, which includes few soft measures. As of September 2013, four investment projects (with a total amount of $46 million) for (i) climate-proofing of road infrastructure, (ii) enhancement of flood and drought management, (iii) climate-proofing of agricultural infrastructure and business-focused adaptation, and (iv) southern economic corridor towns development, a large technical assistance grant ($7 million) for mainstreaming climate resilience into development planning in key vulnerable sectors, as well as seven project preparation grants, which are all project preparation grants envisaged in the SPCR, have been approved, thus demonstrating remarkable progress.

2.5.3.2 Analysis of mainstreaming

Coordination. The way the NSDP describes activities with regard to climate change adaptation indicates that climate change adaptation stays under the jurisdiction of the Ministry of Environment (MOE) in a fragmented manner, which indicates lack of meaningful involvement of planning and/or the finance ministry in climate adaptation. This is a rather common phenomenon observed in other countries as well (Kalame et al. 2011; Juhola 2010). The SPCR also points out that a formal coordination mechanism between disaster risk reduction and climate change adaptation is not present despite overlapping agendas between the two. Nevertheless, support from the highest levels of government is observed in Cambodia. Its NAPA was endorsed by the Council of Ministers chaired by the Prime Minister, who has also

[13] Based on an interview with an MOE official made in 2012.
[14] This is mainly because only the Asian Development Bank (ADB) is expected to administer investments under SPCR. ADB does not have projects on public health in Cambodia. From an interview with a member of ADB staff.

been the honorary chair of the National Climate Change Committee since 2009. Therefore, coordination is considered "fair."

It should be noted that both MOE and the Ministry of Economy and Finance (MOEF) appoints national PPCR focal points, while MOEF is designated as the national implementing agency of SPCR. This may infer that climate change adaptation is gradually shifting from a sectoral issue under MOE to a national development agenda.

Recognition. Mainstreaming climate change is not identified in the NSDP Update or NAPA. The SPCR addresses the need for mainstreaming, and includes a component to support capacity-strengthening for mainstreaming. Thus, recognition is "fair."

M&E. The M&E arrangement is not specified in the NAPA, and apparently there is no mechanism to monitor the overall implementation of the NAPA. The M&E is "weak."

Financial feasibility. Financial resource requirements for priority projects in the NAPA amount to $129 million, or 18% of the average annual net ODA inflows to the country. This may not be fully funded by development partners in a short time. The financial feasibility is "medium."

Experience. Cambodia's development of NAPA was as early as that of Bangladesh. Although many development partners have been providing significant support for the country's climate change adaptation, most of these are in early stages of implementation, and not necessarily aligned with NAPA priorities. Developments observed in the SPCR, such as incorporating soft components and highlighting mainstreaming, may indicate that the country is learning lessons from NAPA implementation (or more precisely lack of it). Experience is judged as "fair."

Time compatibility. The SPCR adopts a medium-term programmatic approach, which is compatible with the NSDP update. However, the SPCR was developed nearly 1.5 years after the NSDP update. There is compatibility in terms of time horizon, but the timing was not harmonized. Time compatibility is "fair."

2.5.3.3 Level of mainstreaming

Relevance. The NAPA mainly focuses on three issues: agriculture and water resources, the coastal zone, and human health. These issues are all reflected in the NSDP Update 2009-2013. Therefore, adaptation priorities are "highly relevant" to those of national development. These (sub)sectors are, however, not discussed in the context of climate change in the NSDP Update. The SPCR rightly acknowledges that the national development plans do not address climate change directly, and that there is no evidence yet of addressing climate change adaptation concerns in sectors particularly vulnerable to climate change, such as water resources and agriculture. Therefore, climate adaptation is "not considered."

Country's own initiative. The NSDP update and SPCR indicate preparation of a national climate change strategy and action plan, and establishment of a national climate change fund. An update of NAPA is also planned in the SPCR.[15] The climate change trust fund does already

[15] The updated document is not yet available as of September 2013.

exist, but it is currently fully funded by development partners. The country's initiatives are "not demonstrated" yet.

There is "minimal" mainstreaming in Cambodia. However, the SPCR process and its output indicate substantial progress in mainstreaming. Thus mainstreaming is said to be in its nascent stage in Cambodia.

2.5.4 Lao PDR

2.5.4.1 Policy development process and key features

The Seventh National Socio-Economic Development Plan (SNSEDP) was formulated in July 2011. The SNSEDP was deliberated about one year after the publication of NAPA in 2009. The SNSEDP refers to climate change adaptation. Climate change is identified as a challenge in the implementation of the SNSEDP, and the need for adapting to climate change is stressed for economic development of the country. Although NAPA states that it is in line with the objectives of the (Sixth) National Socio-Economic Development Plan (2006-2010) and National Growth and Poverty Eradication Strategy (2004), no specific link is presented in the NAPA. One project in NAPA for improving agricultural resilience is being implemented, and another for effective governance for small scale rural infrastructure and disaster preparedness was approved for LDCF funding as of September 2013.

2.5.4.2 Analysis of mainstreaming

Coordination. The preparation of NAPA was led by the Water Resources and Environment Administration (WREA),[16] and it was approved by the government, presumably the National Environment Committee chaired by the deputy prime minister. The national steering committee on climate change was established in 2008, also chaired by the deputy prime minister. This indicates the existence of a coordination mechanism as well as support from the highest levels of government. However, involvement of key development ministries such as the Ministry of Planning and Investment is not demonstrated in the documents. Thus, coordination is "fair."

Recognition. Mainstreaming is neither identified as a priority action in the NAPA, nor mentioned in the SNSEDP. The rating is "poor."

M&E. The arrangement is provided in the NAPA only briefly, where sectoral ministries will be responsible for M&E with WREA leading the collaboration. No specific M&E arrangement for the overall implementation of NAPA is yet in place.[17] It is considered "weak."

Financial feasibility. Requirements presented in the NAPA are rather modest in Lao PDR, amounting to $24 million. This is about 5.5% of the average annual net ODA inflow to the country. Therefore, the feasibility is "high."

Experience. The NAPA was prepared only in 2009, and only one project under the NAPA priority activities is ongoing. Experience is "limited."

[16] WREA has been upgraded to the Ministry of Natural Resources and Environment (MONRE).
[17] Based on an interview with an MONRE official made in 2012.

Time compatibility. The SNSEDP covers a five-year period, but the NAPA addresses urgent needs only with a short time horizon. The NAPA was developed more than two years after the SNSEDP was formulated. Thus, there is no time compatibility in terms of time horizon and timing. It is rated "low."

2.5.4.3 Level of mainstreaming

Relevance. The SNSEDP highlights (i) use of early warning systems to forecast floods and other disasters, and (ii) rehabilitating and improving hydrologic stations, coherently with priority activities in NAPA. Moreover, integrating disaster risk reductions strategy and climate change adaptation into sector development plans is stressed, as a measure to achieve the Millennium Development Goals target. Other priority issues and sectors identified in NAPA such as food security (agriculture and forestry sectors) are also included in key development issues in the SNSEDP. Therefore, adaptation priorities are "highly relevant" to those of national development. In the SNSEDP, climate change adaptation is, albeit in general terms, addressed as a factor to be taken into account in a number of sectors including water resources management, agriculture, and urban development. Adaptation is "partially considered" in the development.

Country's own initiative. The government's own initiative is exemplified in the establishment of its national strategy on climate change in 2010, although no link to the budget allocation is observed. The initiative is "partially demonstrated."

The level of mainstreaming in Lao PDR is limited, and actions specifically associated with mainstreaming are yet to be taken. As the NAPA is still relatively new, more implementation experience would direct the government as to how to go about strengthening mainstreaming. Lack of capacity for effective implementation is identified in Lao PDR (Gass et al. 2011), which may be the reason for slow implementation.

2.5.5 The Maldives

2.5.5.1 Policy development process and key features

The Seventh National Development Plan (SNDP) (2006-2010) and NAPA were developed nearly at the same time. Prepared shortly after the Indian Ocean Tsunami in December 2004, the SNDP is designed to create new opportunities to place the country as a middle income country, as well as to rebuild and reconstruct homes and infrastructure on the concept of "build back better." The SNDP identifies the vulnerability of low-lying islands to climate change impacts, particularly rise in sea-level, as one of the key challenges of the country. One project in NAPA for integrating climate change risks into the safer island development program (described in 2.5.5.3 below) is being implemented with funding from LDCF as of September 2013. According to the Ministry of Housing and Environment (MOHE), two more priority projects (tourism-related and water security) are also in the process of implementation.[18]

2.5.5.2 Analysis of mainstreaming

[18] Based on an interview with an MOHE official in 2012.

Coordination. The NAPA stresses that the NAPA team closely worked with officials of the Ministry of Planning and National Development, and Ministry of Finance and Treasury. Inter-ministerial coordination between the Ministry of Environment, Energy and Water[19] and the Ministry of Planning and National Development is implied in the SNDP, although no specifics are provided. High-level political commitment is observed by the fact that the preface of the NAPA was written by the President. There does not seem to be a permanent high-level coordination mechanism with regard to climate change. Overall, coordination is rated "fair."

Recognition. Mainstreaming is not discussed either in NAPA or SNDP. The rating is "poor."

M&E. The NAPA proposes that the National Commission for the Protection of the Environment will oversee the implementation of NAPA, and that a special inter-agency taskforce will ensure the mobilization of international financial assistance and allocation of public financing to priority projects by respective government agencies. However, the inter-agency taskforce was not established. A NAPA implementation strategy, which was also planned during preparation of the NAPA, was not in fact developed. Therefore, the M&E is "weak."

Financial feasibility. The NAPA resource requirements amount to $108 million, more than twice the annual net ODA receipts of the country. It would be difficult to expect that these will be met by additional external resources provided by development partners. Thus, feasibility is rated "low."

Experience. It has been about five years after the NAPA was formulated. Considering that three projects are being implemented, experience is considered "fair."

Time compatibility. The time horizon is different between the SNDP and NAPA. However, these documents were discussed in parallel and finalized within a difference of one year. Thus, the timing is compatible while the time horizon is not. The rating is "fair."

2.5.5.3 Level of mainstreaming

Relevance. The Maldives' NAPA prioritizes projects in the sectors of coastal and water resources, food security, infrastructure, and public health. Population and development consolidation, a key strategic component of the regional development policy in the SNDP, is consistent with the "Safer Islands Strategy" of NAPA, whereby communities living on smaller, less populated, and potentially more vulnerable islands would be resettled on larger islands with better natural protection and enhanced by coastal protection. Development of infrastructure including coastal protection is proposed in the SNDP. "Positioning the Maldives to adapt to the impacts of climate change and rise in sea-level" has become a policy under environmental management in the SNDP. Other priority subsectors in the NAPA are also identified as development priorities in the SNDP. However, these are not discussed in the context of climate adaptation and resilience. In short, adaptation priorities are "highly relevant" to the development agenda, but climate adaptation is only "partially considered."

[19] The Ministry of Environment, Energy and Water has been reorganized into the Ministry of Housing and Environment.

Country's own initiative. The government adopted the world's first Strategic National Action Plan that integrates disaster risk reduction and climate change adaptation in June 2011 (UNISDR 2011). However links to budget allocation are yet to be observed. The initiative is "partially demonstrated."

Mainstreaming is still limited in the Maldives. The progress of mainstreaming will be inferred from the forthcoming 5-year national development plan.[20]

2.5.6 Nepal

2.5.6.1 Policy development process and key features

Nepal has a short history in dealing specifically with the issue of climate change. The National Capacity Self Assessment study (Government of Nepal 2008) clearly identified that the lack of institutional capacity for climate change risk management and poor coordination amongst the agencies concerned are the main reasons why climate change risks management is not formally integrated into development planning at the national, sectoral, district, and village levels. The NAPA process started only in 2009. The NAPA and the Three Year Plan (TYP) (2011-2013) were finalized almost at the same time in 2010. In Nepal's NAPA, unlike those of other countries reviewed in this study, priority activities are clustered into consolidated profiles, as a programmatic approach. One priority project in NAPA for GLOF risk reduction was approved with funding from the LDCF in March 2013, and two more projects for catalyzing ecosystem restoration for resilient natural capital and rural livelihoods, and reducing vulnerability and increasing adaptive capacity for sustainable livelihoods in the agricultural sector, are planned as of September 2013.

Following the development of NAPA and TYP, Nepal formulated the SPCR in 2011. The SPCR formulation process started even before the finalization of NAPA. In developing the SPCR, activities were undertaken to address gaps in the NAPA process while ensuring compliance with PPCR guidelines. The highest priority risks identified during SPCR preparation are (i) quantity and quality of water, (ii) food security, and (iii) ecosystem health, based on which five investment components are proposed. Although these issues are more or less addressed in NAPA-prioritized activities, it is not clear how these programs are aligned between SPCR and NAPA because of the different classification used. Three investment projects (with a total amount of $63 million) for (i) building climate resilience of watersheds in mountain eco-regions, (ii) building climate-resilient communities through private sector participation, and (iii) building resilience to climate-related hazards, one large technical assistance grant ($7 million) for mainstreaming climate change risk management in development, and three project preparation grants were approved by September 2013.

2.5.6.2 Analysis of mainstreaming

Coordination. In Nepal, the Ministry of Environment (MOE) led the work of both NAPA and SPCR. The Multi-stakeholder Climate Change Initiatives Coordination Committee (MCCICC) was formed in April 2010 under the chairpersonship of the Secretary of MOE. Commitment from

[20] A new development plan is not yet publicly available as of September 2013.

the highest levels of government is also confirmed by the fact that the Prime Minister created the Climate Change Council (CCC) under his own chairpersonship in July 2009, and that the NAPA was endorsed by the Cabinet. Nevertheless, the high involvement of finance and planning ministries has not been verified, and the fact that climate change adaptation is rather regarded as a sectoral issue under the MOE in the TYP implies the limited involvement of these ministries in the agenda of climate change adaptation so far. Coordination is considered "partial."

Recognition. Mainstreaming climate change is not discussed either in the TYP and NAPA. The SPCR, on the other hand, identified mainstreaming as a priority program. Recognition is thus "fair."

M&E. Compared to its predecessors, Nepal's NAPA is more advanced in terms of elaborating on institutional arrangements and M&E. It specified that the MOE will undertake the central-level M&E to track performance on adaptation, administered by the Climate Change Programme Coordination and Monitoring Unit. At the central level, the MOE will coordinate with and report to other ministries through the MCCICC and CCC, and an implementation and monitoring system at the district and local levels is also provided. M&E arrangements for the SPCR are also similar, with the addition of a steering committee for each component and the overall Climate Change Program Steering Committee. Although it is yet to be seen how this arrangement will work effectively and achieve the intended objectives, the M&E is "good."

Financial feasibility. Resource requirements identified in the NAPA, which includes medium- to long-term resource needs by adopting a programmatic approach, amount to $350 million. This is significantly higher than that of other countries in the study (except Bangladesh's updated NAPA). This amount accounts for nearly 50% of the annual average net ODA inflow. The financial feasibility is "low."

Experience. Because of the short history of Nepal in specifically dealing with the issue of climate change adaptation, experience of implementation is still "limited." However, the country has placed climate change adaptation high on the national development agenda since 2008, with increased support from development partners.

Time compatibility. In Nepal, both NAPA and SPCR are medium-term plans, compatible with the TYP. As mentioned above, the NAPA and TYP were finalized almost at the same time, soon followed by the SPCR. Therefore, the rating is "high."

2.5.6.3 Level of mainstreaming

Relevance. Efforts have been made to ensure an interface between the national development plan and the NAPA. In the TYP, one section is devoted to environment and climate change, and it acknowledges that NAPA preparation has been initiated. It was not possible to list or effectively integrate the priority adaptation projects in the TYP as the NAPA was still being formulated. Only a blanket statement is found in the TYP with respect to NAPA programs: "the programs directed by NAPA in six sectors will be implemented." While four out of the nine priority programs in the NAPA stress empowering communities in implementing adaptation, the role of communities is not well articulated in the TYP except for forest management. Ecosystem

management, highlighted in two priority programs in NAPA, is hardly mentioned in the TYP. On the other hand, consistency is found in disaster risk reduction including water-induced disaster prevention highlighted in the TYP, where developing an early warning system for minimizing the effects posed by natural disaster and climate change is identified as a strategy. This is aligned with a prioritized program, “GLOF and disaster risk reduction” in the NAPA. Other priority sectors in the NAPA such as public health and urban development are also prioritized in the TYP. However, how the sectors will adapt to climate change is generally not clarified, while some sectors such as forest management, water and sanitation refer to consideration of climate change. Overall, adaptation priorities mentioned in the NAPA and SPCR are “partially relevant” to the priorities in TYP, and adaptation is “partially considered.”

Country’s own initiative. The country’s own initiatives are observed by formal adoption of the climate change policy in January 2011. The policy includes establishment of (i) a climate change fund for implementing programs related to climate adaptation and resilience, and low-carbon development; and (ii) a climate change center as a semi-autonomous technical institution for the formulation and implementation of climate change-related programs and research. Although these have not been established to date, initiatives are “partially demonstrated.”

Climate adaptation mainstreaming is “limited,” but may be accelerated with the commencement of SPCR activities. The next development plan will demonstrate the progress of mainstreaming.

2.6 Overall analysis

The NAPAs of all the six countries acknowledge that they are in line with the national development plans or strategy. However, except for Bangladesh, and to some extent Lao PDR, the Maldives, and Nepal, consistency stops at a mere statement, without demonstrating links. The national development plans of the remaining two countries, Bhutan and Cambodia, do not mention NAPAs, which indicates that climate adaptation has not yet been brought to a major agenda of the country’s development.

The analysis suggests that mainstreaming is advanced in Bangladesh, limited in Lao PDR, the Maldives, and Nepal, and minimal in Cambodia and Bhutan. The success in mainstreaming efforts in Bangladesh can be attributed to (i) enhanced coordination among key ministries supported by the highest levels of government, (ii) explicit recognition of mainstreaming, (iii) lesson-learning from earlier experience, and (iv) time compatibility between the national development plan and adaptation plans. As a result, adaptation priorities are integrated in the development plan and discussed in the context of climate change. The establishment of a fund with its own funding to support adaptation projects demonstrates support from the finance ministry.

Table 2-6 highlights the difference in ratings between the overall evaluation and each of the factors. Among the six factors proposed, coordination is most closely linked to the level of

mainstreaming. The importance of coordination is recognized in a number of preceding studies (see Section 2.2), but reconfirmed here. Recognition, M&E, and time compatibility are relatively well associated with the level of mainstreaming. Explicit recognition of the need for mainstreaming helps to make mainstreaming happen. The M&E is also linked with the level of mainstreaming, but no countries thus far produced a comprehensive post-evaluation report of NAPA implementation. This is an area that requires strengthening in all countries in order to ensure effective mainstreaming. Compatibility in time horizon and timing of establishing development and adaptation plans matters for effective mainstreaming. Experience of implementation could be an important factor affecting the progress of mainstreaming, but this study faced a challenge in objectively assigning a rating. Financial feasibility was found to be not closely linked to the level of mainstreaming. This would be explained by the fact that development partners can still selectively provide financial and technical support to priority projects or programs of their interests and expertise, even if the overall financial needs are too high. Bangladesh and Nepal have high resource requirements due to the medium-term nature of their NAPAs, and this will not be a constraint on implementation. Among the six countries, Cambodia is rated poorly despite medium ratings in five out of six factors. Its recent progress through the preparation of SPCR improved the recognition rating, but the timing of preparation of the latest development plan (2008-2009) contributed to the lower overall mainstreaming score. Poor implementation capacity may be affecting the slow progress of mainstreaming.

Table 2-6: Link between factors and level of mainstreaming

Evaluation	Minimal	Minimal (Nascent)	Limited			Advanced
Factor Rating	Bhutan	Cambodia	Lao PDR	Maldives	Nepal	Bangladesh
++	F		F		M, T	C, R, M, I, T
+	I	C, R, F, I, T	C	C, I, T	C, R	
-	C, R, M, T	M	R, M, I, T	R, M, F	F, I	F

C: Coordination; R: Recognition; M: M & E; F: Financial feasibility; I: Implementation experience; T: Time compatibility

The study identified that an important factor that hampers mainstreaming is incompatibility between NAPAs and national development plans in terms of the time horizon. The NAPAs generally lack long-term perspectives as they highlight priority activities (projects) by addressing urgent and immediate needs of LDCs. Bangladesh overcame this problem by developing the BCCSAP before developing its SPCR. In Nepal, prioritized activities in the NAPA include both urgent and immediate needs and long-term adaptation strategies in key vulnerable sectors, and are clustered into programs, unlike NAPAs of other countries developed earlier.

Then, the PPCR was invented to address gaps and weaknesses in the NAPA by taking a programmatic approach with a longer-term horizon. Cambodia and Nepal benefited from the PPCR process, and they identified the need for mainstreaming in the SPCR. Closely linked with funding, SPCR's implementation is more encouraging than that of NAPA, while implementation results are yet to be seen.

Development partners play an important role in promoting mainstreaming (Sietz et al 2011). Since Bangladesh is well known for its high vulnerability to climate change impacts, many development partners piloted their adaptation-related assistance in Bangladesh.[21] Nepal's substantial progress in the adaptation agenda since 2008 has been assisted by several development partners. Technical assistance to strengthen mainstreaming has been approved for all the three SPCR countries with SPCR funding. Even to a relatively advanced country such as Bangladesh, support is being provided to strengthen institutional capacity, and enhance knowledge and awareness of climate change adaptation (ADB 2011). Lao PDR is also receiving support from the Asian Development Bank (ADB) for capacity development in climate adaptation (ADB 2010). It should be noted that the six countries analyzed have been and are being supported by almost the same development partners. Preparation of NAPA in all six countries was supported by the Global Environment Facility (GEF) and UNDP, except that Nepal's NAPA was additionally supported by the Government of Denmark and UK Department for International Development (DFID). The development of SPCR as well as its implementation in Bangladesh and Nepal is supported by ADB, International Finance Corporation (IFC), and the World Bank, while the SPCR in Cambodia is supported only by ADB. Therefore, differences in the level and approach of mainstreaming resulting from the involvement of different development partners are not observed in the analysis.

The analysis also provides practical insights on how the scope of NAPAs can be improved. First, as mentioned above, it should have a medium-term horizon. Second, the need for mainstreaming should be well discussed among the key stakeholders. Third, the M&E arrangement needs to be well elaborated, with clearly defined roles and responsibilities, specific indicators and targets, and measures to strengthen M&E capacity. Fourth, the implementation capacity of technical ministries to execute priority projects needs to be further highlighted, together with enhanced understanding and awareness of climate change consequences and options for strengthening resilience. Fifth, adaptation plans should be consulted with potential financiers from an early stage. This would enable tapping their advisory support and meeting their requirements early. A few interviews with officials of LDCs revealed frustration on the part of LDCs due to difficulties in receiving necessary funding for implementation of NAPAs which were supposed to address urgent and immediate adaptation needs of the LDCs. Consultations with potential beneficiaries raised their expectations, which have often not been met to date. SPCR demonstrates its benefits by facilitating mainstreaming and creating a direct link with funding. Lastly but quite importantly, finance and planning ministries need to be proactively involved in the planning process to ensure integration in the country's development plans and

[21] One initiative was the establishment of the Bangladesh Climate Change Resilience Fund in 2010, which is a multi-donor trust fund separate from the government's trust fund, contributed by Denmark, the European Union, Sweden, Switzerland, and the United Kingdom, with technical support from the World Bank, to support the implementation of the BCCSAP. Development partners have contributed $125 million to date.

budget allocation. These issues are gaining importance because of a decision made by COP 16 in 2010 to support the NAPA update, as well as a decision in COP 17 in 2011 to formulate national adaptation plans (NAPs). The NAPs again emphasize the integration of climate change adaptation into development planning processes and strategies. Therefore, be it NAPA update or preparation of NAP, it is critical to incorporate the lessons of NAPAs to facilitate mainstreaming.

2.7 Conclusion

Two perspectives are proposed in assessing the success of mainstreaming climate change adaptation into national development plans: (i) integration of climate change adaptation consideration into development priorities; and (ii) a country's own initiatives. An analysis of the level of mainstreaming in six LDCs in South and Southeast Asia found that there is a large difference among countries: while Bangladesh is advanced, mainstreaming is generally still limited or minimal in other countries. Bangladesh's adaptation priorities are well integrated into development plans, and these development priorities are discussed in the context of climate change adaptation. The fact that the country has developed the BCCSAP and established its CCTF with the government's own funding of about $300 million to implement the BCCSAP clearly demonstrates the success of mainstreaming efforts.

The study proposed an analytical framework that comprises six factors that would determine the success of mainstreaming efforts, and applied it to assess the link with the level of adaptation mainstreaming. The analysis indicated that four factors out of six are closely associated with the overall level of mainstreaming. Coordination among relevant agencies, particularly between the environment ministry and finance and/or planning ministries, is found most relevant to the level of mainstreaming. This needs to be supported by the highest levels of the government. Recognition of the need for mainstreaming, M&E, and time compatibility also have good relevance, and improvement in these areas will likely enhance the level of mainstreaming. The study faced a challenge in objectively assigning a rating to implementation experience. Financial feasibility measured by the financial resource requirements of adaptation plans vis-à-vis the ODA receipts of the country is found to be largely irrelevant to the level of mainstreaming. This analytical framework can be applied to assess the level of and bottlenecks in mainstreaming in other countries as well.

The analysis further provides policy recommendations for strengthening NAPAs to facilitate mainstreaming: NAPAs should (i) have a medium-term horizon, (ii) recognize the need for mainstreaming, (iii) have a clear M&E arrangement, (iv) address implementation capacity issues, (v) involve potential financiers in the process, and (vi) meaningfully involve key stakeholders, particularly finance and/or planning ministries.

Chapter 3: Climate adaptation mainstreaming at city level

3.1 Introduction

As the impacts of climate change are observed significantly differently in different localities, adaptation measures need to be location-specific. Strengthening resilience to climate change is critical in cities in developing countries, as their vulnerability, measured in terms of exposure, sensitivity, and adaptive capacity, is high. Urban climate adaptation is rapidly becoming an emerging policy domain (Birkmann et al 2010). However, many urban adaptation plans or strategies have thus far been developed in developed countries, and still only a handful of plans are available from developing countries. There is even less experience in implementation of these plans.

There are direct benefits from adaptation in cities, by addressing the consequences of climate change such as heavy rainfall, flooding, or extreme temperatures, in contrast to the rather indirect benefits from climate mitigation. However, cities particularly in the global South have surprisingly focused much more on mitigation than adaptation (Bulkely et al 2009). This can be attributed to the historical dominance of the mitigation agenda within the international arena, better availability of external support including financing such as the Clean Development Mechanism (CDM), and compatibility of time-horizon among development plans, mitigation (rather than adaptation which needs a longer-time horizon), and terms of elected representatives. Although mitigation interventions may demonstrate tangible changes over the short-term, benefits of adaptation interventions will become evident over the long-term.

Nevertheless, there has been a very large expansion in the literature of relevance to climate change adaptation in urban areas in recent years. As some cities are much more advanced than others, it is important to identify what specific factors are contributing to adaptation planning. This chapter reviews the literature and identifies key determinants/factors in mainstreaming climate adaptation into the development plans of developing country cities, and compares them with those identified at country level in Chapter 2.

3.2 Factors affecting urban adaptation planning in cities

3.2.1 Review of adaptation planning in developing country cities

Although it is difficult to estimate how many cities in developing countries have developed adaptation strategies and plans or adequately incorporated climate change adaptation considerations in their development plans, not many examples can be found in the international peer-reviewed and gray literature. The literature covers both cities that have successfully advanced the climate chang adaptation agenda in their planning, and those that have not. Carmin et al (2012a) sent a questionnaire in 2011 to 1,075 cities in the world, both developed and developing country cities that are members of ICLEI – Local Governments for Sustainability, and received a reply from 468 cities. According to the answers, 68% of cities

report initiating some form of adaptation planning. But this percentage is likely biased as respondents to the questionnaire are likely more sensitized than others. Moreover, the quality of planning is not questioned or validated.

Carmin et al (2012b) examine the development of adaptation planning in Durban (South Africa) and Quito (Ecuador). In both cases, climate adaptation was advanced in the planning by linking to existing development agenda, and making it a part of current citywide priorities and initiatives. In Durban, the Headline Climate Change Adaptation Strategy, led by the Environment Planning and Climate Protection Department (EPCPD) and launched in 2006, did not catalyze the development of adaptation actions. This was because the strategy did not specify goals or activities that departments (e.g., water supply, health) should pursue. Preoccupied with other urgent development challenges and pressures, these departments might have perceived climate change as a distant threat, or an issue that EPCPD should address. In response, sector specific adaptation plans (called Municipal Adaptation Plans (MAPs)) were developed in alignment with existing business plans, development objectives, and available funding and skills of concerned sectors in consultation with sector departments. Roberts (2010) observed that sector-specific MAP worked better, though implementation depended upon the capacity of sector departments. What was done here is precisely 'mainstreaming' – incorporating climate adaptation considerations into existing development agenda (of concerned sectors), rather than developing stand-alone climate adaptation plans. In Quito, from the beginning, the city incorporated climate adaptation into existing plans and programs in the belief that this will increase the likelihood that adaptation measures will be successfully developed and implemented. As a result, the Quito Strategy for Climate Change was approved by the Metropolitan Council in 2009. In both cases, inter-departmental cooperation within the municipality was a critical factor in mainstreaming. Carmin et al (2012b) analyzed endogenous and exogenous forces that led to adaptation initiatives in these two cities, presented in Table 3-1 below. In summary, they conclude endogenous forces are more influential in emerging policy domains such as climate adaptation, and that three factors that drive adaptation initiatives in both cities are (i) efforts of champions;[22] (ii) existing natural hazards and risks that will make cities more vulnerable as a consequence of climate change; and (iii) seeing adaptation as a means to secure the cities' development paths. On the other hand, as a front-runner, these cities were not pressured by mandates or recommendations of external parties. They further point out that other cities that follow are likely to exhibit different patterns of action, with the option of adopting practices that have been identified and vetted, possibly with external assistance and under an international or national framework or mandates.

[22] Champions refer to an individual or an organization who is inspired to push the adaptation agenda forward.

Table 3-1: Exogenous and endogenous forces that affect advancement of adaptation initiatives: case of Durban and Quito

	Durban	Quito
Exogenous forces:		
National climate regulations and plans	No mandates	No mandates
Support from development partners	Came in later	Not relevant
Diffusion of information and ideas	Few sources of diffusion shaping the adaptation initiative	Not relevant
Others		Hosting a regional conference on climate change
Endogenous factors:		
Local champion or leadership	Led by a city official	Mayor and metropolitan councilor
Managers and staff in city departments (internal collaboration)	Supported the initiative	Supported the initiative
Partnership with civil society actors	Not a major player, but supported initiative	Played a role in promoting the agenda through research and training
Current/historical problems associated with climate change	Flooding and coastal erosion	Water scarcity

Source: Carmin et al (2012), summarized by author.

Heinricks et al (2011) review the experience of eight cities – Bogota (Colombia), Cape Town (South Africa), Delhi (India), Pearl River Delta (China), Pune (India), Santiago de Chile (Chile), Sao Paolo (Brazil), and Singapore – and compare their progress toward adaptation, including an analysis of motivating factors that drive adaptation planning and action.[23] They find that key drivers of adaptation action include (i) clear awareness by local stakeholders of local vulnerability to climate change, often linked to historical disaster experiences; (ii) support and priority for already existing strategies, ensuring mainstreaming of adaptation action and serving as an opportunity to developing existing local development goals further; (iii) strong local leadership; (iv) interpersonal and inter-institutional interaction to establish confidence in priorities; (v) dedicated climate teams, and (vi) enhancing financial capacities.

Bulkeley et al (2009) undertook a review of the evidence base and 10 case studies of cities in eight countries, seven of which are developing countries: Beijing (China), Cape Town (South Africa), Hong Kong (China), Yogyakarta (Indonesia), New Delhi (India), Melbourne (Australia), Mexico City (Mexico), Mumbai (India), Sao Paolo (Brazil), and Seoul (South Korea). They found key drivers and challenges promoting the adaptation agenda are as follows: (i) availability of data and information about local impacts from climate change; (ii) good

[23] Among them, Cape Town, Delhi, and Sao Paolo have local adaptation strategy/plans.

governance (particularly of local governments); (iii) access to financial and human resources, provided by the national government or international donors; (iv) coordination of policies and measures across both local agencies and levels of government; (v) empowerment and training of civil society to help strengthen service provision, environmental management, and the livelihoods of the most vulnerable people; and (vi) nurturing a sense of readiness for disaster emergency (existence of trigger events).

Tanner et al (2009) conducted rapid climate resilience assessments in 10 Asian cities: Bangkok (Thailand), Chennai (India), Chittagong (Bangladesh), Cochin (India), Dalian (China), Da Nang (Viet Nam), Hangzhou (China), Ho Chi Minh City (Viet Nam), Ningbo (China), and Surat (India). While their main interests were in developing an analytical framework to link good urban governance with urban climate resilience, the following factors are identified to contribute to facilitating adaptation initiatives: (i) levels of awareness and understanding of climate risks; (ii) levels of motivation among elected representatives and government departments; (iii) access to resources; (iv) accountability in city planning and participation of city residents in planning processes; and (v) national level engagement with international climate policy.

By reviewing the experiences of climate resilience building in 10 secondary cities in South and Southeast Asia, Brown et al (2012) find coordination with other agencies and the capacity of local governments important as key challenges in implementing adaptation.

Other than these comparative studies of cities, individual city-level adaptation planning is discussed for Mombasa (Kenya) (Kithiia and Dowling 2010); Ho Chi Minh City (Viet Nam) (Birkmann et al 2010, Storch et al 2009); and Dhaka (Bangladesh) (Roy 2009), among others. However, these cities do not have an adaptation plan or strategy, and discussions in the literature are centered on either how climate change adaptation can be mainstreamed and integrated into development planning or review of adaptation options. Although the factors that have supported or will facilitate climate adaptation mainstreaming is not a main topic of these papers, these papers stress stakeholder engagement, better understanding of local impacts of climate change, and capacity building of local governments to facilitate mainstreaming. Other studies on climate adaptation in cities often highlight the importance of capacity of local governments (e.g., Sharma and Tomar 2010).

Climate change adaptation specific to a city in a developing country, which at least discusses the need for adaptation, and may include impact assessment and proposal of adaptation options, is increasingly available in the literature, and examples in recent years include Kampala (Uganda) (Lwasa 2010); Dhaka (Bangladesh) (Alam and Rabbani 2007, Haque et al 2012); Chittagong (Bangladesh) (Ahammad 2011); Jakarta (Indonesia) (Firman et al 2011); Ho Chi Minh City (Vietnam) (Storch and Downes 2011); and Mumbai (India) (Ranger et al 2011). Hunt and Watkiss (2011) list up cities which were studied on climate adaptation. However, these papers generally do not discuss factors required to promote climate adaptation mainstreaming, except for highlighting the need for local government capacity in effectively implementing various adaptation measures.

3.2.2 Review of adaptation planning in developed country cities

Regarding the analysis of factors affecting adaptation actions at the local level in developed country cities, the work undertaken by Kazmierczak and Carter (2010) would be most comprehensive. They first review previous research both in developed and developing countries, and summarize the main factors affecting the development and implementation of adaptation strategies by these studies. Then they undertake 15 in-depth case studies, all of which are cities in developed countries, on issues relating to climate change adaptation planning and decision-making. Many of the factors overlap with those identified by reviewing the previous research, while some other lessons are also identified. However, some factors they identified have a different nature and characteristics: for example, “clear action plan” is not a factor for successful adaptation planning or mainstreaming; and “adaptation actions delivering wider benefits” refer to the nature of adaptation options, rather than a factor for promoting planning. Moreover, some factors such as “need for development despite climatic impacts” would be common to all developing countries. Therefore, these factors can be narrowed down to 10 potential key determinants for developing country cities: (i) policy framework at higher levels; (ii) current problems associated with climate change; (iii) leadership and championship; (iv) public awareness and engagement; (v) internal collaboration; (vi) external collaboration (partnership); (vii) learning from others; (viii) developing a sound evidence base; (ix) access to funding, including subsidies and incentives; and (x) monitoring and evaluation.

In a survey of 468 cities, more than 60% of which are in the United States, Carmin et al (2012a) report that the three top-ranked key challenges to urban adaptation planning are (i) securing funding for adaptation; (ii) communicating the need for adaptation to elected officials and local departments; and (iii) gaining commitment and generating appreciation from national government for the realities of local adaptation challenges.

3.3 Discussions

3.3.1 Selection of key factors

Key factors identified in the studies reviewed in Sections 3.2.1 and 3.2.2 are summarized in Table 3-2 below.

Table 3-2: Summary of factors for promoting adaptation planning at city level

	Carmin et al (2012b)	Adjusted from Kazmierczak and Carter (2010)	Heinricks et al (2011)	Bulkeley et al (2009)	Tanner et al (2009), other studies
Exogenous forces:					

National climate regulations and plans/policy frameworks at higher levels	No	Yes	Yes	Not discussed	National-level engagement important
Support from development partners/access to funding	No	Yes	For some	Yes	Yes
Availability/ diffusion of information and ideas, evidence base	Few sources of diffusion shaping the adaptation initiative	Yes	Yes	Yes	Level of understanding of climate risks
Others	Enhance city visibility as an environmental leader	Learning from others	Hosting a regional conference on climate change		
Endogenous factors:					
Leadership/championship	Yes	Yes	Yes	No	Not discussed
Internal collaboration	Yes	Yes	Yes	Yes	Yes
Partnership (with higher level of government, civil society actors, public)	Not a major player, but supported initiative.	Yes	Played a role in promoting the agenda through research and training.	Stressed as "good governance"	Accountability mechanism in city planning, stakeholder engagement
Current/historical problems associated with climate change	Yes	Yes	Yes	Yes	Not discussed

Based on this, key factors for adaptation mainstreaming may be identified as follows. Among the exogenous factors, availability of local-level data and information on the direct and indirect impacts of climate change is considered important. Since impacts of climate change may significantly differ from one city to another, a solid science and knowledge base is a prerequisite for effective adaptation planning. External support including financial assistance is also an important catalyst to promote mainstreaming. Considering the financial, technical, and human resource constraints that most local governments in developing countries face, development partners and international NGOs have an important role to play. However, it is also possible that, as in the case of Durban and Quito, external support comes in later, after progress has been made in mainstreaming adaptation into the development planning. Development partners are generally willing to support good performers for further advancement. Presence of legislative or policy frameworks and requirements at higher levels will help set a framework for adaptation responses within local governments. This, however, may not be as relevant in developing countries as in developed countries, as legislative requirements set at the

national level may not be necessarily translated into immediate actions by developing country cities due to resource and capacity constraints of local governments and general lack of close collaboration between them. As discussed in Carmin et al (2012b), these two factors, external support and mandates set at a higher level, may be increasingly more relevant over time, as climate adaptation becomes a more mature policy field. A number of developing country cities in Asia are receiving support in climate-resilient planning from development partners, such as the Cities and Climate Change program of UN-HABITAT and Asian Cities Climate Change Resilience Network of the Rockefeller Foundation.

Among the endogenous factors, leadership and championship is considered essential. The leadership would take a different form than that witnessed in the context of mitigation, as leadership for adaptation requires a focus on the needs of communities across the city, as opposed to pioneering innovations in particular sectors in the case of mitigation (Bulkeley et al 2009). This leadership needs to foster stakeholder engagement, inter-departmental collaboration, and consultation processes. While political will and leadership matters for a multi-sectoral and complex issue like climate change adaptation, a local champion who is not a political leader could also make a major change (as observed in Durban). Relevant to leadership is good governance. One particular feature of adaptation, different from mitigation, is that the urban poor are usually most vulnerable to the impacts of climate change. They tend to live in areas where basic infrastructure and services are less available, and exposure to risks from extreme weather events such as flooding is the highest. Their housing may not be meeting building codes and will be the first to be affected. Insurance is not available to protect them against these risks. Therefore, good governance, represented by enhanced accountability, inclusiveness, and transparency, needs to be demonstrated by local governments, so that development investments will improve service coverage and support better housing for the poor, thereby reducing their vulnerability. Capacity of local governments is also often discussed as a crucial factor in adaptation planning and implementation, or any matter relating to development and poverty reduction in urban areas. While their capacity is certainly crucial, good governance captures better the required features in the context of climate adaptation. Tanner et al (2009) discuss five key characteristics of good urban governance comprising (i) decentralization and autonomy, (ii) accountability and transparency; (iii) responsiveness and flexibility; (iv) participation and inclusion; and (v) experience and support.

Internal collaboration is another important determinant. Unlike business-as-usual development planning or mitigation planning where sector-wise intervention can be effective, adaptation is a cross-sectoral and multidisciplinary issue. For example, reducing flooding in cities will need not only a flood control infrastructure, but also better urban planning and land-use management, revision of building codes, emergency planning, raising the awareness of the public on hazards and evacuation, better solid waste management (so as not to clog drainage systems), among others, in order to be effective. Current problems associated with climate and its variability is also a crucial factor for promoting adaptation agenda. Existing problems will make it easier for all stakeholders to link their development issues with adaptation, and trigger actions to address adaptation in their development endeavors.

Therefore, key factors for adaptation mainstreaming at city level would include (i) a solid knowledge base on climate impact and vulnerability; (ii) leadership and championship; (iii) good governance of local governments; (iv) internal collaboration; and (v) existing problems linked with climate. These factors will be further examined in the case of Bangkok, discussed in Chapter 5. Although not discussed well in the literature, monitoring and evaluation (M&E) will be particularly important after planning is done, so that the implementation of development plans which incorporate adaptation will be checked and necessary remedial actions can be taken. However, lack of implementation experience and a longer time-horizon required before its benefits are evaluated result in limited focus on M&E to date. These factors play an important role in the cycle of development planning that mainstreams adaptation and its implementation, as presented in Figure 3-1. Existing problems linked with climate works as a trigger for mainstreaming. Then a sound knowledge base needs to be formed, which will become the basis of adaptation-mainstreamed planning and project preparation. Throughout the cycle of planning and implementation, good governance ensures inclusive and participatory processes, particularly important for adaptation as the poor tends to be most vulnerable. The whole process requires internal collaboration as well as leadership and championship, due to the cross-sectoral and multidisciplinary nature of adaptation.

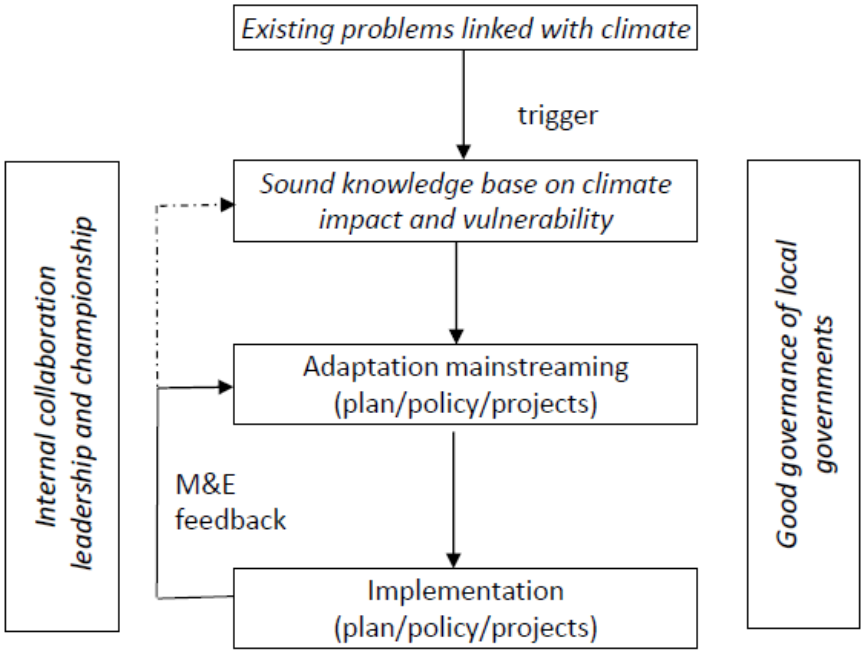

Figure 3-1: Planning and implementation, and role of five factors (shown in italics)

3.3.2 Comparison of key factors at the country and city levels

Chapter 2 reviewed the National Adaptation Programmes of Action (NAPAs) in six least developed countries (LDCs) in South and Southeast Asia and concluded that four factors are

closely related to the level of mainstreaming at the country level: (i) inter-ministerial coordination supported by the highest levels of government, (ii) recognition of the need for mainstreaming, (iii) M&E, and (iv) compatibility of the plans in terms of the time horizon and timing of planning. The factors identified at country and city levels are compared to understand differences and commonalities in the approaches for promoting mainstreaming. The factors as well as Figures 2-1 and 3-1 are reviewed.

First, internal collaboration and leadership and championship identified at the city level are essentially synonymous with inter-ministerial coordination supported by the highest levels of government. This reflects the multidisciplinary nature of adaptation that goes beyond the jurisdiction of any one ministry or department, which also requires intervention of leaders to bring changes from the status quo. A difference is that local champions (individual or organization) may be good enough at the local/city level, but (political) leadership becomes necessary on the national scale. The remaining three key determinants at the city level, on the other hand, reflect the need for location-specific intervention of adaptation. Adaptation planning at the city level requires a solid knowledge base on the impacts of climate change and their variability on a particular city and its vulnerability, and such work can be triggered by climate-related events and problems. At country level, understanding impacts and vulnerability was identified as an important factor, although it was not included in the evaluation.[24] The concept of good governance involves consultative and participatory processes in planning, which was also identified as a factor at the country level. Similarly, this was not included in the analysis at country level because of the difficulty in objectively assessing the quality. Consultation and participation is more important at city level to address the needs of climate-vulnerable poor, as climate change often has bigger impacts on the poor who do not have adequate housing and access to infrastructure. Existing problems linked with climate, was noted as an important factor in the success of Bangladesh's mainstreaming which builds upon their experience on disasters, and would be relevant at the country level, if disasters are affecting large and/or important areas of the country. Therefore, all five factors at city level are relevant at country level as well.

Similarly, other factors at the country level, which are not discussed much at the city level, are relevant for cities too, while the approach for mainstreaming is somewhat different. At the national level, LDCs developed adaptation plans (i.e., NAPAs and/or SPCRs) separately from their medium-term development plans. Therefore, by reviewing both documents, it was possible to assess whether mainstreaming needs are recognized, whether the solid M&E framework exists, and whether there is time compatibility between the two plans. On the other hand, very few developing country cities have developed stand-alone adaptation plans. Without a plan, these factors cannot be verified. Time compatibility will not be a problem unless separate plans are worked out for (general) development and climate adaptation. In fact, lack of stand-alone adaptation plans provides an opportunity for cities in developing countries to move straight to mainstreaming climate adaptation in their existing or new development plans by avoiding parallel processes. As it will ensure time compatibility of adaptation priorities and development priorities, mainstreaming adaptation into development planning would be a more

[24] This is not because this factor is less important at country level, but rather because there is no distinctive difference among countries that prepared NAPA. Necessary assessments have been undertaken during NAPA processes. See Section 2-4.

plausible approach than making a separate adaptation plan. Another reason different factors have been identified is because the planning process is more solidly established at the country level: many countries have decades of experience in national development planning; NAPA processes were closely supported by development partners (GEF and UNDP); and NAPAs were prepared in accordance with the Guidelines. Therefore, consultation processes (good governance) and existing problems linked with climate did not become bottlenecks in the planning. It is the author's view that a clear institutional arrangement for M&E including mandates, scope, indictors, and targets, as well as the need for mainstreaming, are both important factors at the city level too, which will be assessed once a development plan integrating (mainstreaming) climate change adaptation is formulated. Relevance of the factors at the country and city levels is summarized in Table 3-3 below:

Table 3-3 Key factors affecting the level of mainstreaming at country and city levels

Country level	**City level**	Remarks
(i) inter-ministerial coordination supported by the highest levels of government	(i) leadership and championship	Coherent due to cross-sectoral and multidisciplinary nature of adaptation
	(ii) internal collaboration	
(ii) recognition of the need for mainstreaming		Applicable at city level once an adaptation plan is developed
(iii) monitoring and evaluation (M&E)		Applicable at city level once an adaptation plan is developed
(iv) compatibility of the plans in terms of time horizon and timing of planning		Applicable if two plans are separately developed
(understanding impacts, vulnerability, and needs)	(iii) solid knowledge base on climate impact and vulnerability	Underscores the fact that climate impacts and adaptation requirements are location-specific
(consultation and participation) (government capacity)	(iv) good governance of local governments	Participation and inclusiveness are critical, more so at the local level as the poor tend to be most vulnerable.
	(v) existing problems linked with climate	Country-level mainstreaming can also be influenced by climate-related disasters (e.g., Bangladesh).

Therefore, there is high overall coherence among key factors affecting mainstreaming, accentuated by different approaches and priorities due to scales in question. Characteristics that NAPAs should have for successful mainstreaming would be largely applicable to city-level planning: a city-level development plan with adaptation mainstreaming should (i) have a medium-term horizon, (ii) recognize the need for mainstreaming, (iii) have a clear M&E arrangement, (iv) address implementation capacity issues, (v) involve potential financiers in the process, and (vi) meaningfully involve key stakeholders, particularly finance and/or planning departments of local governments. A solid knowledge base on local impacts of climate change and good governance in the form of participation and inclusiveness are further added because of the need for location-specific planning.

3.4 Conclusion

Through a literature review, exogenous and endogenous factors that are important in promoting adaptation mainstreaming at city level have been identified. Although it is not possible to objectively conclude a definitive list, key determinants include: (i) a solid knowledge base on climate impact and vulnerability; (ii) leadership and championship; (iii) good governance of local governments; (iv) internal collaboration; and (v) existing problems linked with climate. Comparing them with the factors at country level tested in Chapter 2 indicates high coherence, with difference coming mainly from (i) difference in scale being discussed, and (ii) difference in planning approaches. The location-specific nature of adaptation stresses the need for a solid knowledge base on climate impact and vulnerability, and good governance represented by inclusive processes and participation. The high coherence of factors derived through different processes at country and city levels signifies the validity of the factors selected.

Chapter 4: Climate adaptation mainstreaming at project level: climate-proofing

4.1 Introduction

Climate adaptation mainstreaming at the country and city levels was discussed in Chapters 2 and 3. Development plans that incorporate climate adaptation, either at national or city level, then need to be translated into implementation. Implementation usually takes the form of specific projects, while actions arising from climate-mainstreamed development plans can also take the form of policy, regulatory, organizational, and financial interventions without accompanying physical alterations. In order to be effective and sustainable in strengthening the resilience of cities, each of these measures needs to properly take account of future climate change and variability, or 'mainstream' climate adaptation. It is essential to assess whether proposed adaptation measures, be it a project or regulatory development, are effective in reducing vulnerability and strengthening resilience to climate change. Therefore, climate-proofing, which is an approach for ensuring mainstreaming at project level, is the main theme of this Chapter.

For any city, the scale of risks from climate change and variability is highly influenced by the quality of housing and infrastructure in that city (Huq et al 2007). Generally, cities in high-income nations have had their risks reduced as a result of decades of investment in housing and infrastructure: people are living in legal housing built with permanent materials meeting safety standards, and served with risk-reducing infrastructure including paved roads, storm and surface drainage, piped water supply systems, and solid waste management. However, the situation can be very different in developing country cities: cities are faced with an 'adaptation deficit,' as discussed in Chapter 1; and many people are living in poor-quality housing in disaster-prone areas, becoming the first to be affected in extreme weather events. This points to the need for improving infrastructure in developing countries. As infrastructure investments have long operational lives, in some cases up to 100 years or longer, it is critical that such investments take climate impacts into account.

This Chapter has two objectives. The first objective is to identify advantages and challenges of climate-proofing by undertaking a comparative review of seven cases in developing countries in Asia where climate-proofing assessment has been conducted. The second objective is to specifically look into the robustness of proposed adaptation options under uncertainty. The analysis highlights the importance of assessing synergies, complementarity, and conflicts among the options, which are hardly discussed in the literature, by analyzing specific adaptation options for the water supply and urban drainage systems in Khulna, Bangladesh. Before discussing the two issues, the Chapter first discusses two main approaches for climate-proofing, since each approach requires caution in deriving appropriate adaptation options.

4.2 Methodology

Review of the existing literature forms the basis of this Chapter, particularly for the discussion of two main approaches of climate-proofing (Section 4.3) and review of seven case studies (Section 4.4). There are still a very limited number of quantitative climate impact assessments in developing countries, including in Asia, as reviewed by Hunt and Watkiss (2011). Moreover, the vast majority of research studies stop at impact assessment (Wilby and Dessai 2011), and do not provide specific adaptation options. Through a careful literature search, seven climate-proofing studies in developing Asia have been found and are reviewed for a comparative analysis. They are, namely, (i) urban flooding in Bangkok (Thailand) (Panya Consultants 2009; ADB et al. 2010), (ii) urban flooding in Ho Chi Minh City (Viet Nam) (ADB 2010a; ADB et al. 2010), (iii) urban flooding in Manila (Philippines) (Muto et al. 2010; ADB et al. 2010), (iv) urban flooding in Khulna (Bangladesh) (ADB 2010b; ADB 2011b), (v) water supply in Khulna (Bangladesh) (ADB 2010b; ADB 2011b), (vi) inland monsoon flooding in Bangladesh (World Bank 2010a; World Bank 2011a), and (vii) cyclones in Bangladesh (World Bank 2010b; World Bank 2011a). Hallegatte et al (2010) carried out a quantitative assessment of flood risks, climate change impacts, and adaptation benefits in Mumbai, India, but they did not consider design of the infrastructure for adaptation and quantify such costs. Similarly, World Bank (2011b) did not monetize costs and benefits of adaptation in Kolkata, India, when they assessed vulnerability and damages from climate change by urban floods. Thus these are not included in this comparative study. Studies estimating costs of adaptation at the macro level, for a country as a whole or the global level (e.g., World Bank 2010c; Parry et al 2009), are not included as they do not indicate area- or type-specific climate-proofing of infrastructure. The analysis demonstrates the level of detail that the assessments can provide in quantitative terms, and how the findings can be used for decision-making and further design work. Limitations and weaknesses of assessments are also flagged by referring to four criteria for evaluating adaptation options, proposed by Adger et al (2005).

Additional analysis is conducted for Khulna, Bangladesh. Major reasons for focusing on Khulna are the availability of background data, its uniqueness to address both water supply and urban flooding systems, as well as the author's familiarity with the study. The analysis relies on a review of existing documents, both peer-reviewed journals and gray literature. Adaptation options identified in the case-study documents are further analyzed by applying criteria based on those proposed by Hallegatte (2009) to measure robustness under uncertainty. The analysis also makes use of the author's hands-on knowledge and experience in Khulna, which was obtained through implementing a technical assistance project funded by the Asian Development Bank (ADB), including field visits and engaging in discussions with various government agencies. This helps to triangulate the information provided in key documents, and is further supplemented by a few interviews with city officials and experts concerned.

4.3 Climate-proofing: concept and approaches

Adaptation planning at the project level requires information on the location-specific impacts of climate change, as the impacts of climate change and adaptation options could

significantly vary among locations (Hallegatte et al. 2011). However, many studies to date have been primarily in qualitative terms particularly in developing countries, and climate change risk assessment at the city-scale is still in its infancy (Hunt and Watkiss 2011). A qualitative assessment does not provide decision-makers with key information on whether taking adaptation measures proposed on the basis of assessments is effective and economically justified. Another difficulty is the lack of information on how much and by when the infrastructure needs to be strengthened to adapt to climate change: it has been widely understood, for example, that urban drainage and flood control systems need to be strengthened to cope with more intense and frequent rainfalls caused by climate change; but without quantitative data, the national or local governments cannot decide by when and to what extent the improvements are necessary.

The need for incorporating climate change in the design of infrastructure is increasingly recognized (e.g., Sanchez-Rodriguez 2009). This is often referred to as 'climate-proofing.' Although there are several definitions of 'climate-proofing,' as found in ADB (2005) and Klein et al. (2007), and discussed comprehensively in Sveiven (2010) and UNDP (2011), it is defined in this paper as **the explicit consideration and internalization of climate change to deliver intended services of a proposed intervention at acceptable levels over the expected life of the intervention.** Since mainstreaming means integrating climate change adaptation into development planning, policies, and strategies (UNFCCC 2002; OECD 2006; Lasco et al. 2009), climate-proofing infrastructure is part and parcel of the mainstreaming process (UNDP 2011), or one stage (project stage) of mainstreaming (Sveiven 2010). Klein (2010) criticizes climate-proofing as a "mainstreaming minimum" in contrast to a "mainstreaming plus" which takes a comprehensive approach that seeks synergies with development, including removing existing financial, legal, institutional, and knowledge barriers to adaptation, and strengthening the capacity of people and organizations to adapt. However, this paper does not limit the concept of climate-proofing to adjustment of infrastructure design only; climate-proofing can (and usually does) include soft measures such as institutional and social interventions (see Table 1-3) to ensure delivery of services.

One key feature distinguishing mainstreaming and climate-proofing is that climate-proofing is highly focused on implementation aspects at the project level, whereas mainstreaming places a higher emphasis on processes and frameworks at the policy, planning, and program levels (Olhoff and Schaer 2010). Climate-proofing is effectively made through quantitative assessments of specific impacts of climate change on infrastructure and services (e.g., water supply, surface water drainage) and identification of adaptation options that will strengthen resilience and reduce vulnerability to acceptable levels. This type of analysis is often supported by development partners including multilateral development banks such as the Asian Development Bank (ADB) and World Bank, primarily because they want to make sure that the infrastructure they support, which has a long-term service life, takes climate variability and future climate change into account, and the national and local governments in developing countries often do not have adequate capacity to undertake such analysis by themselves. As many developing countries are faced with 'adaptation deficit,' and thus need improvement of infrastructure and services urgently, climate-proofing is all the more important in developing countries to ensure sustainability of service delivery by the infrastructure. ADB developed

guidelines for climate-proofing in the transport and agricultural sectors (ADB 2011a, 2012). German Technical Cooperation (GTZ 2010) also issued a guidance note for climate-proofing.

However, climate-proofing is not devoid of weaknesses and challenges. A major challenge is to address the issue of large uncertainties involved in the assessment, as climate-proofing often relies on projections made for a few decades or more distant from now. Climate-proofing through a quantitative assessment generally starts with climate-scenario building and downscaled climate projections, followed by consequent changes (e.g., increased run-off), impact assessment (e.g., level of flooding), valuation of damages (costs), identification of vulnerabilities, and identification of measures to negate or alleviate impacts. This has been classified as the Predict-Then-Act (or Adapt) or cause-based method (Lempert et al. 2004; Gersonius et al. 2012). Downscaling becomes more sophisticated and *ensemble of* models is used instead of only one model to reduce the bias in projection. However, concerns have been expressed for this method due to large uncertainties involved in the projection (e.g., World Bank 2012). Critiques suggest an effect-based approach instead, which starts by specifying an outcome used to define acceptability thresholds to manage the impacts, assesses the likelihood of attaining or exceeding this outcome as a result of changing drivers, and identifies viable adaptation strategies. A number of research articles have been published to demonstrate the effectiveness of this method (e.g., Kwadijk et al. 2011; Gersonius et al. 2012). Lal et al (2012) describe the former as the top-down scenarios-impacts-first approach and the latter as the bottom-up vulnerability-thresholds-first approach, and summarize the strengths of each approach. The steps of these two approaches are copied in Figure 4-1 below. The approach taken would have significant implications for the management of uncertainty, the timing of adaptation options, and the efficiency of policymaking. The scenarios-impacts-first approach is most useful to raise awareness of the problem, to explore possible adaptation strategies and to identify research priorities, when sufficient data and resources are available to produce state-of-the-art climate scenarios at the spatial resolutions relevant for adaptation, and when future climate impacts can be projected reliably (Lal et al 2012). The vulnerability-thresholds-first approach, on the other hand, is particularly useful for identifying priority areas for immediate action, and assessing the effectiveness of specific interventions when planning horizons are short, resources are very limited, or uncertainties about future climate impacts are very large. Features of the two approaches are summarized in Table 4-1. They further stress that these two approaches are complementary and need to be integrated (also in Mastrandrea et al 2010). Regardless of the approaches used, it is important to note that future uncertainty should not become a barrier to analyze and implement actions for reducing risks to climate change.

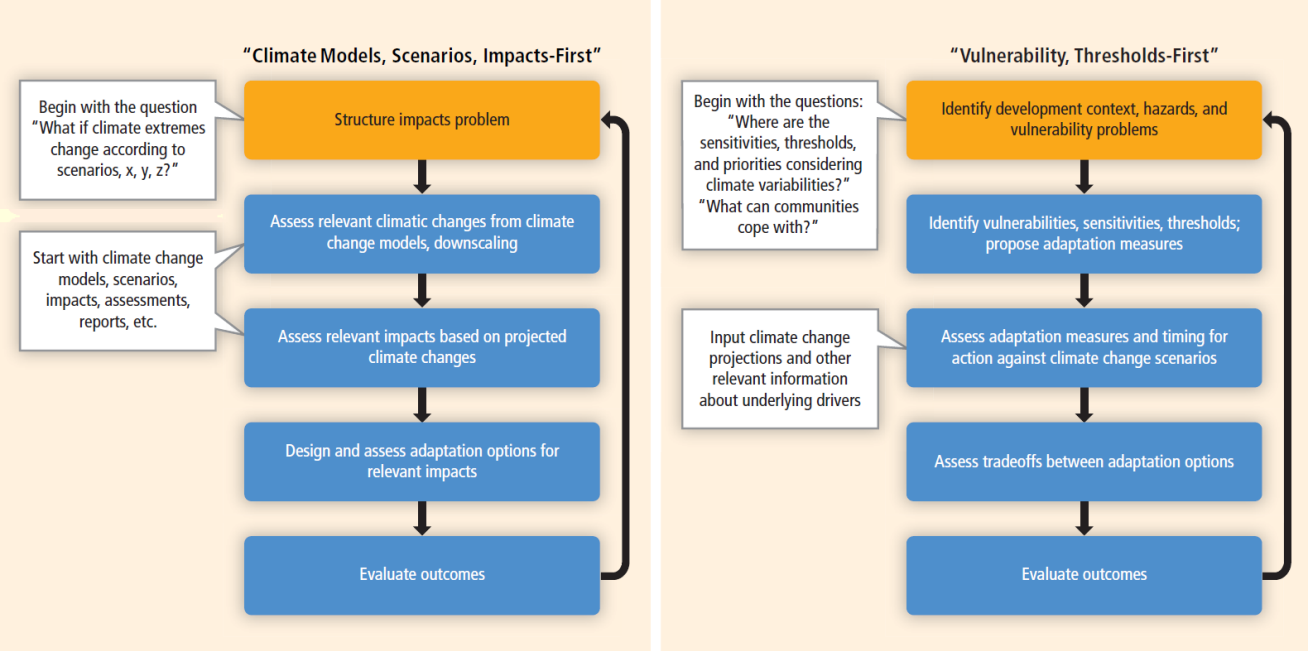

Figure 4-1: Comparison of stages of top-down scenario-impacts-first approach and bottom-up vulnerability-thresholds-first approach

Source: Lal et al (2012) (Figure 6-2, page 350)

Table 4-1 Features of two approaches

	Impacts-first (predict-then-act)	Thresholds-first
Applicability	When uncertainties are not large; When sufficient data and resources are available to produce state-of-the-art climate scenarios	When uncertainties are very large; When resources are limited
Usefulness	Raising awareness; Exploring possible adaptation strategies	Identifying priority areas for action now
Weakness	Best estimate may not be robust under different scenarios; Less consideration to current risks and non-climatic factors	Vulnerability assessment and computer processing may be time-consuming; Largely qualitative results

Source: Author based on Lal et al (2012)

The World Bank (2012) further argues limitations of the predict-then-act approach due to deep uncertainty linked to climate change. Citing that downscaling results to project climate variables at appropriate spatial and temporal scales disagrees even on the sign of rainfall changes significantly in West Africa, they stress the importance of robustness over a traditional decision-making process focused on optimality. The issue of robustness is particularly well discussed in the context of climate change uncertainties (e.g., Lempert et al. 2004; Dessai and Hulme 2007; Dessai et al. 2009; Lempert and Groves 2010). Dessai and Hulme (2007) define robust decisions as decisions that work well even with the inclusion of various uncertainties, or decisions that are insensitive to uncertainties known at the time. In this context, robust decision-making has been applied in some cases (Lempert and Kalra 2011; World Bank 2013). The

approach is somewhat similar to the vulnerability-thresholds-first approach, by beginning with a candidate decision, and identifying the future conditions under which that decision is vulnerable. Then strategies are identified to reduce those vulnerabilities, and the key tradeoffs among potential strategies are presented. These robust strategies, not necessarily optimal ones, which would perform reasonably well over a wide range of plausible futures, are often adaptive, designed to evolve over time in response to new information.

While evaluating two approaches further is beyond the scope of this study, and complementarity of the two should be pursued as mentioned above, these two approaches have other implications too. A cost-benefit analysis (CBA), which is a popular tool for assisting decision-making and recommended when both costs and benefits can be monetized (UNFCCC 2002), goes well with the scenarios-impacts-first approach, which is more straightforward and probably easier to understand for many people. In situation with limited uncertainty, the CBA and sensitivity analysis (changing parameters and/or assigning probabilities) can provide very useful information to decision-makers. Under deep uncertainty where different opinions exist about the parameters and probabilities to be used, the CBA should be applied with caution and complemented with open consultations and discussions. Under the vulnerability-thresholds-first approach (including robust decision-making), costs and benefits are usually not discussed, although it should be possible to do the CBA once robust strategies are determined.

It should also be noted that, even in the vulnerability-thresholds-first approach, uncertainties cannot be avoided with respect to the likelihood of the specified outcome to be exceeded and the timing of the event. Climate projections still need to be used to formulate plausible scenarios in the analysis. Another issue commonly found in developing countries is that the existing infrastructure is inadequate even with the current climate risks (adaptation deficit). This would mean that the “adaptation tipping points” used in the latter approach are already exceeded. It is the author’s understanding that this is the key reason all the seven cases reviewed in this paper used the former approach. Just recently, a study demonstrating the applicability of robust decision-making was undertaken for flood risk management in Ho Chi Minh City (World Bank 2013). This study did not discuss “tipping point” but assessed the robustness of a proposed infrastructure improvement plan. This is another case of climate-proofing.

4.4 Climate-proofing: review of case studies

4.4.1 Summary findings

A comparative review is made of the climate risks studied, analyses adopted, quantified costs and benefits of climate impacts and adaptation options including the availability of cost breakdown, and scope of adaptation options. Then, advantages and challenges of climate-proofing work are discussed. A summary of the review of the seven studies is given in Table 4-2.

Table 4-2 Summary of the studies reviewed

Location	Bangkok	Ho Chi Minh City	Manila	Khulna		Bangladesh	
Climate risks studied	Urban flooding	Urban flooding	Urban flooding	Urban flooding	Water availability and salinity intrusion in water supply	Inland monsoon floods	Cyclones
Time horizon	2050	2050	2050	2030, 2050	2030, 2050	2050	2050
Emission scenario used*	A1FI, B1	A2, B2	A1FI, B1	A2, B1	A2, B1	A2	Not specified
Analysis made	Cost-benefit analysis	Preliminary cost estimates of hard measures for flood control	Cost-benefit analysis	Cost-benefit analysis (including an estimate of adaptation deficit)	Least-cost analysis	Estimates of adaptation costs	Estimates of current adaptation deficit and adaptation costs
Cost of climate impacts	Yes	Yes	Yes	Yes	Not monetized	Not monetized	Yes
Cost of adaptation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cost breakdown (scope and unit cost)	Available	Not clear	Available	Available	Not available to the public	Available (but not area-specific)	Available
Key adaptation options	Canal improvement, increased pumping capacity	Combining infrastructure-based solutions with eco-system-based adaptation measures. Soft measures include livelihood protection, early warning systems, zoning controls, and mangrove forests.	River embankment, increased pumping capacity, dam construction	Improvement of drains, river dredging	Relocating water intake upstream or constructing a larger reservoir	Road height enhancement	Polders and multipurpose cyclone shelters
Other measures to enhance key options	Land subsidence suppression, flood forecasting and warning system, land use control		Land-use planning, disaster preparedness	Solid waste management, building codes, land-use planning, early warning systems	Water demand management, reduction of water leakage	Sound public policies, planning and institutions, design standards	

* As described in the IPCC Special Report on Emission Scenarios. See footnote 48.

Firstly, regarding the climate risks assessed, all studies except for the water supply system in Khulna deal with increased risks of flooding (or inundation), which may be caused by more intense rainfalls associated with monsoons or cyclones. This represents the seriousness of flood risks particularly in urban areas, due to less percolation of rainwater, high population density, concentration of assets, and increased rate of urbanization. The surface water supply system in Khulna is facing risks in terms of water availability and salinity of river water caused by sea-level rise, and change in rainfall patterns leading to a change in water flows.

Second, identified costs (and benefits) of climate change and adaptation are reviewed. Among the seven studies reviewed, five studies monetized the costs of damages, while values vary widely among the climate scenarios chosen and locations. The damage costs of a 1-in-30 year flood in 2050 under the A1FI climate scenario are estimated at $4.5 billion in Bangkok and $1.5 billion in Manila. Costs of climate change up to 2050 are between $6.2 billion and $49.5 billion for regular flooding events, and between $0.42 billion and $6.9 billion for extreme flooding in Ho Chi Minh City.[25] Damages of a 1-in-10 year flood in 2050 amount to $1.6 billion in Khulna.[26] A 1-in-10 year cyclone in 2050 will result in additional financial damage and loss of $4.6 billion in Bangladesh. Even in two studies where damage costs were not monetized, the magnitude of impacts were shown quantitatively, in terms of the number of days in a year when river salinity is higher than the drinking water quality standards in case of the water supply in Khulna, and the increase in inundation area and population exposed to inundation for inland monsoon floods in Bangladesh. While assessing the accuracy of these values is beyond the scope of this review, quantitative data on the potential damage of impacts due to climate change provide decision-makers in developing countries with the clear magnitude of problems of climate change in a form which is easy to understand.

Furthermore, all seven cases made at least a preliminary cost estimate of key adaptation measures, i.e., infrastructure improvement. Investment costs corresponding to the floods mentioned above are $1.1 billion in Bangkok and $246 million (without a dam) in Manila; $750 million in Ho Chi Minh City, though estimates are preliminary; and $38 million in Khulna's drainage system improvement.[27] The estimate of additional investment to cope with more intense cyclones is $2.4 billion in Bangladesh. To deal with the added inundation from inland monsoon floods in Bangladesh, $3.3 billion is estimated to be required.[28]

In three out of seven cases (Bangkok, Manila, and urban flooding in Khulna), the benefits of adaptation measures in the form of reduction in damage and loss from flooding, were also estimated, thereby enabling a CBA. In all three cases, adaptation investments are proven to be economically feasible, although the analysis should be regarded as indicative only. Quantitative recommendations for infrastructure improvement, such as the size of the

[25] The numbers in Ho Chi Minh City reflect the sum of a series of annual damages that are expected to occur from now up to 2050, and thus are not comparable with others which correspond to a single event.
[26] This estimate looks quite high, considering the current population of the city (about one million) and the level of assets available in the city. Significant uncertainties in the damage assessment are discussed in ADB (2011b).
[27] These proposed investments do not necessarily fully offset the flood damage.
[28] Investment costs for the water supply system in Khulna are estimated but not made available to the public.

impounding reservoir for Khulna's water supply or increase in pumping capacities in Bangkok, are provided. A breakdown of costs corresponding to the scope of infrastructure investment (such as heightening of the embankment, widening of drains) is available in most cases, including the feasibility level of details for drainage system improvement in Khulna. These design recommendations will constitute an important basis of further design work for the infrastructure. Despite the uncertainty, which is discussed later, economic impact estimates allow for a better understanding of the human activities affected by climate change, and serve as a basis for dialogue, understanding, and decision-making to limit the cost of climate change (Hallegatte et al 2011). The use of the geographic information system (GIS) to present projections of flooding with future climate change further facilitates understanding by residents and other stakeholders.

In terms of the adaptation options proposed, similarities are observed among the studies, because the risks studied are increased flooding and inundation except for the water supply in Khulna. Embankments of rivers, improvement of drains, and increase in pumping capacity are key structural options, while non-structural options such as land-use controls and early warning systems are also recommended. In the water supply system in Khulna, relocating the water intake upstream or installing a larger reservoir are proposed as core adaptation options. Detailed designs at the next stage will take account of the quantitative impacts of climate change on the proposed infrastructure, and consider the specific scope of work of non-structural measures. In all cases, recommendations did not merely stop at designs of infrastructure, but covered a wide range of non-structural measures such as policy, regulatory, and behavioral issues to ensure long-term delivery of services.

4.4.2 Discussion

These pilot cases have demonstrated that climate-proofing is possible through a quantitative analysis (scenarios-impacts-first approach), and quantitative information derived in the analysis would be useful for decision-makers as well as designers of infrastructure. Regarding the water supply system in Khulna, a decision was taken about the selection of a core adaptation option based on the analyses conducted. Following the findings and recommendations of climate-proofing work, the urban drainage system in Bangkok and Khulna, water supply system improvements in Khulna, and polder improvement in coastal areas of Bangladesh, have moved to or will move to the specific engineering design stage followed by physical investment, at least partially. Based on the findings of the studies, which are mostly at the level of a master plan or pre-feasibility study, further engineering studies can be undertaken to determine the detailed scope of adaptation measures.

Adger et al. (2005) proposed elements of effectiveness, efficiency, equity, and legitimacy in judging successful adaptation. They clarify that effectiveness relates to the capacity of an adaptation action to achieve its expressed objectives, and that two key indicators of effectiveness are robustness to uncertainty and flexibility. Efficiency refers to economic efficiency including the costs and benefits of goods that cannot be expressed in monetary values. Equity refers to distributional consequences of adaptation, and legitimacy is the extent

to which decisions are acceptable to those affected by the decisions. They also stress that the relative weight allocated to each criterion is not given, but will vary between countries, between sectors within countries, and over time. Smit and Wandel (2006) similarly discuss that common variables employed to rank the relative merits of possible adaptations are benefits, costs, implementability, effectiveness, efficiency, and equity. As benefits and costs are within the element of (economic) efficiency, and implementability is synonymous with the overall feasibility of an adaptation option judged from other perspectives, this paper adopts the four elements proposed by Adger et al. Among the four elements, the above analysis generally addresses efficiency and effectiveness. However, the issue of equity, or impacts on the poor, is not analyzed in detail. As the poor usually have less access to risk-reducing housing and infrastructure, they will likely be most severely affected by climate change. The design of infrastructure and other supplementary measures need to take account of distributional effects of costs and benefits. Legitimacy also requires further attention, because the proposed measures need to be widely accepted by stakeholders including the local governments responsible for implementation of the proposed option, as well as people to be directly affected by the proposed interventions. However, less attention to the issues of equity and legitimacy might have stemmed from the fact that these case studies focused more on identifying adaptation options as well as their costs and benefits.

In addition, other limitations and challenges of these studies are observed. First, costs of supplementary measures (mostly non-structural measures) are not estimated. This is probably because of the focus of the studies that assess the design of the infrastructure required to deal with climate change, and lower costs of supplementary measures relative to infrastructure investments. Nevertheless, the total costs of adaptation should be estimated and compared with the total benefits. Second, feasibility of adaptation options, particularly supplementary measures, is not discussed. Land-use planning, early warning systems, and building codes that incorporate climate change vulnerability are standard recommendations for reducing vulnerability from urban floods, but cities in developing countries have not been historically successful in implementing these systems, irrespective of climate change. There is likely a gap between measures suggested from the assessment, and what can actually be implemented on the ground given institutional constraints and barriers (Hallegatte and Corfee-Morlot 2011). Third is the cost and time required for the assessment. The studies for Khulna, for both water supply and urban flooding, took nearly one and a half years, and cost about $500,000.[29] Although specific data on costs and time spent on other studies are not readily available, they may be significant. While these assessments are quite sophisticated and comprehensive with support from major development partners, cases that are undertaken by developing country cities by themselves or with little resources are not found. Resources are justified for large cities with large infrastructure investment requirements, but more simplified and less resource-intensive work may be needed for smaller cities.

Issues of uncertainties are well acknowledged and discussed in all the studies reviewed. What appears to be effective and efficient adaptation options under a specific

[29] http://www.adb.org/sites/default/files/projdocs/2012/42469-012-ban-tcr.pdf, accessed 10 August 2013. The cost included training programs and workshops.

scenario may or may not be necessarily so among widely different scenarios. There is a risk for over-investment or under-investment. While these studies rightly caution the limitations of assessment and stress the importance of incorporating soft measures, no specific analyses were undertaken to ensure the robustness of adaptation options. A key weakness of CBA is to incorporate deep uncertainty as discussed above. Therefore, the next section assesses the issue of uncertainty.

4.5 Robust adaptation under uncertainty

4.5.1 Framework for assessment

In order to address specifically the issue of uncertainty in future climate and its impacts, Hallegatte (2009) proposed a decision-making framework that comprises five practical strategies: (i) 'no-regret' strategies that yield benefits even in the absence of climate change; (ii) 'reversible and flexible' strategies; (iii) 'safety margin' strategies that reduce vulnerability at null or low cost; (iv) 'soft' strategies; and (v) strategies that reduce decision-making time horizons. He added conflicts and synergies of adaptation options as an important consideration to make (also found in Sovacool 2011). These five strategies are often cited in other literature discussing decision-making under uncertainty (e.g., Wilby and Dessai 2010, Smith et al. 2011, Lal et al. 2012). In this research, among the five strategies proposed, the soft strategy is consolidated with the reversible and flexible strategy as these two are quite similar, and the reduced decision-making time horizon is not included due to its limitation in application to infrastructure development. Synergies (and conflicts) between options, another criteria recommended by Hallegatte (2009), is retained, while interpretation is broadened in this analysis: i.e., co-benefits with other policy measures such as disaster risk reduction, environmental conservation, and public health improvement, in addition to climate change mitigation. In this section, these strategies are applied to check the robustness of adaptation options. The two sets of criteria to evaluate adaptation at project level are presented in Figure 4-2 below. Although Adger et al (2005) proposed flexibility under effectiveness, flexibility is an important element to measure robustness. Robustness could affect efficiency, equity, and legitimacy in addition to effectiveness, but is most closely linked with effectiveness.

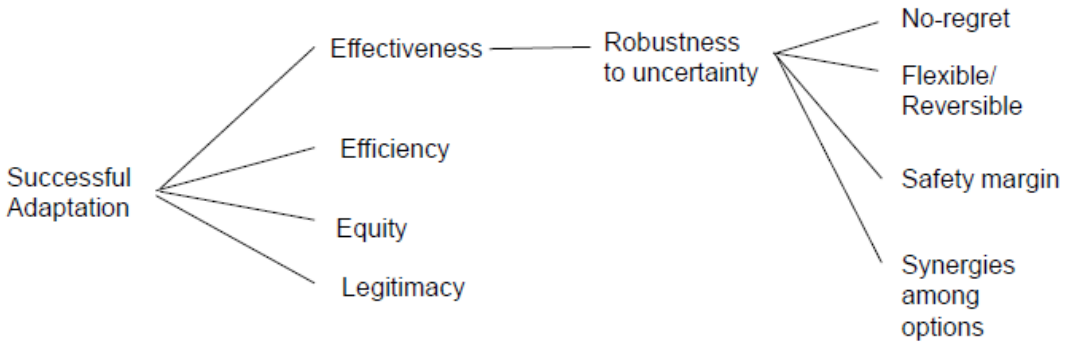

Figure 4-2: Successful adaptation at project level

4.5.2 Assessment of robustness of adaptation measures proposed in the Khulna case study

The adaptation options proposed for the Khulna study, both for water supply and urban flooding, are assessed by applying the framework mentioned above. Khulna, the third largest city in Bangladesh with a population of about one million, is located in southwestern Bangladesh, where the consequences of climate change are expected to be particularly severe. As a deltaic plain, the land is flat, and the average altitude of the city area (47 km^2) is only about 2.5 meters above mean sea level (ADB 2011b). Khulna currently relies entirely on groundwater, and due to poor water supply in terms of coverage and service hours (24% and 12 hours per day respectively in 2011; Local Government Division 2013), it plans to develop a new surface water supply system. Moreover, the city is suffering from chronic waterlogging problems during the rainy season. An increased risk of flooding due to increased frequency and intensity of heavy precipitation caused by climate change is an important subject in urban areas because of a growing urban population, and potentially large damage and losses (e.g., Djordjevic et al. 2011; Haque et al. 2012).

In order for an adaptation option to be robust to different future scenarios, it should meet all these four criteria. However, the proposed options should not be reviewed individually in isolation from each other. It is important to consider a set of adaptation options as a whole, as more than one measure can and should be implemented to adapt to climate change. Therefore, an option that consolidates individual options is included as a consolidated option. The results are summarized in Table 4-3. It should be noted that two more adaptation options are added to the original analysis: namely, rainwater harvesting for water supply, and land subsidence suppression for urban drainage.

Table 4-3: Evaluation of given adaptation options

	Adaptation option	NR	R/F/S	SM	Sy	Remarks/co-benefits
Water supply	Impounding reservoir	Y/N	Y/N	Y	N.A	Core option
	Physical loss reduction (replacement of old pipes, pressure management, etc)	Y	Y/N	N.A.	Y	May involve large physical investment; resource conservation
	Water demand management (e.g., through tariff, conservation campaign, water saving devices)	Y	Y	N.A.	Y	Resource conservation
	Rainwater harvesting	Y	Y	N.A.	Y	Resource conservation, groundwater recharge
	Consolidated option	Y	Y	Y	Y	A safety-margin approach was not preferred by the water utility.
Urban drainage	Improvement of drains, river dredging	Y	N	Y	N.A	Core option
	Solid waste management	Y	Y	N.A.	Y	Public health, possibly mitigation by reducing CH_4 emissions
	Building codes	Y	Y	Y	Y	Avoid maladaptation; disaster risk reduction
	Land-use planning	Y	Y	Y	Y	Avoid maladaptation; disaster risk reduction

	Early warning systems	Y	Y	Y	Y	Disaster risk reduction
	Land subsidence suppression	Y	Y/N	N.A.	Y	Harmonized with introduction of surface water supply system
	Consolidated option	Y	Y	Y	Y	All options are complementary.

N = no, N.A. = not applicable, NR = no-regret, R/F/S = reversible, flexible, and soft, SM = existence of safety margins, Sy = synergies with others, Y = yes, Y/N = depends on the implementation.

4.5.2.1 Water Supply

Among the four options, the size of capital investment required is large for an impounding reservoir and physical loss reduction, relatively small for rainwater harvesting, and small for demand management. The latter two can be classified as soft measures. The impounding reservoir option[30] may or may not be a no-regret option: although the salinity level of raw water is on an increasing trend and exceeded the national drinking water quality standard in terms of chloride concentration for 15 days for the first time in 2010[31] (ADB 2011b), it is still early to conclude whether a reservoir is a must for the surface water supply system without climate change. The impounding reservoir option has some flexibility, although this is a hard engineering measure. It will be constructed in rural areas near the water intake, so it is possible to take an adaptive management approach, whereby the physical investment is made in a phased manner, depending upon the result of water quality monitoring of the river. The initial size of the impounding reservoir is rather small while securing land for future expansion; the reservoir will be expanded depending on the actual rise of river salinity in the future. An opposite approach may also be possible, whereby a safety margin is added to the size of the reservoir so that water that meets the national water quality standards can be supplied even under more extreme conditions.

Physical loss reduction is a no-regret measure. As the current physical loss of water supply is rather high in Khulna, estimated at 36% (ADB 2011c), a successful reduction to 15% will lead to savings in costs of water supply. This option is not reversible, but the extent of reduction can be flexible. Demand management may be able to reduce the demand by 10% (from the designed per capita domestic water demand of 120 liters per day), if volumetric water pricing, or charging economic costs of water to consumers, is introduced effectively in addition to awareness-raising. Rainwater harvesting may augment the water supply available by an additional 10% or so. With these three measures combined, an almost 40% reduction in the volume of required raw water may be possible. All these three options have co-benefits in terms of resource conservation.

However, the implementation of these three options cannot negate the need for an impounding reservoir: if the river salinity in terms of chloride concentration exceeds the national standards, an alternate source of water is required. Thus, an impounding reservoir, a core adaptation option, will still be necessary. Another important point is that other adaptation options

[30] The government chose the option of a larger impounding reservoir over that of a water intake upstream. The reservoir is to store river water when the river salinity is low, and supply water when the river water is too saline.
[31] In Bangladesh, maximum allowable chloride concentration for drinking water is 1,000 mg/L in the coastal zone including Khulna, and 600 mg/L in other areas.

are compatible with and supplementary to this core option, and may provide great potential for cost savings by reducing the required size of the reservoir. Therefore, the consolidated option, which is a combination of the four measures, can meet all four strategies, as it has no-regret, and flexible and soft components, could apply safety margins, and creates synergies among individual measures. The consolidated option can ensure robustness to different future scenarios, although further analysis is warranted for a best mix of these hard and soft measures, which is beyond the scope of this study. In this particular case, the water utility chose the phased approach over the safety-margin approach with regard to an impounding reservoir, as it saves initial investment costs.

4.5.2.2 Urban Flooding

Drainage system improvement including improvement of drains, river dredging, and sluice gate improvement, is a core adaptation option without which the problem of urban floods cannot be sufficiently addressed. Including this, all the given options are no-regret measures, as Khulna is already suffering from chronic waterlogging (due to the adaptation deficit mentioned above), and all these measures, though to a different extent, would contribute to alleviate the problem. One difference with the water supply is that the core option is not very flexible - widening or constructing new drains in a phased manner in dense urban areas is not a practical option. Therefore, it will be sensible to implement the core option early with some safety margins incorporating future climate change, and ensure effectiveness through implementing and strengthening other adaptation options which are more flexible. All non-core adaptation options are compatible with the core option. Enforcement of building codes and land-use planning and controls is needed to avoid maladaptation: strengthened protection through infrastructure improvement should not foster new settlements into areas prone to urban floods. These measures can be implemented with a safety margin, and have co-benefits in terms of disaster risk reduction. Solid waste management is also important to ensure functionality of drains and bring public health benefits. This also has potential for climate change mitigation through a reduction in the generation of methane gas. An early warning system is another soft measure used to mitigate impacts of urban flooding, and can incorporate a safety margin in the warning system. Land subsidence, currently estimated at about 10 mm per year in Khulna (ADB 2011b), exacerbates urban floods, and reduction in the rate of subsidence is another soft option.

As in the case of water supply, a consolidated option can meet all four strategies, with no-regret and flexible/soft approaches, safety margins, and synergies among measures. Thus as a whole, these options are considered robust to future climate change and variability.

In discussing adaptation measures to flood risks in Mumbai, India, Hallegatte et al (2010) proposed different strategies to cope with different risk layers: improved drainage system for frequent low-impact events; zoning and land-use plans for rarer events that cannot be avoided through improved drainage; and early warning, evacuation, and insurance for exceptional floods that cannot be avoided with improved drainage or zoning. It is important to analyze the nature and scope of each option, and formulate a set of actions that are mutually reinforcing.

Lastly, it is interesting to note that a reduction in the volume of abstraction of groundwater, which will be made possible with the introduction of the surface water supply systems (and to a lesser extent by introduction of rainwater harvesting leading to groundwater recharge), may slow down the pace of subsidence, although the cause of subsidence is not well studied. There is compatibility between the improvement of water supply systems and that of urban drainage systems.

4.6 Discussion

4.6.1 Evaluating adaptation options

The above assessments made clear that the key objective of the intervention needs to be retained at the center of the analysis, in order to adapt to climate change. No matter how efficient in implementing other measures, the impounding reservoir will still be necessary for the water supply in Khulna. Otherwise a very different option, such as increased abstraction of groundwater instead of surface water, or accepting saline water exceeding the standard when necessary will need to be adopted. Similarly, improvement of drainage systems is essential in any case. Core engineering options are required in both cases. Effective implementation of non-structural measures such as land-use control and building codes will not negate the need for improving drainage systems, although the extent of improvement may be reduced. Another important consideration is compatibility among the proposed adaptation options: some may create synergies, while others may create conflicts. For example, an increased use of groundwater resources to cope with high river salinity, if selected as an adaptation option, may lead to further land subsidence and have negative consequences for the urban drainage system. Compatibility is linked to co-benefits (or co-costs), which is also synonymous with no-regret, as no-regret implies there are other benefits even without climate change. Desalination, while it was not recommended for the water supply in Khulna due to the lack of financial viability, would lead to higher energy consumption and greenhouse gas emissions; so this is not compatible with other objectives.

These findings caution the use of multi-criteria analysis (MCA), a widely applied approach to environmental issues when all costs and benefits cannot readily be given monetary values (UNFCCC 2002). Though the MCA has been used in prioritizing adaptation measures among many plausible options (e.g., Haque et al 2012, De Bruin et al 2009), it normally does not differentiate between core and supplementary options, and just gives ratings to each option, without looking into the relationship among options. Viguie and Hallegatte (2012) also discuss the importance of addressing synergies and conflicts among policy options.

4.6.2 Remaining issues

As climate-proofing of infrastructure usually provides adaptation options to be implemented by government agencies, further research is warranted to integrate this initiative with bottom-up local adaptation measures taken by communities and households. This is

particularly important for developing countries where the capacity of government agencies is normally limited. Berrang-Ford et al (2011) find that most adaptations in low-income countries are reactive, occurring at the individual and community level with weak involvement of government stakeholders, while adaptations are more proactive or anticipatory, and likely to include governmental participation in high-income countries. The analysis should address the institutional capacity of responsible government agencies, and arrangements to be made between those agencies and households or communities. Moreover, distributional effects of adaptation measures, including who benefits and who loses, cannot be overstressed (e.g., Leichenko 2010), though such an analysis is not made in this paper.

As for the water supply in Khulna, Khulna Water Supply and Sewerage Authority (KWASA) is responsible for the implementation of climate-proofed surface water supply system development. All the adaptation options discussed earlier are under their jurisdiction. However, the coverage of water supply services is still low, and many of the poor have no access to piped water supply systems. Therefore, unless coverage is substantially increased together with supply augmentation, people without access will continue to rely on other sources of water such as shallow tube-wells, which are reported to be increasingly saline (Roy et al 2012). Roy et al (2012) raised a concern over a ban imposed by KWASA on deep tube well installation as this would further expose poor urban people to scarcity of safe drinking water. Any project needs to be inclusive, and reduce the vulnerability of urban poor to the impacts of climate change.

Urban drainage system improvement is further complicated. Among the adaptation options analyzed, Khulna City Corporation (KCC) is responsible for improvement of drains and river dredging, solid waste management, implementation of building codes, and early warning systems, while Khulna Development Authority (KDA) is responsible for land-use planning. KWASA has a role to play in land subsidence suppression as it has authority to regulate groundwater abstraction.[32] Moreover, among flood management measures, improvement of river embankment and major hydraulic structures fall under the responsibility of the Bangladesh Water Development Board (BWDB), whereas re-excavation, dredging, and rehabilitation of existing drains and construction of new drains are the responsibility of KCC. Roy et al (2012) cite a coordination issue between KCC and BWDB about the operation of sluice gates, and KDA's ignorance of urban poor settlements in its urban planning. They also stress unsecure tenure as a key issue for the poor to make investments in their shelter and basic service improvement, thereby making them particularly vulnerable to the impacts of extreme and severe events which would be exacerbated with climate change. Institutional arrangements to foster better collaboration should be further studied in improving urban drainage systems.

Reviewing the actions taken in Khulna in light of the five factors discussed in Chapter 3 reinforces the above discussion. As Khulna suffers from chronic waterlogging problems and received support from ADB in the areas of climate impact assessment and identification of adaptation options (to climate-proof proposed development projects), two factors, namely existing problems linked with climate, and a solid knowledge base on climate impact and vulnerability have been addressed. However, an effective mechanism for internal collaboration,

[32] It is not known to what extent KWASA is exercising this authority.

leadership and championship are yet to emerge. Good governance in the areas of inclusive planning and participatory processes also needs strengthening. Khulna's success in implementation of mainstreaming hinges upon the progress of these remaining three factors.

4.7 Conclusion

The advantages of climate-proofing through quantitative climate assessments at project level have been confirmed. The quantitative assessments provide specific information on the level of damage and required costs of adaptation, and propose specific adaptation options. Most cases reviewed in this Chapter present how much the infrastructure needs to be improved to adapt to climate change, which will facilitate decision-making and provide a basis for further project formulation work. This is especially useful in cities in developing countries, where basic infrastructure is often inadequate, urban population is rapidly growing, and urgent infrastructure improvement is needed (Hallegatte and Corfee-Morlot 2011). As mentioned above, some cities have already moved forward to the implementation of specific projects, although this may not be solely attributed to the success of climate-proofing work, but rather to the fact that development partners were directly involved in climate-proofing. A climate-proofed infrastructure is expected to deliver intended benefits and services over its service life despite the changing climate, although the success of climate-proofing on the ground has yet to be observed. Out of the four criteria of effectiveness, efficiency, equity, and legitimacy, these case studies focused on effectiveness and efficiency. Limitations of these case studies include lack of attention to equity and legitimacy, and rather perfunctory analysis on the feasibility of soft measures.

Issues on uncertainty cast doubts on the effectiveness and efficiency of adaptation measures proposed through quantitative assessments. Therefore, it is essential to further analyze the nature of each proposed option. To further verify effectiveness under uncertainty, the four strategies of no-regret, reversible and flexible, safety margins, and synergies among options, are applied to specific adaptation options in the water supply and drainage systems in Khulna, Bangladesh. While each adaptation option does not always meet all four criteria, consolidated measures as a whole meet all the criteria and are evaluated as robust to uncertainty. This underscores the need to review not only each option individually, but compatibility between options. Consolidated measures include core engineering options to achieve the main objective of the project, and other hard and soft measures that are flexible, compatible, and mostly no- or low-regret. Although finding a quantitative best mix of these measures (in terms of cost and output) is not possible in this study, adopting a set of measures ensures robustness to various future scenarios. Further work is warranted to address the issue of equity and legitimacy, and to assess the institutional capacity of relevant government agencies, based on which an appropriate institutional arrangement should be formulated. Reviewing adaptation options through the use of the five factors identified in Chapter 3 reveals remaining weaknesses in the proposed intervention. In the case of Khulna's water supply and urban drainage systems improvement, an effective coordination mechanism led by strong leadership or championship would be a key for ensuring mainstreaming.

Chapter 5: Climate adaptation mainstreaming in Thailand, in Bangkok, and for flood management systems in Bangkok

5.1 Introduction

This Chapter focuses on climate adaptation mainstreaming in Bangkok, Thailand. As Chapters 2, 3, and 4 discussed mainstreaming at country, city, and project levels respectively, this Chapter makes an assessment of a selected case at each level in depth, for Thailand (country level), Bangkok (city level), and urban flood management in Bangkok (project level). First, the level of mainstreaming and factors that affect the level of mainstreaming are analyzed for Thailand, by applying the analytical framework developed in Chapter 2. This is important in assessing adaptation mainstreaming in Bangkok, as there could be a vertical relationship between adaptation mainstreaming at the country level and that of the city level. As reviewed in Chapter 3, the adaptation framework established at the central level could define planning at the local level.

Second, adaptation mainstreaming in Bangkok is analyzed. After reviewing Bangkok's climate risks and vulnerability, an assessment is made as to the level of adaptation mainstreaming, by using the five key factors for adaptation mainstreaming at city level derived in Chapter 3. The assessment focuses on the Bangkok Metropolitan Administration (BMA), the local government administering the city of Bangkok, governed by the BMA Act 1985. Third, adaptation mainstreaming is analyzed at project level, focusing on urban flood management in Bangkok, as urban floods are considered the most critical climate-related risk in Bangkok. Assessment is made of the level of climate adaptation mainstreaming, as well as the appropriateness of specific measures for climate-proofing urban flood management. This provides concrete insights on how Bangkok should change its business-as-usual by "mainstreaming" climate adaptation in its planning and actions.

5.2. Methodology

The first analysis, mainstreaming in Thailand, follows the methodology used for six LDCs in Chapter 2 to the extent possible for easier comparison. One major difference is that Thailand does not have a NAPA since it is not an LDC. But it developed a National Strategy on Climate Change Management (NSCCM) instead. The literature review is supplemented by a few interviews with officials of the government and resource persons familiar with the issue. Documents reviewed are shown in Table 5-1.

Table 5-1: Documents reviewed in the assessment

Country	Climate change plan/strategy		National development plan		Other key documents reviewed and their publication month/year
	Title	Month/year of publication	Title	Month/year of publication	
Thailand	National Strategy on Climate Change Management (2008-2012)	November 2009	Eleventh National Economic and Social Development Plan (2012-2016)	2012 (month unknown)	Environmental Quality Management Plan (2012-2016), 2012 Second National Communication under UNFCCC, March 2011

The second and third analyses are also primarily based on the review of the available literature, including documents made available by various departments of BMA. In the second analysis for assessing the level of mainstreaming in Bangkok, the five factors selected in Chapter 3 are applied. Measures taken for urban flood management are reviewed by referring to the two sets of project-level criteria discussed in Figure 4-2. Interviews were conducted with officials of relevant departments of BMA, including the Department of Environment (DoE), Department of Drainage and Sewerage (DDS), City Planning Department (CPD), Bangkok Fire and Rescue Department (BFRD), and Department of Social Development (DSD), and additional data and information were collected in the field.[33] Discussions were also held with experts working on climate change adaptation in Bangkok.

5.3 Adaptation mainstreaming in Thailand

5.3.1 Policy development process, and key features of plans and strategies

The first national strategy on climate change was prepared in October 2006 by the Ministry of Natural Resources and Environment through its Office of Natural Resources and Environmental Policy and Planning (ONEP). After that, ONEP organized additional consultations with various stakeholders, and collected information regarding policies and plans of ministries and agencies relevant to climate change, such as the Ministry of Energy, Ministry of Agriculture and Cooperatives, and Department of Marine and Coastal Resources to make the strategy more coherent and integrated. The NSCCM (2008-2012) is a revised outcome, which was approved by the National Committee on Climate Change (NCCC) and acknowledged by the cabinet in January 2008. The period of the strategy, 2008-2012, is mostly in line with the Tenth National Economic and Social Development Plan (2007-2011). Salient features of the NSCCM are highlighted in Table 5-2 below. Four strategic pillars out of the total six (pillars #1, 3, 4, and 5 in Table 5-2) are related to adaptation.

[33] Interviews with BMA officials were held twice, in June 2013 and December 2013. The first interview was mainly intended to understand the situation, collect information, and identify issues. The second interview was to discuss draft findings and recommendations. Earlier interviews in June 2012 and September 2012 were held with the DoE of BMA and resource persons in this area, for scoping research topics and collecting information.

Table 5-2: Salient features of Thailand's NSCCM (2008-2012)

Vision	Thailand is prepared to cope with, and adapt itself to the impacts of climate change. It is also ready to cooperate with the world community to reduce or relieve climate change on the basis of sustainable development.
Mission	(1) To enable all sectors to cope with the impacts of climate change, and adapt themselves accordingly. (2) To reduce GHGs from various kinds of activities through undertakings based on the concept of sustainable development. (3) To build up a corpus of knowledge, to create readiness of all sectors, as well as to create mechanisms to achieve integrated planning, and to implement measures aimed at effectively solving problems relating to the country's climate change. (4) To cooperate with the world community to solve problems relating to climate change without negatively affecting the country's socio-economic and environmental development.
Strategic pillars	(1) Building capacity for climate change adaptation (2) GHG mitigation based on sustainable development (3) Research and development of adaptation and mitigation (4) Awareness-raising and public participation in climate change (5) Building institutional capacities and coordination (6) International cooperation in climate change mitigation

GHG = greenhouse gas.
(Source) NSCCM.

The Eleventh National Economic and Social Development Plan (11-NESDP) (2012-2016) was developed in 2012, led by the National Economic and Social Development Board (NESDB).[34] The 11-NESDP does not refer to the NSCCM, probably because the implementation period of NSCCM ends in 2012. Key features of the 11-NESDP are summarized in Table 5-3 below. It stresses that the country's development will emphasize building resilience at the family, community, society, and national levels for sustainable development under the philosophy of sufficiency economy,[35] and specifically refers to the need for creating a low-carbon society and preparing for climate change and natural disasters. One of the four missions is about safeguarding people and the nation from the effects of climate change and disasters, and upgrading the ability to adapt to climate change and ensuring preparedness to respond to natural disasters are highlighted under the sixth strategy: managing natural resources and the environment toward sustainability.

[34] The NSEDB, under the Prime Minister's Office, issues the country's medium-term economic and social development plan. The first plan was issued in 1961.
[35] The concept of the Sufficiency Economy Philosophy, bestowed upon by His Majesty King Bhumibol Adulyadej, was utilized during the 1997 economic crisis, and continued to be important in coping with both external and internal crises that encompassed economic, social and political dimensions. It emphasized a balanced approach toward issues of social, economic, natural resource and environmental development. The main goal was to improve the quality of life for Thai people and adhere to the principle of moderation. This philosophy has been formally adopted as the guiding principle of the country's development strategy since the eighth NESDP (1997-2001).

Table 5-3 Key features of the 11-NESDP

Vision	A happy society with equity, fairness, and resilience
Missions	(1) To promote qualities of a fair society that include increased social security and protection, provide fair access to resources and the judicial system, and empower people so they may actively participate in the development process under good governance. (2) To create a population with enhanced integrity, with the capacity for lifelong learning, and with knowledge and skills appropriate to their ages, and to strengthen social institutions and local communities so they may effectively adapt to changes. (3) To enhance production and services through greater efficiency, knowledge, innovation, creativity, and folk wisdom, and to develop food and energy security, restructure the economy and consumption practices to be environmentally healthy, and to strengthen international cooperation with neighboring countries for economic and social security. (4) To build a secure base of natural resources and a sound environment, support community participation, and safeguard people and the nation from the effects of climate change and disasters.
Direction of Development	Empowerment of social capital Strengthening of economic capital Restoration of natural resources and environmental capital
Development Strategies	(1) Creating a just society (2) Developing a lifelong learning society (3) Strengthening of the agricultural sector and security of food and energy (4) Restructuring the economy toward quality growth and sustainability (5) Creating regional connectivity for social and economic stability (6) Managing natural resources and the environment toward sustainability

(Source) 11-NESDP.

The Environmental Quality Management Plan (EQMP) (2012-2016) was prepared for the same period by ONEP. It has six principles, i.e., (i) sustainable development, (ii) ecosystem approach, (iii) precautionary approach, (iv) polluters-pay principle and beneficiaries-pay principle, (v) public-private partnership, and (vi) good governance, and six strategies, i.e., i) shifting towards environmentally-friendly production and consumption, (ii) sustainable conservation and restoration of natural resources, (iii) enhancement of good governance through the management of natural resources and environment, (iv) ensuring good environmental quality for all, (v) creating resilience to climate change and natural disasters, and (vi) human development as a basis for an environmentally responsible society.[36]

The ONEP is also leading the preparation of a new Climate Change Master Plan covering the period of 2013-2050 (MONRE 2013). This is Thailand's second draft of its master plan as the first was scrapped in 2010, due to public protest of its non-participatory approach. The second round began in 2011 and closed with a series of public consultation forums in four regions and in Bangkok, including a separate round with the private sector.[37] After the last round of public consultation was held in August 2012, the plan is going through the final approval

[36] According to ONEP (based on an interview), 11-NESDP and EQMP were developed through close coordination.
[37] Reported in UNDP's website, and confirmed through personal communication with an ONEP official. http://www.undp.org/content/thailand/en/home/presscenter/articles/2012/08/10/thailand-s-climate-change-master-plan-nears-completion/ accessed on 23 June 2013.

process. It was approved by a sub-committee in late 2013, and is expected to be approved in early 2014.[38]

5.3.2 Analysis of mainstreaming

The NSCCM, analyzed by the six factors that could determine the success of mainstreaming efforts (discussed in Chapter 2), is summarized in Table 5-4 and discussed below. Although the analysis in Chapter 2 revealed that four factors are more relevant to the success of mainstreaming, this analysis was done for all six factors.

Table 5-4: Analysis of Thailand's NSCCM (2008-2012)

Approval authority of NSCCM	Cabinet, National committee on climate change chaired by Prime Minister
Recognition of mainstreaming	Not stated
M&E	Not stated
Resource requirements	Not stated
Time compatibility between NSCCM and national development plan	11-NESDP was developed about 5 years after the first NSCCM. Both are medium-term plans.
Lead Agency	Ministry of Natural Resources and Environment

Coordination: The NSCCM was formed by ONEP, but with additional inputs and consultations with relevant ministries after the first strategy on climate change was developed. Under the NSCCM, principal and supplementary agencies are assigned to each measure, which include other ministries such as the Ministries of Interior, Agriculture and Cooperatives, Science and Technology, and Public Health. However, the Ministry of Finance is not mentioned even a single time either in the preparation and implementation of the NSCCM, and NESDB is rarely mentioned either. On the other hand, the 11- NESDP well recognizes the need for climate change adaptation. This would indicate that NESDB, responsible for preparing the NESDP, took the importance of climate change adaptation into account separately from the practices of formulating and implementing the NSCCM. The cabinet acknowledged the NSCCM after the NCCC chaired by the Prime Minister approved it.[39] UN-ESCAP describes the NCCC as follows: Although the NCCC was an important factor contributing to meeting Thailand's reporting requirements under the UNFCCC, the frequency of the Committee's meetings is relatively low, making it difficult for partnership to emerge among government ministries, businesses and the nongovernmental sectors. [40] Although building coordination is one of the strategic pillars of NSCCM, specific measures generally stop at creating a network of staff and organizations dealing with climate change only, and do not include strengthening of existing measures or

[38] Based on an interview with an ONEP official in December 2013.
[39] A national subcommittee on climate change, established in 1994, was upgraded to the National Committee on Climate Change chaired by the Prime Minister in 2006.
[40] http://www.unescap.org/drpad/vc/conference/ex_th_235_ncc.htm accessed on 6 July 2013

establishing new inter-agency committees to address climate change in a more comprehensive and systematic way. Therefore, coordination is rated “fair” in Thailand.

Recognition: Mainstreaming is not discussed either in the NSCCM and 11-NESDP. The rating is “poor.”

M&E: No arrangement on M&E is provided in the NSCCM. No documents are publicly available on the implementation results of M&E of the NSCCM though the implementation period was already completed in 2012.[41] It is considered “weak.”

Financial feasibility: Unlike the standard template of NAPA which includes financial resources required for its implementation, Thailand’s NSCCM does not discuss financial implications of its implementation. It is not clear whether the actions in the NSCCM were included without financial commitment, or whether these actions were already included in ministries’ plans and re-labeled as climate-related actions under the NSCCM.[42] Therefore no rating is given for this criterion.

Experience: The first NSCCM was prepared in October 2006, and the five-year implementation period of NSCCM is already complete. The new master plan under preparation will likely incorporate lessons of NSCCM implementation. Without any M&E reports, it is difficult to judge the extent of implementation experience in Thailand. However, some measures such as developing climate models pursuant to Thailand’s context and training of relevant staff’s capacity building in the NSCCM were undertaken. Thus, experience is rated “fair.”

Time compatibility. The NSCCM and 11-NESDP both cover a five-year period. However, these two plans cover different 5-year periods without overlap. The previous NESDP period (2007-2011) generally overlaps with that of the NSCCM (2008-2012), but these two plans are not linked. The rating is “fair.”

The ratings of Thailand using the same rating systems as in Chapter 2 are summarized in Table 5-5 below.

Table 5-5: Mainstreaming analysis of Thailand (1)

Factors	**Aspects reviewed and rating**	Thailand rating
Coordination	Aspects: (i) High involvement of planning and/or finance ministry, (ii) Prime minister (or President)’s commitment, and (iii) existence of a highly functional coordination committee Rating: ++ (good) At least two of the three including (i) are satisfied.	+

[41] Although ONEP plans to conduct post-evaluation of the NSCCM as a part of developing an action plan for the implementation of the master plan, scheduled in 2014, the author is of the view that the post-evaluation should have been undertaken before finalizing the master plan itself.

[42] According to the clarification made by ONEP, most programs were already included in respective ministries’ plans. It was important to make these ministries understand that their programs are linked to climate change mitigation/adaptation.

	+ (fair) Only one is satisfied, or only (ii) and (iii) are satisfied. - (weak) None of the above is satisfied.	
Recognition	Aspect: Mainstreaming is explicitly recognized as a priority in NSCCM and development plans. Rating: ++ (high) Mainstreaming is recognized in both NSCCM and development plans. + (fair) Mainstreaming is recognized only in NSCCM. - (poor) Mainstreaming is not recognized as a priority in the document.	-
M&E	Aspects: Institutional arrangement of M&E, and clarity of its mandates and scope Rating: ++ (good) A clear and streamlined M&E arrangement exists with clearly defined mandates and scope. + (fair) A clear M&E arrangement exists without clearly defined scope. - (weak) An M&E arrangement is not clear or does not exist.	-
Financial feasibility	Aspect: Financial resource requirements in NSCCM compared to average annual net ODA receipts Rating: ++ (high) Requirements in NSCCM are less than 10% of net ODA receipts. + (medium) Requirements in NSCCM are less than 30% of net ODA receipts. - (low) Requirements in NSCCM are not less than 30% of net ODA receipts.	NA
Experience of implementation	Aspects: Years of NSCCM implementation after its formulation and experience of adaptation programs/projects within or outside NSCCM Rating: ++ (adequate) NSCCM has been implemented for 3 years or longer, and clear evidence of implementation of specific programs/projects is observed. + (fair) Some evidence of implementation of specific programs/projects is observed, with 3 years or longer implementation of NSCCM, or clear evidence of implementation of specific programs/projects is observed with less than 3 years of implementation of NSCCM. - (limited) Only limited implementation is observed.	+
Time compatibility	Aspect: Timeframe and timing of development plans and that of NSCCM Rating: ++ (high) Both the time horizon (duration) and timing match well. + (medium) Either the time horizon or timing matches. - (low) Neither the time horizon nor timing match.	+

5.3.3 Level of mainstreaming

Relevance: The NSCCM has six strategic pillars, and four out of six are related to climate change adaptation: Building capacity for climate change adaptation (pillar 1); research and development of adaptation and mitigation (pillar 3); awareness-raising and public participation in climate change (pillar 4); and building institutional capacities and coordination (pillar 5). As the titles of these pillars indicate, actions are mostly 'soft' measures, from creating knowledge, databases, and better understanding of climate change and its impacts on various sectors and different areas of the country, to raising public awareness, training staff, and creating networks for better coordination. Physical investment actions are generally limited, but include restoration of water resources, mangrove forests, and seashores, and construction of breakwaters and artificial coral reefs. Other adaptation measures such as installing warning systems, setting and enforcing land use plans, and developing disaster insurance systems in risk areas are also in the NSCCM. The EQMP has one strategy on climate adaptation out of six, named "creating

resilience to climate change and natural disasters," but specific work programs under this strategy are limited to capacity-building.

11-NESDP incorporates climate concerns and prioritizes resilience to climate change. Global warming and more frequent and severe natural disasters are cited as a major global change facing the country. Strengthening resilience and adapting to changes, not only with regard to climate but other socio-economic changes both globally and internally, is a key message throughout the document, and "to build secure natural resources and environmental bases through supporting community participation and improving resilience that will cushion impacts from climate change and disasters" is one of the four missions of the 11-NESDP. Development strategy under the natural resources and environmental management strategy includes "upgrading the ability to adapt to climate change." More specifically, actions include (i) developing knowledge about the impact of climate change and adaptation to it; (ii) developing management tools to deal with climate change such as formulating long-term plans and databases; (iii) strengthening community readiness to respond to climate change by allocating adequate resources and communicating information concerning risks and risk management, and supporting long-term community planning. Strategies on climate change are mostly "soft", and these priorities are "highly relevant" to the priorities identified in the NSCCM.

11-NESDP rightly recognizes that natural disasters such as flood and drought are getting more frequent and severe, and that climate change will increase the frequency and severity of forest fires, droughts, floods, landslides, and storms. Thus as response to natural disasters, it recommends to (i) map risk areas at the national, regional, and provincial levels, (ii) upgrade the efficiency of disaster management, (iii) develop databases and a telecommunication system, and (iv) establish disaster relief planning for the entire population.[43]

On the other hand, discussion on climate adaptation is mostly confined to the strategy for managing natural resources and the environment (including disaster management), and not well linked to other development strategies. The need for considering the effects of climate change is discussed in food security, but not under other strategies such as "restructuring the economy towards quality growth" and "creation of regional connectivity." Thus adaptation is "partially considered."

Country's own initiative: The NSCCM and the long-term climate change master plan under preparation is the country's own initiative. However, no evidence is found of incremental budgetary allocation to adaptation activities as a result of the NSCCM, as most programs in the NSCCM were already in the relevant ministries' programs. It is not yet clear whether the government will allocate its own budget for implementing the master plan, including actions on climate adaptation. The initiative is "partially demonstrated."

A summary of the analysis is in Table 5-6. Overall, the level of mainstreaming in Thailand is limited. The word "mainstreaming" is not used in the NSCCM, EQMP, nor 11-NESDP. While the need for climate adaptation is well recognized in these documents, specific

[43] The 11-NESDP was formulated prior to the devastating 2011 floods that hit Thailand including Bangkok.

actions are still mostly limited to capacity-building, creating knowledge, and awareness-raising, and within the field of natural resources and environmental management.

Table 5-6: Mainstreaming analysis of Thailand (2)

Perspective	**Aspects reviewed and rating**	Thailand rating
Relevance: (i) alignment	Aspect: Alignment between adaptation priorities (in NSCCM) and those of national development Rating: ++ (highly relevant) Adaptation priorities are closely aligned with development priorities. + (partially relevant) Some adaptation priorities are aligned with development priorities. - (not relevant) Most adaptation priorities are different from development priorities.	++
(ii) consideration of climate adaptation	Aspect: Consideration of climate change adaptation in the development priority sectors Rating: ++ (well considered) Climate change adaptation is taken into account in most development priority sectors (score of 2). + (partially considered) Climate change adaptation is taken into account in some development priority sectors (score of 1). - (not considered) Climate change adaptation is not taken into account in most development priority sectors (score of 0).	+ (1)
Country's own initiative	Aspects: (i) Budget allocation to adaptation activities and (ii) development of policy and/or strategy on climate change adaptation other than NAPA, or relevant initiatives Rating: ++ (highly demonstrated) Both of the above actions are taken (score of 2). + (partially demonstrated) One of the above actions is taken (score of 1). - (not demonstrated) Neither of the above actions is taken (score of 0).	+ (1)
Mainstreaming scores	Adding the score for relevance (ii) and country's own initiative	2
Overall evaluation	Total score of 4: advanced; 3: medium; 2: limited; 0-1: minimal	limited

In order to promote mainstreaming, Thailand will need to strengthen inter-ministerial coordination, particularly bringing in key ministries such as the Ministry of Finance and NESDB in adaptation planning. Based on the findings of Chapter 2, recognition of the need for mainstreaming and establishing a clear and functional M&E mechanism will also likely enhance the level of mainstreaming. Another important issue is to make adaptation plans compatible with national development plans in terms of their time horizon. Although the NSCCM had a medium-term time horizon, the climate change master plan under preparation covers the period of 2013-2050, much longer than 5 years that Thailand uses for national development planning. Although formulating a long-term plan for climate change is sensible due to the need for long-term perspectives in addressing climate change, the plan needs to be translated into medium-term priority measures and actions in order to be aligned with development plans. Upon approval of

the master plan, the ONEP plans to develop a medium-term action plan during 2014 as the master plan is a broad framework document. An action plan for adaptation may be termed National Adaptation Plan (NAP) if it meets the requirements of a NAP defined by the UNFCCC.[44] The medium-term action plan needs to be harmonized with the 12th NESDP, which will be formulated in 2016.

5.4. Adaptation mainstreaming in Bangkok

5.4.1 Introduction of Bangkok

Bangkok, the capital of Thailand since 1782, is not only the country's political, economic, and administrative center, but also a regional and global hub. The city has become one of the emerging megacities in Asia. The Bangkok Metropolitan Administration (BMA) administers an area of 1,569 km^2, with a registered population of 5.7 million in 2010, which is approximately 10% of the total population in Thailand. However, if non-registered population, estimated to be about 4 million, is included, the total population in BMA is around 10 million. According to the United Nations Department of Economic and Social Affairs, the population of Bangkok was 8.4 million in 2011, and is expected to grow to 11.2 million by 2025.[45] Located on the lower plain of the Chao Phraya River Basin, the city's average ground level is 0.5 to 1.5 meters above mean sea level (MSL) only, which makes the city susceptible to sea-level rise and storm surge. Land subsidence, although slowing down to about 1.0 cm a year from a peak of 10 cm a year in 1978, is still a major risk to the city's vulnerability (Panya Consultants 2009).

Due to rapid urbanization, water bodies such as ponds, wells, canals, and ditches were filled up and replaced by buildings and other structures. This resulted in more frequent flooding in the past. Major flooding in Bangkok was recorded in the years 1942, 1975, 1978, 1980, 1983, 1995, and 1996, with the one in 1983 considered the worst before the 2011 flood. The recent flood in 2011, which affected Bangkok as well as surrounding and upstream provinces, caused catastrophic damage to both life and property. The total death toll in the country rose to 680, and damage costs skyrocketed to 1.43 trillion Baht ($46.5 billion), according to an estimate in December 2011 (World Bank 2012a).[46]

5.4.2 Bangkok Metropolitan Administration

BMA has 50 administrative districts in 6 administrative zones. It has 16 departments as shown in Figure 5-1. It has 95,573 staff members as of March 2011, consisting of 22,025 officers, 16,042 school teachers, 42,226 permanent employees, and 15,280 temporary employees. The number of staff in each department is in Table 5-7.

[44] Based on an interview with an ONEP official in December 2013.
[45] http://esa.un.org/unpd/wup/CD-ROM/Urban-Agglomerations.htm accessed on 15 July 2013
[46] This is the world's fourth costliest disaster, surpassed only by the 2011 earthquake and Tsunami in Japan, the 1995 Kobe earthquake in Japan, and Hurricane Katrina in 2005.

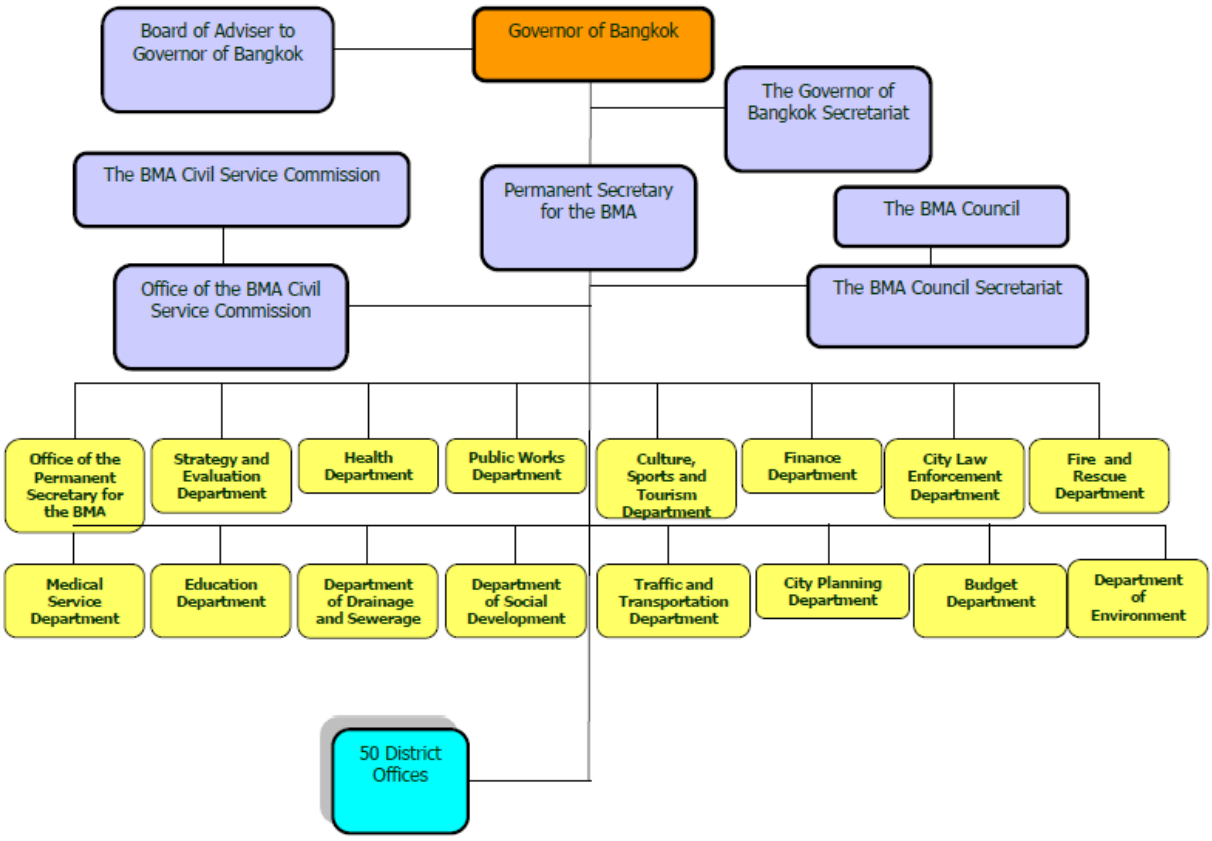

Figure 5-1: Organizational structure of BMA (Source: BMA)

The Governor of Bangkok, having a 4-year term, is elected by the public. 61 city councilors are also elected. Although there is no climate change department or section, the Air Quality and Noise Management Division of the Department of Environment (DoE) is serving as the focal point in BMA on issues related to both climate change mitigation and adaptation. Specific issues are managed by sector departments, such as the Department of Drainage and Sewerage (DDS) for flood management, and DoE for solid waste management.

Table 5-7 Number of Personnel in BMA (including temporary employees)

Department/Office	Number of personnel
Executives, secretariat, and others	314
Office of the BMA civil service commission	208
Office of the Permanent Secretary	1,273
Strategy and Evaluation Department	358
Medical Service Department	7,541
Health Department	4,443
Education Department	641
Public Works Department	2,668
Department of Drainage and Sewerage	5,837
Department of Environment	4,974
Culture, Sports, and Tourism Department	1,192
Finance Department	1,691
City Law Enforcement Department	448
Department of Social Development	674
Traffic and Transportation Department	365
City Planning Department	261
Fire and Rescue Department	2,259
Budget Department	159
436 schools	20,579
50 district offices	39,688
Total	95,573

(Source) BMA

BMA is a signatory to the Durban Adaptation Chapter,[47] which was launched at the UNFCCC Conference of the Parties (COP) 17 held in the City of Durban, South Africa in

[47] Signatories to the Durban Adaptation Charter call upon local and sub-national governments to commit and upscale action to accelerate their adaptation efforts by committing to the following: (i) mainstream adaptation as a key component of all local government development planning, (ii) understand climate risks through conducting impact and vulnerability assessments, (iii) prepare and implement integrated, inclusive and long-term local adaptation strategies designed to reduce vulnerability, (iv) ensure that adaptation strategies are aligned with mitigation strategies, (v) promote the use of adaptation that recognizes the needs of vulnerable communities and ensures sustainable local economic development, (vi) prioritize the role of functioning ecosystems as core municipal green infrastructure, (vii) seek the creation of direct access to funding opportunities, (viii) develop an acceptable, robust, transparent, measureable, reportable and verifiable (MRV) register, (ix) promote multi-level and integrated governance, and advocate for partnerships with sub-national and national governments on local climate action, and (x) promote partnerships at all levels, and city-to-city cooperation and knowledge exchange.

December 2011. While about 950 local government organizations from 27 countries are the signatories to the Charter, BMA is the only signatory in Thailand.

The names of the 50 districts in Bangkok are given in Figure 5-2 below.

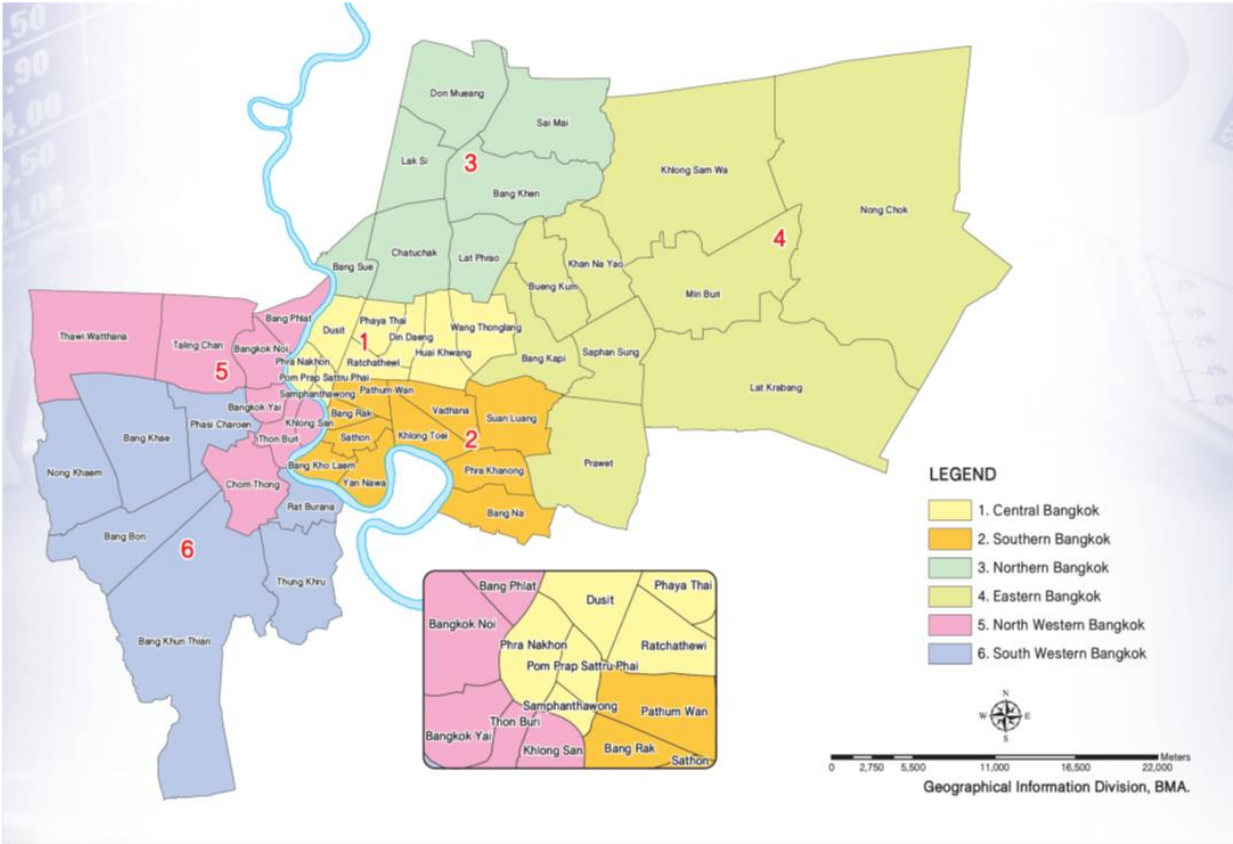

Figure 5-2: The 50 Districts of Bangkok (Source: BMA)

5.4.3 City's vulnerability and climate risk

5.4.3.1 Observed climate

Bangkok's 30-year average annual rainfall between 1981 and 2010 is 1,648 mm/year (BMA 2013). Monthly rainfall peaks in September and October, and 86% of annual rainfall is

recorded in the rainy season of May-October. Although it has been observed that precipitation in Thailand and the number of rainy days in Thailand are showing a decreasing trend since the middle of the twentieth century, precipitation in Bangkok has not shown a clear trend in the last 30 years. In 2011, when serious floods hit Thailand, monthly rainfall in Bangkok was higher than the average from March to October, resulting in an annual rainfall of 2,258 mm, 33% higher than the average. Rainfall in Northern Thailand, upstream of the Chao Phraya River, was also higher than the 1971-2000 average by 42% in 2011 (TMD 2011).

Bangkok's temperature is on an increasing trend. The average maximum temperature increased by nearly 1^{o}C over the last 50 years to 33.4^{o}C, while the average minimum temperature increased by about 2^{o}C over the last 50 years to about 25.4^{o}C. Moreover, the number of days hotter than 30^{o}C is also rising (BMA et al 2009).The impacts of climate change on Bangkok have thus become increasingly visible, and have become the subject of serious concern.

5.4.3.2 Climate projection

Several studies were conducted to project future climate in Thailand. Based on a summary from the projections of 8 global circulation models (GCMs) under moderate increase in greenhouse gas, the Special Report on Emissions Scenario (SRES) A1B scenario,[48] in the Central Plain and Chao Phraya River basin, where Bangkok is located, annual average maximum temperature is expected to increase from the current 33.49^{o}C to 36.41^{o}C–38.22^{o}C with a median value of 36.90^{o}C (+3.41^{o}C) in 2045-2065 (START 2010). Similarly, annual average minimum temperature will increase from the current 23.74^{o}C to 26.74^{o}C-28.46^{o}C with a median value of 27.67^{o}C (+3.93^{o}C) in 2045-2065. Temperature increases projected by the Integrated Research System for Sustainability Science (IRS3) of the University of Tokyo are less, with 1.9^{o}C and 1.2^{o}C in 2050 under A1FI and B1 scenarios respectively (Panya consultants 2009).

START (2010) projected an annual average precipitation increase from 1,095 mm to 839mm-1,627 mm with a median value of 1,210 mm (+10.5%) in 2045-2065 under the SRES A1B scenario. IRS3 reported that the mean basin precipitation for Bangkok would increase by 3% and 2% by 2050 corresponding to A1FI and B1 scenarios. It should be noted, however, some models project reduction in the amount of rainfall with climate change.

The sea-level rise in the Gulf of Thailand is expected to rise by 29 cm and 19 cm by 2050 corresponding to A1FI and B1 climate scenarios (Panya Consultants 2009), while another

[48] The scenarios in the SRES are grouped into four scenario families (i.e., A1, A2, B1, and B2) that explore alternative development pathways, covering a wide range of demographic, economic, and technological driving forces and resulting GHG emissions. A1 assumes a world of very rapid economic growth; a global population that peaks in the mid-21st century; and swift introduction of new and more efficient technologies. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B). A2 describes a very heterogeneous world with self-reliance and preservation of local identities. B1 describes a convergent world with the same global population that peaks in the mid-21st century, as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. B2 describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. See IPCC (2000) for more details.

study projects 8.2 cm-28.9 cm with a median of 20 cm in 2030-2049 from the baseline period of 1981-2000 (START 2010).

For urban floods, rainfall intensity of short duration is a major concern. For Southeast Asia, global climate models suggest that the intensity of a daily precipitation event during 2046-2065 would be 10-15% higher than that in the period 1981-2000 (IPCC 2012). 20-year return values of annual maximum 24-hour precipitation in 1981-2000 will become those of 8-10 year return period events in 2046-2065.

5.4.3.3 Vulnerability assessment

Only a few studies exist with regard to assessing the climate vulnerability of Bangkok. Bangkok is ranked 7th in terms of population exposure in the 2070s in the world, according to a study of ranking the exposure of the world's large port cities (total 136) to coastal flooding due to sea-level rise, storm surge, and land subsidence today and in the 2070s (OECD 2007, Hanson et al 2011). Assuming 0.5 m sea-level rise, 10% increase in extreme water levels for tropical storms, and 0.5 m land subsidence, all by 2070, the exposed population will be about 5.1 million in Bangkok in the 2070s from the current 0.9 million.[49] In the same study, Bangkok is ranked 10th in terms of assets exposed to coastal flooding in the 2070s. A further study based on this initial screening estimated Bangkok's average annual losses at $734 million in 2050, which is 23% higher than that in 2005, under scenarios with socio-economic change, land subsidence, sea-level rise, and taking adaptation actions (e.g., coastal flood defenses) to maintain a constant probability of flooding (Hallegatte et al 2013). This is the 18th largest in the world. Another study identifies sea-level rise and floods as dominant hazards in Bangkok, and Bangkok's vulnerability is the highest in Thailand (Yusuf and Francisco 2009).

Floods are generally considered the largest risk related to climate change in Bangkok. A study financed by the World Bank summarized the possible consequences of climate change in the Bangkok Metropolitan Region as follows: (i) flood-prone areas will increase by about 30% between 2008 and 2050, and 7% of areas will remain inundated for over one month; (ii) flood volume will increase by the same percentage as precipitation, but flood peak discharge will increase more; (iii) the economic damage of flooding will rise four-fold in 2050; and (iv) buildings and houses will be the most affected infrastructure (Panya Consultants 2009). Flood risks are exacerbated by sea-level rise, land subsidence, and storm surges. According to the study, certain areas, such as Bang Khun Thien and Don Muang districts of Bangkok, will be severely affected in terms of the number of population and buildings.

However, to date, no detailed vulnerability or risk assessments inside BMA have been undertaken. These assessments should identify areas and/or communities particularly vulnerable or at risk from climate change such as floods and heat waves. Lack of such assessments will make meaningful adaptation planning a major challenge, as discussed later.

[49] Population distribution by elevation within city boundaries was derived using population database and topographic data. Then population exposure, or 'at risk' population, was calculated as a function of elevation of water levels related to the 1:100 year storm surge.

As evidenced in the literature and recent 2011 floods, there is little room for argument that urban flood is the most prominent issue in Bangkok in discussing climate adaptation. Therefore, urban floods will be the focus of discussion in subsequent sections.

5.4.4 Analysis of mainstreaming in Bangkok

The level of mainstreaming in Bangkok is first analyzed by reviewing its development plan. Since Bangkok does not have a climate change (adaptation) strategy or plan yet, review of such a strategy/plan is not possible. Then, status is assessed by using the five key factors for adaptation mainstreaming selected in Chapter 3.

5.4.4.1 Development plan

BMA, as a special local government with responsibility for providing infrastructural, economic, social, health, and education services to the people in its area, has released its development plans since the 1970s, from the first plan (1977-1981) to the sixth plan (2002-2006), as a framework for direction and control of development activities. It developed its first performance plan for 2005-2008, under the government's first performance plan for the same period that demands various state agencies to formulate action plans in accordance with its own plan. Recognizing the need for determining long-term development strategies, vision, and goals in order to provide a principle track for developing Bangkok into a sustainable metropolis, BMA decided to formulate a 12-year development framework plan covering the period of 2009-2020, which will be sub-divided into 3 phases of performance plans with 4 years for each phase according to the terms of elected governors (BMA 2008).

The 12-year development plan has five strategies: (i) strengthening infrastructure for a regional megacity, (ii) developing a strong economy and knowledge-based society, (iii) striving for Green Bangkok, (iv) providing a good quality of life in a cultural megacity, and (v) mastering best service and megacity management. Climate change falls under Strategy (iii). The Phase 1 plan (2008-2012) only referred to mitigation of climate change including indicators for CO_2 emissions, and BMA's action plan on global warming mitigation in 2007-2012 did not include any action on adaptation. The Phase 2 plan (2013-2016), developed in 2012, however, incorporates adaptation to climate change (BMA 2012a). One of the targets under this strategy is to build readiness for mitigation of and adaptation to impacts of climate change. Specific activities/measures in this field include (i) strengthening Bangkok in coping with climate change through supporting research and developing knowledge aimed at a low carbon society, as well as developing mechanisms and measures to implement relevant policy and strategy successfully; (ii) building people's capacity for coping with and reducing the risks of impacts from climate change through promotion of and participation of all stakeholders in a low carbon society; and (iii) building a network among organizations in Bangkok, and those inside and outside the country, aimed at reducing risks from climate change by sharing knowledge, technology, experience, and implementation measures, including seeking support for research and budgets. While the language stresses mitigation issues more by reiterating the word "low carbon society," the intention for addressing both mitigation and adaptation is observed.

Prevention and problem-solving with regard to flooding is underscored under the same strategy, which is indirectly linked to climate adaptation. Improving effectiveness of drainage systems for flood prevention receives the highest attention under this strategy, and specific measures proposed include (i) improving drainage systems to prevent flooding from the Chao Phraya river through large scale drainage tunnels and construction of dykes; (ii) increasing the drainage capacity of major roads to cope with intensive rainfall (intensity of 60 mm/hour) by building/improving drains and pumping stations; and (iii) increasing water management efficiency by developing retention ponds with an additional capacity of 0.5 million m^3. Incorporating climate change considerations into the design of improved drainage systems, however, is not discussed.

A review of the plan in light of the four factors used at country level identifies the following. First, the Phase-2 development plan elaborates measures, indicators, performance targets and activities, which will form a solid basis for M&E. However, institutional arrangements including mandates of relevant departments are not clarified. An evaluation of Phase-1 development is not yet available as of December 2013.[50] Neither inter-departmental coordination nor recognition of the need for climate adaptation mainstreaming is indicated in the plan. Time compatibility is not relevant as there is no separate adaptation plan available. Adaptation priorities are not clear, and there is no city's own initiative on adaptation. All these imply that Bangkok is still in an early stage of mainstreaming.

There is no policy or regulatory framework at the central level that requires or encourages local governments to develop a climate change plan or strategy. However, BMA has recently started a process for developing a Bangkok Master Plan for Climate Change 2013-2023 under a Japan International Cooperation Agency (JICA) technical cooperation project (JICA 2013a). The project comprises drafting a master plan as well as the individual and institutional capacity development of BMA, and started in March 2013 for a period of 24 months. Five sectors are covered in the master plan, namely (i) environmentally sustainable transport, (ii) energy efficiency and alternative energy, (iii) efficient solid waste management and wastewater treatment, (iv) green urban planning, and (v) adaptation planning. So only the last one relates to adaptation. The institutional arrangement under the JICA project comprises three layers: steering committee, working group, and task forces. Five task forces for each sector have been formed, and members include seven departments of BMA. These are the Departments of Environment (which is also the overall focal point), Fire and Rescue, Public Works, City Planning, Strategy and Evaluation, Drainage and Sewerage, and Traffic and Transportation. Relevant ministries and national agencies will participate in the steering committee and working group. The link between BMA's existing plans (framework development plan and/or performance plan) and this master plan is not clearly defined in available documents.

[50] The Strategy and Evaluation Department is generally responsible for evaluation.

5.4.4.2 Assessment of mainstreaming through application of five factors

Factor 1: Solid knowledge base on climate impact and vulnerability

Although data on climate projections are available, detailed vulnerability or risk assessments are not available in Bangkok. This makes target interventions to reduce climate risks and vulnerability quite difficult. As discussed earlier, it is often the case that slum communities with poor basic infrastructure and housing are most vulnerable to the impacts of climate change. However, Webster and McElwee (2009) discuss that long-standing slums in areas such as Klong Toey in Bangkok will not be significantly affected by most major potential climate change-induced flood events because they are interwoven into the relatively well-protected inner city area. They point out that vulnerability in the Bangkok Metropolitan Region is likely to be associated as much with employment disruption as residential life per se, and the socio-economic groups most impacted would not be the poorest, but industrial workers and middle class suburbanites in Bang Khun Thien District which is suffering from coastal erosion. But it is not clear how they came to this conclusion. Marome (2011) also found that impacts of the 2006 floods in Bangkok were comparable across different income levels, demonstrating a relatively strong adaptive capacity of low income households, by studying 380 households in four districts of eastern Bangkok. Damages and losses of the 2011 flood broken down to different income groups are not available. Understanding the city's vulnerability among different areas and groups (e.g., poor and non-poor) would be a priority area in order to promote mainstreaming.

Factor 2: Leadership and championship

In 2011, when Bangkok was faced with a huge flood, the Governor of Bangkok took initiatives to coordinate with the central government as well as to alleviate suffering by dispatching rescue and recovery teams to critical areas, and providing various forms of assistance to help flood victims cope with the adverse effects of the disaster. However, top leadership for promoting the climate change agenda in Bangkok, particularly in the field of climate change adaptation, has not been sufficiently demonstrated yet. A high-level command operation is possible when a disaster hits, but no high-level committee exists for disaster prevention or climate adaptation. Leadership can be made more proactive. No 'champion' to rigorously pursue climate change adaptation or adaptation mainstreaming has yet emerged.

Factor 3: Good governance of local government

Tanner et al (2009) assessed urban governance of 10 Asian cities including Bangkok by using a climate-resilient assessment framework which comprises (i) decentralization and autonomy, (ii) accountability and transparency, (iii) responsiveness and flexibility, (iv) participation and inclusion, and (v) experience and support (See also Section 3.2.1). Although there is no ranking or quantitative evaluation among the 10 cities, governance assessment of Bangkok is generally positive: municipal authority is decentralized; it has a high level of fiscal autonomy; and it has the capacity and authority to improve flood management systems.

However, weaknesses are found in citizen participation: there is little citizen oversight due to bureaucratic procedures; and participation level among marginalized groups is low.

Field interviews revealed that various activities have been conducted to strengthen citizen participation in the work of BMA. For example, the City Planning Department (CPD), in preparing the Bangkok Comprehensive Land Use Plan (CLUP), went through public consultation processes including 30 days of public comments and consultation meetings at the initial stage, and 90 days of public comments on the draft. The CLUP was approved in 2013 and issued as a ministerial regulation from the Ministry of Interior. The Bangkok Fire and Rescue Department (BFRD) is strengthening public communication by supporting community networks to raise awareness of, and improve readiness of the public for disasters including fire, earthquakes, and floods (BMA 2012b). It also disseminates a booklet that provides procedures before, during, and after a disaster to enhance the resilience of people exposed to risks. Similarly, the Department of Social Development (DSD) distributes a booklet to communities to be better prepared for floods. Nevertheless, citizen participation remains a major challenge in a big city like Bangkok.

Factor 4: Internal collaboration

Tanner et al (2009) commented on overlapping functions and poor coordination between governments in the case of Bangkok. This view was found to hold true through interviews. There was no built-in mechanism to facilitate collaboration among departments, and it was observed that each sector's plans are normally developed within the departments concerned.[51] There have been cases of coordination as evidenced in the involvement of the Department of Drainage and Sewerage (DDS) in the preparation of the CLUP, but the level of involvement is not very strong. Furthermore, BMA will need to strengthen involvement of more influential departments such as budget or planning in the climate planning process. Involvement of the BMA Council, which has the authority to approve the development plans and annual budgets of BMA, is also limited despite its importance.

Factor 5: Existing problems linked with climate

The severe flooding Bangkok encountered in 2011 provides an excellent opportunity to raise public awareness and enhance readiness for similar events. Urban floods would be even more severe with climate change, so climate adaptation can be integrated into flood prevention and management plans. Interestingly, one interviewee in BMA clarified that people are more willing to cooperate if they explain that the measures are to prevent floods of a similar extent from happening again, than if they explain that the measures are to adapt to climate change. In reality, there is no clear distinction between flood mitigation and climate adaptation, indicating the need for mainstreaming rather than tackling the issue separately.

[51] For example, there was no involvement of the Department of Drainage and Sewerage in the preparation of Bangkok's public disaster prevention and mitigation plan, even though flooding is a major public disaster in Bangkok.

5.4.4.3 Discussion on mainstreaming in Bangkok

In short, climate adaptation mainstreaming has not been adequately recognized in Bangkok. The city's own initiatives are not adequately demonstrated. While the Phase 2 plan clearly demonstrates advancement of the climate adaptation agenda, activities are generally confined to soft areas only, such as knowledge development, capacity-building, and networking, and do not include integration of climate change adaptation considerations into development projects.

The analysis applying the five key factors further indicates that recurrent flood problems in Bangkok, including the devastating 2011 flood, provide a strategic opportunity to incorporate climate considerations in Bangkok's development plans (factor 5), but flood management plans do not explicitly discuss climate change. A key bottleneck is lack of a micro-level sound knowledge base on Bangkok's vulnerability to climate change (factor 1), which should be the first action for effective mainstreaming as depicted in Figure 3-1. Bangkok currently does not have a solid vulnerability assessment. It does not even have a hazard map. The planning process should start from a hazard map to identify current areas of high exposure, and be built into a risk map by incorporating the vulnerability of different areas and groups.[52] "Hot Spot Mapping," which involves overlaying various maps displaying different climate-related impacts to identify which areas are subject to the most impacts, or the greatest severity of a given impact, would be useful in identifying areas and communities that deserve particular attention and support. Vulnerability assessment for floods, which poses the highest risk among climate-related risks in Bangkok, should not be very difficult, as data from the 2011 floods are already available, and supplementary data collection can be made in the field through focus group discussions. Satellite images of the 2011 floods and hydro-dynamic modeling will help identify flood-prone areas. The development of a climate change master plan, recently initiated in BMA by designating DoE as the focal point for preparation of the plan, should start with vulnerability or risk assessment.

The master plan will also showcase whether and how mainstreaming can be advanced. Applying the five determinants to the master plan suggests the following: First, it has to be made clear how the final master plan will be integrated (mainstreamed) into development plans and projects of relevant sectors. Considering the segregation of work among departments in BMA (factor 4), there is a risk that the overall climate change master plan may not be effectively implemented, as experienced in Durban, South Africa (see Chapter 3). A master plan will need to be translated into sector development plans that relevant departments can own and implement. It is encouraging that BMA plans to develop an action plan after the formulation of the master plan.[53]

Second, a public consultation process for the development of a master plan should be clearly specified. The process for preparing the master plan should be inclusive and

[52] The World Bank (2012b) clarifies that the basic steps involved in a risk assessment process are (i) hazard estimation with reference to location, level of severity, and the frequency of event occurrence; (ii) estimation of exposure of elements at risk; (iii) estimation of vulnerability; and (iv) estimation of risk by integrating hazard, exposure, and vulnerability.

[53] Based on an interview with a BMA official in December 2013.

participatory, although holding meaningful consultations in a large city such as Bangkok could be a major challenge (factor 3). Identifying vulnerable communities and groups will help hold more focused and targeted consultations in the planning process, and enhance equity and legitimacy of the plan. Thirdly, political leadership is essential to elevate climate change from an environmental issue to a broader development agenda (factor 2). Climate change is largely regarded as an environmental issue in Thailand at both the national and local levels, and this perception needs to be changed. If this perception continues, actions for climate adaptation will likely stop at conventional soft measures such as enhancing knowledge, awareness-raising, and capacity-building as observed in the 11-NESDP. Moreover, strong leadership is essential in breaking through persistent barriers among departments in BMA. Once a comprehensive master plan is developed, it is important to translate it into sector-specific plans by reviewing existing plans through a 'climate lens' to ensure that future actions will take account of implications arising from climate change. Learning from lessons at the country level also suggests that time compatibility should be ensured between the climate change master plan and development plans. The 10-year master plan needs to be translated into a medium-term action plan, which should have the same time frame as the development plan. The Phase 3 plan (2017-2020) can be developed as a climate-mainstreamed development plan to ensure the same time horizon.

An analysis using the five factors derived in Chapter 3 proved to be useful in assessing the status of and direction for climate adaptation mainstreaming in Bangkok.

5.5 Bangkok's flood management systems

5.5.1 Overview

Bangkok is prone to two types of flooding. The first type is river (fluvial) flood. Located at the mouth of the Chao Phraya River (which has a catchment area of 159,000 km^2), a large volume of water passes through the middle of Bangkok. River floods occur when the surface water runoff exceeds the capacity of the river to accommodate the flow. This was the cause of the devastating 2011 flood. The second type is pluvial (overland) flood, sometimes referred to as urban flood. A high amount of rainfall is not absorbed into the land, and flows over land and through urban areas before it reaches drainage systems or watercourses. This kind of flooding often occurs in urban areas, as the lack of permeability of the land surface means that rainfall cannot be absorbed rapidly enough.

Flooding in Bangkok is mainly caused by large upstream runoff (causing river flooding), and heavy local rainfall (leading to pluvial flooding), but is also affected by the tidal effect. Following months of heavy downpours in the rainy season in the Chao Phraya River Basin, the River draining the northern part of the country flows through the center of Bangkok on its way to the Gulf of Thailand. At the same time, since the city is close to the sea, the direction of flow of the Chao Phraya River at high tides can be reversed, and in the process the river can overflow its banks when tidal surges meet the heavy runoff from upstream. The Department of Drainage and Sewerage (DDS) of BMA summarizes the causes of flooding as follows (BMA, undated):

(i) Heavy rainfall in a short period of time results in inability to immediately drain water from roads, lanes and houses, causing temporary flooding.

(ii) There is runoff from northern and eastern parts flowing through Bangkok due to the slope of ground level. This mostly causes a flooding problem in the eastern part of Bangkok.

(iii) Excessive runoff from the North and the Chao Phraya River Basin flowing through Bangkok to the sea causes overflow and flooding in the area.

(iv) High tide from the sea occurs at the same time as excessive runoff from the North through Bangkok, which causes a high water level in the Chao Phraya river.

(v) Land subsidence due to pumping of a large amount of underground water makes the area subside to a level lower than mean sea level, causing difficulty in draining of inundation.

(vi) Insufficient drainage system.

Many measures were taken to alleviate flooding in Bangkok. Construction of the Bhumibol Dam in 1964 and Sirikit Dam in 1971 played a major part in reducing flooding risks in the lower delta including Bangkok. Additional flood protection works include the construction of additional storage dams, comprising the Pasak Dam in 1998 and Khwae Noi Dam in 2008. Following the catastrophic floods in 1983, the King's Dyke was constructed at the northern and eastern boundaries of Bangkok to prevent water in the eastern flood plain from inundating the city center. Since Bangkok is a flat and lowland area, it has developed a polder system for flood protection and drainage measures, including (i) preventing the inflow of water from outside the polder by constructing flood barriers, such as dykes; earthen, road and railway embankments; and many types of buildings; (ii) discharging water out of the polders, using pumping stations, water gates, tunnels and sewers, and improving drainage canals by constructing dykes and dredging canals; and (iii) retaining rainwater temporarily in holding ponds and wells, and by constructing and improving such facilities to form temporary retention basins, or "monkey cheeks."

Despite these significant investments, due to funding constraints to fully implement the projects proposed in the Master Plan[54] and rapid urbanization sprawling into agricultural areas in suburbs converting them to impervious surface, among others, the city is still vulnerable to flooding, as demonstrated by the unprecedented 2011 floods. The literature highlights land subsidence as a critical factor in this regard: it undermines the efficiency of the city's flood defenses because the high-point of the dykes gradually sinks as the ground beneath these defenses subsides. Land subsidence also dramatically affects the efficiency of the sewer system and underground pipes built to rapidly eliminate rainwater, a situation which tends to aggravate the flooding of urban areas during the monsoon season and periods of very high

[54] After the 1995 flood, the World Bank supported the review of the Chao Phraya River Flood Management Plan. Then, JICA provided assistance to develop an Integrated Plan for Flood Mitigation based on recommended work plans of the World Bank report.

tides. Further, it makes the process of draining the low lying areas of the city that are sinking, more difficult, leading to the formation of stagnant water after flooding (BMA et al 2009).

Immediately after the prolonged flood in 2011, the Government of Thailand requested JICA's assistance. JICA, in collaboration with NESDB, the Royal Irrigation Department (RID), and the Department of Water Resources (DoWR), finalized the Flood Management Plan for the Chao Phraya River Basin in February 2013 (JICA 2013b). The plan proposes effective operation of existing dams, diversion and bypass channels, and river improvement work in order to alleviate flood impacts, including in Bangkok.

5.5.2 Adaptation mapping for Bangkok's flood management

First, a set of flood management measures, which could also be plausible adaptation options for Bangkok's urban flood management, is proposed by reviewing the literature on flood management and disaster risk reduction.

Urban flood management is a serious and growing development challenge, and is certainly the biggest climate-related risk that Bangkok faces. Many publications are available about flood management options. The World Bank (2012b) details structural and non-structural measures as in Table 5-8:

Table 5-8: Integrated Urban Flood Risk Management: Key measures

Structural measures	Non-structural measures
• Conveyance • Flood storage • Drainage systems • Infiltration and permeability of urban areas • Groundwater management • Wetlands and environmental buffers • Building design, resilience and resistance • Flood defenses • Barrier and embankment systems for estuary and coastal flood protection	• Flood awareness campaigns • Health planning and awareness campaigns • Land use planning and flood zoning • Flood insurance, risk financing, compensation and tax relief • Solid and liquid waste management • Emergency planning, rescue, damage avoidance actions and temporary shelters • Business and government continuity planning • Early warning systems • Evacuation planning

Source: World Bank (2012b), Chapters 3 and 4

The publication also presents a range of options with implications on costs and benefits as in Figure 5-3. The figure indicates that combining alternatives that perform well under different scenarios then becomes a preferred strategy rather than finding an optimal solution. "Reduced social vulnerability" is included as an option, which is highly robust to uncertainties and yields higher benefits relative to costs. Though this is not usually identified as a flood management option, it would be an effective measure due to the poor's high vulnerability to disaster risks including floods.

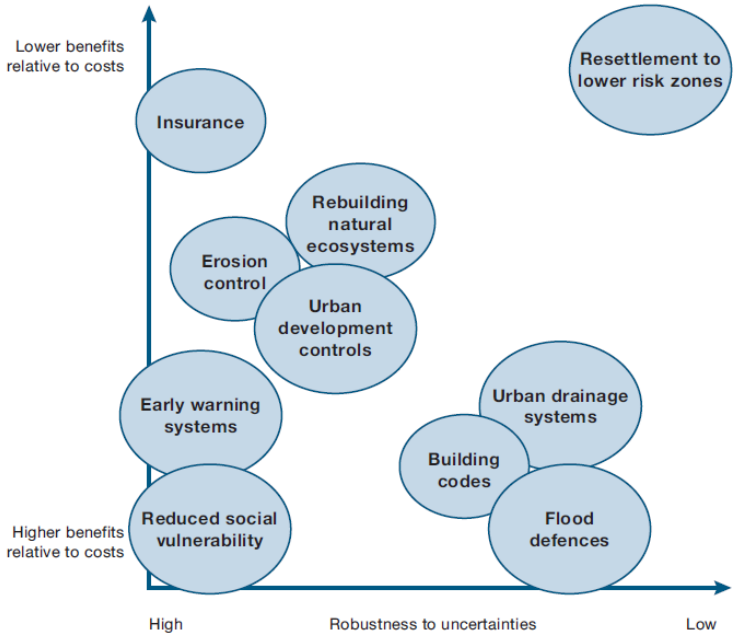

Figure 5-3: Relative costs and benefits of flood management options

Source) World Bank (2012b), (Figure 10, page 41)

UN-HABITAT (2011) lists preparedness actions for storm floodwater management in discussing climate adaptation, as in Table 5-9:

Table 5-9: Climate adaptation actions for storm and floodwater management

	Preparedness goal	Preparedness actions
Storm and floodwater management	Increase capacity to manage storm water.	• Increase capacity of storm water collection systems and ensure their maintenance (which usually includes a need to extend solid waste collection services to all districts). • Modify urban landscaping requirements to reduce storm water runoff. • Preserve ecological buffers (e.g. wetlands).
	Reduce property damage from flooding.	• Move or abandon infrastructure in hazardous areas. • Change zoning to discourage or prevent development in flood-hazard areas. • Update building codes to require more flood-resistant structures in floodplains.
	Improve early warning systems for storm and flood events.	• Increase the use of climate and weather information in managing risk and events – including the systems that ensure populations at risk get warnings and are able and willing to move temporarily to safe locations when needed. • Update flood maps to reflect changes in risk associated with climate change.

Source) UN-HABITAT (2011), (Table 6.5, page 146)

The United Nations Office for Disaster Risk Reduction (UNISDR) launched the “Making Cities Resilient Campaign” in 2010 to support sustainable urban development by promoting resilience activities, and increasing local level understanding of disaster risk. It developed “Ten Essentials for Making Cities Resilient.” Although this is not intended for urban floods alone, the

list is relevant to structural and non-structural options for coping with urban flood risks. The ten essentials are copied in Table 5-10.

Table 5-10: Ten Essentials for Making Cities Resilient Checklist

1. Put in place **organisation and coordination** to understand and reduce disaster risk, based on participation of citizen groups and civil society. Build local alliances. Ensure that all departments understand their role in disaster risk reduction and preparedness. 2. **Assign a budget** for disaster risk reduction and provide incentives for homeowners, low-income families, communities, businesses and the public sector to invest in reducing the risks they face. 3. Maintain up-to-date data on hazards and vulnerabilities, **prepare risk assessments** and use these as the basis for urban development plans and decisions. Ensure that this information and the plans for your city's resilience are readily available to the public and fully discussed with them. 4. Invest in and maintain **critical infrastructure that reduces risk**, such as flood drainage, adjusted where needed to cope with climate change. 5. Assess the **safety of all schools and health facilities** and upgrade these as necessary. 6. Apply and enforce **realistic, risk-compliant building regulations and land use planning principles**. Identify safe land for low-income citizens, and upgrade informal settlements, wherever feasible. 7. Ensure that **education programmes and training** on disaster risk reduction are in place in schools and local communities. 8. **Protect ecosystems and natural buffers** to mitigate floods, storm surges and other hazards to which your city may be vulnerable. Adapt to climate change by building on good risk reduction practices. 9. Install **early warning systems and emergency management** capacities in your city, and hold regular public preparedness drills. 10. After any disaster, ensure that the **needs of the affected population are placed at the centre of reconstruction**, with support for them and their community organisations to design and help implement responses, including rebuilding homes and livelihoods.

Source) UNISDR (2013) (emphasis given by UNISDR)

There are several ways to classify these measures, other than simply grouping them as structural and non-structural measures. The World Bank (2012b) uses the four categories, (i) increased preparedness, (ii) flood avoidance, (iii) emergency planning and management, and (iv) speeding up recovery and using recovery to increase resilience, although each measure is not clearly categorized. Similarly, UN-HABITAT (2011) uses the four categories, (i) long-term protection, (ii) pre-disaster damage limitation, (iii) immediate post-disaster response, and (iv) rebuilding.

As the above literature shows, there is no universal "fixed menu" for flood management. Thus, in this study, flood management measures as in Table 5-11 are proposed and used for subsequent analysis by consolidating the various representative measures mentioned above. Urban flood management needs to be integrated and holistic; therefore, an effective strategy requires a combination of these measures, depending upon local characteristics, financial and technical capacity, and the preference of the public. It does not mean that all measures are required in a particular city including Bangkok; but there should be a reason why some actions are not needed or relevant. The nature of these options is also added in the Table, reflecting the discussions made in Chapter 4 to assess the robustness of proposed measures.

Table 5-11: Major flood management measures and nature of options

Flood management option	Hard/soft	Other characteristics*	Long-term protection /preparedness	Damage avoidance /limitation	Emergency response	Recovery /rebuilding
Flood management and drainage infrastructure improvement (conveyance, flood defense, embankment)	Hard	Safety margin (No regret)	X	X		X
Natural buffers (e.g., wetlands)	Hard	Safety margin	X	X		
Groundwater management/rainwater harvesting	Hard/Soft	Synergies No regret	X	X		
Reducing social vulnerability: upgrading or provision of basic services to slums and low-income communities	Hard/soft	Synergies No regret	X	X	X	X
Land use planning and zoning	Soft	Safety margin	X	X		X
Building codes	Soft	No regret	X	X		X
Early warning systems	Soft	Flexible No regret	X	X	X	
Emergency planning and rescue	Soft	Flexible No regret			X	
Awareness-raising	Soft	Flexible No regret	X		X	X

* Other characteristics are (i) no regret, (ii) flexible/reversible, (iii) safety margin, and (iv) synergies with other measures. Details are found in Chapter 4.

5.5.3 Analysis of flood management measures

Climate adaptation mainstreaming in the context of flood management means that these measures should be “climate-proofed” as discussed in Chapter 4, so as to be effective in coping with not only the current flood risks, but also the increasing level of risks in the future with climate change. Key flood management measures are analyzed from three viewpoints: (i) whether and to what extent the measures are practiced or are planned to be practiced in Bangkok; (ii) whether the measures incorporate climate change considerations in their design and planning; and (iii) whether climate considerations are incorporated appropriately, if climate change is taken into account.

A summary of the analysis and status of implementation is given in Table 5-12, together with the main agencies and departments responsible for the selected flood management measures in Bangkok. The results of analysis for each type of flood management are discussed below.

Table 5-12: Summary of analysis, and status of practice of major flood management measures

Flood management option	Main responsible agency/dep't	Q1	Status of practice	Q2	Q3
Flood management and drainage infrastructure improvement	DDS, BMA	Y	Improvement work ongoing. Intends to achieve a level of protection to cope with a flood equivalent to the 2011 flood.	Y (implicit)	N
Natural buffers	DDS, BMA; RID	Y	The current four-year plan targets to increase their size by 0.5 million m^3. Only 2 areas with a capacity of 0.24 million m^3 have been identified.	Y (implicit)	N
Groundwater management/rainwater harvesting	DGR, MONRE; MWA	Y N	Groundwater abstraction is being reduced, and land subsidence has slowed down. Rainwater harvesting is not pursued.	N N	..
Reducing social vulnerability	MWA; DSD, PWD, BMA	Y	Water access is provided by MWA. BMA, through DSD and district offices, is supporting community development of LICs.	N	..
Land use planning and zoning	CPD, BMA	Y	Updated in 2013. Some consideration to flood risk reduction.	Y (implicit)	N
Building codes	PWD, BMA	Y	Building codes exist, but no updates in recent years.	N	..
Early warning systems	DDS, BMA; TMD; RID	Y	A flood control center is in operation, and there are plans to strengthen it.	N	..
Emergency planning and rescue	BFRD, BMA	Y	The Bangkok Public Disaster Prevention and Mitigation Plan 2010-2014 is in place. Plans are available for pre-, during, and post-disaster including floods.	N	..
Awareness-raising	Various departments	Y	Programs implemented by various departments, including preparation for floods.	N	..

Q1= Whether and to what extent the measures are practiced or are planned to be practiced in Bangkok.
Q2 = Whether the measures incorporate climate change considerations in their design and planning.
Q3 = Whether climate considerations are incorporated appropriately, if climate change is taken into account.
N = No, Y = Yes, .. = not applicable.
BMA = Bangkok Metropolitan Administration, CPD = City Planning Department, DDS = Department of Drainage and Sewerage, DGR = Department of Groundwater Resources, DSD = Department of Social Development, BFRD = Bangkok Fire and Rescue Department, LIC = low income communities, MONRE = Ministry of Natural Resources and Environment, MWA = Metropolitan Waterworks Authority, PWD = Public Works Department, RID = Royal Irrigation Department, TMD = Thai Meteorological Department

(i) Flood management and drainage infrastructure improvement

DDS has been implementing a number of drainage-related infrastructure investments. 75.8 km of flood barriers along the Chao Phraya River to prevent overflow of the river bank were constructed by 2012, the drainage capacities of pumping stations inside the polder area of about 1,100 km^2 (650 km^2 east of the Chao Phraya River and 450 km^2 west of the Chao Phraya River) are being increased to a total capacity of 1,638 m^3/s, and seven drainage tunnel projects with a total length of 19 km and capacity of 155.5 m^3/s were completed. Three additional drainage tunnels are planned to be constructed with a total length of 29.3 km and capacity of

180 m^3/s by 2017. As discussed above, the latest 4-year development plan (Phase 2) includes provisions for improving drainage systems through construction of flood barriers, rehabilitation of existing systems, additional drainage tunnels, and improvement of pumping stations, as well as improving road-side drains of major roads.

DDS has developed an "implementation plan for preventing and solving the problem of floods in Bangkok for 2013" (BMA 2013). Its goal is to prevent and solve flood problems caused by rainfall and high tide. It intends to improve flood management systems to cope with a flood equivalent to the 2011 flood in the future. Before the 2011 flood, the highest water level of the Chao Phraya River in Northern Bangkok was +2.27 m (MSL) recorded in 1995. But in 2011, it reached +2.53 m (MSL). Because of this, BMA plans to heighten the flood barrier at that point to +2.50m (MSL) plus 0.50 m of free board. Similarly in other areas along the Chao Phraya River, the height of the flood wall will be increased by 0.2m to 0.5m. Once the short-term plan is completed, BMA has a long-term plan to further improve the system by elevating flood walls, developing canal and drainage capacities, increasing retention ponds, and improving information systems and warning systems in the flood control center. JICA (2013b) assessed that the 2011 flood is approximately of the same scale as a 100-year return period of rainfall in the Chao Phraya River watershed and water volume of the river, so it can be said that BMA plans to manage a flood event with a 100-year return period in the future. Impacts of sea-level rise and storm surge associated with climate change on the flood management system are briefly discussed in JICA's report, but future impacts have not been explicitly incorporated.

Several points can be raised to make these plans more effective and "climate-proof." First, rainfall intensity used for road-side drains, 60 mm/hour for a 2-year return period, is computed based on historical rainfall records, and is not up-to-date.[55] Using future rainfall intensity based on climate projections may create a new challenge due to large uncertainties involved in the projections, but updating the return-period based on recent rainfall records and adding some safety margin will be essential. Second, it is not clear how these development projects have been coordinated with plans and projects in the upstream areas of Bangkok (see Box below on water mega-projects). The 2011 floods created conflicts between communities living upstream of Bangkok and those living inside the polder area.[56] Structural measures may transfer flood risks upstream or downstream, and holistic and integrated planning beyond one local government is essential, particularly in a city like Bangkok where water management upstream of the Chao Phraya River determines the severity of floods.

Box: Government's Initiative on Water Mega-Projects

The Cabinet approved on 18 June, 2013, 284.75 billion baht (about $9.2 billion) for the design and construction of water resource management and flood prevention schemes in the country, which is part of the total 350-billion-baht (about $11.3 billion) project. Four bidders selected through a competitive process will implement 9 modules as follows: (i) dam and reservoir construction in the Ping, Wang, Yom, Nan, Sa Krae Krang, and Pasak river basins (upstream of the Chao Phraya River); (ii) land planning and

[55] This was revealed through an interview with a BMA official in June 2013.
[56] Efforts to save polder areas from floods aggravated floods in upstream areas.

use; (iii) water retention areas, (iv) main river and embankment improvements; (v) flood diversion schemes; (vi) early warning and forecasting information center; (vii) dam and reservoir construction in 17 river basins nationwide; (viii) land planning and use in 17 river basins nationwide; and (ix) main river and embankment improvements. The Water and Flood Management Commission chaired by a deputy prime minister is leading the initiative.

The key objective of this initiative is to improve water resource management and prevent floods in the country, including Bangkok. However, no assessment has been made regarding the relationship (overlap and/or complementarity) between these mega-projects, and flood management infrastructure improvements planned by BMA. DDS's 5-year implementation plan for flood prevention is estimated to cost 48 billion baht ($1.55 billion), including the first phase of 14 billion baht. While planning the above mega-projects, the government has thus far not provided subsidies to BMA for implementation of the plan.

The Central Administrative Court of Thailand ruled on 27 June, 2013 that these mega-projects need to be put on hold until all legal requirements, such as public hearings and environmental impact assessments (EIAs), are met. While the government started public hearings and other actions in accordance with the ruling, procedures have not been completed as of December 2013. Thus the project has not formally kicked off.

Summarized by the author from interviews, newspaper articles, and information available from websites as of December 2013.

(ii) Natural buffers (e.g., wetlands, retention ponds)

Following the King's suggestion of the "monkey cheek" concept (retaining water when the drainage capacity is limited), DDS so far secured 25 retention ponds with a total storage capacity of 12.88 million m^3, comprising 6.87 million m^3 on the eastern side of Bangkok and 6.01 m^3 on the western side of Bangkok. Though DDS wishes to increase the retention capacity of the eastern side by 6.13 million m^3 to make the total 13 million m^3, only 2 places with an additional 0.24 million m^3 have been identified. These are in the design stage (BMA 2013).

(iii) Groundwater management/rainwater harvesting

Though land subsidence has not reduced to a fully satisfactory level, Bangkok is considered a success case in reducing groundwater abstraction and hence land subsidence. The Groundwater Act of 1977 introduced licensing for groundwater activities, and the groundwater tariff was gradually increased from 1.0 Baht per m^3 in 1984 to 8.5 Baht (about $0.28) per m^3 in critical zones in 2004. By combining a strict pricing mechanism with expansion of public water supply (cheaper than groundwater), total abstraction was reduced from 2,700 million liters per day (MLD) in 2000 to 1,500 MLD in 2005, and land subsidence was significantly reduced (World Bank 2012b). According to the Department of Groundwater Resources, total groundwater use in Bangkok was 2,200 MLD in 2004, all of which was by private users. The Metropolitan Waterworks Authority (MWA), a water utility for Bangkok and its vicinity, stopped groundwater pumping in 2002. The total groundwater charge in 2006 was 17.0 Baht ($0.57) per

m^3, consisting of 8.5 Baht of a groundwater tariff and 8.5 Baht of a groundwater conservation fee.[57]

Rainwater harvesting reduces peak outflow and lowers flood risk by storing rainwater. The harvested water can be used for purposes which are less sensitive to water quality (such as irrigation, washing or toilet flushing), but could be used for drinking with necessary treatment. It can also be used to recharge groundwater systems. However, no information was available on rainwater harvesting practices in Bangkok. While MWA is responsible for the water supply in Bangkok, their publications and publicly available information does not indicate any promotional activities with regard to rainwater harvesting.

(iv) Reducing social vulnerability

The Department of Social Development (DSD) of BMA maintains a detailed list of low-income communities (LICs). According to their latest statistics (June 2013), there are 2,054 LICs in Bangkok, comprising 460,000 households with a total population of 2.1 million, including 692 slum communities with a population of 0.7 million. Population, number of households and houses in each LIC are regularly updated by DSD, and the location of LICs is available on ward-level maps. These LICs are receiving community development support in the areas of physical environment, public health, and human resource development. The Public Works Department implements infrastructure improvement in these communities.

LICs may be vulnerable to flood impacts, because of high sensitivity due to poor infrastructure and housing, and low adaptive capacity due to limited financial resources and possible lack of land security. However, due to lack of a hazard map and vulnerability assessment, the level of vulnerability is not known. Support to these LICs is currently being provided not in the context of disaster (or flood) risk reduction, but general community development. Preparation of a hazard map and vulnerability assessment should clarify the level of flood risks in LICs, and offer suggestions as to how vulnerability can be reduced in the LICs by improving livelihood.

(v) Land use planning and zoning

BMA finalized its Comprehensive Land Use Plan (CLUP) in 2013 by updating the plan formulated in 2006. The 2013 CLUP and 2006 CLUP are shown in Figure 5-4 and 5-5, respectively. The City Planning Department (CPD) of BMA led the work of land use planning, based on which the Ministry of Interior issued a regulation. Interview with BMA officials confirmed that flood risks have been considered in determining the zones. The regulation has a clause to promote establishment of water retention/reservoir areas with a view to strengthening flood prevention and mitigation: if a building provides space for water retention of 1 m^3 or larger per 50 m^2 of land, floor area ratio (FAR) can be increased by 5% from the assigned value; if such facilities can retain more than 1 m^3 of water, the FAR can be increased proportionately up to 20% of the assigned value. In addition, the 2013 CLUP introduced a new provision that

[57] From the presentation material of DGR available from: http://siteresources.worldbank.org/EXTWAT/Resources/4602122-1213366294492/5106220-1213649450319/2.7.4_Groundwater_in_Bangkok.pdf accessed 16 July 2013.

requires at least 50% of the open space, in accordance with the open space ratio of each land use category, to have a pervious surface, where trees need to be planted. This is intended to increase green space and reduce flooding from heavy rains. Therefore, although implicitly, impacts on climate change have been taken into account, in terms of offsetting increasing flood risks.

On the other hand, limitations are also observed in the updated CLUP. The CLUP in 2013 is very similar to that of 2006, and it is not clear what lessons have been learned from implementation of the 2006 plan, including the 2011 flood. Introducing a measure to promote water retention capacity through a higher FAR and requiring permeable surface in open space is certainly an improvement, and the enforcement and effectiveness of these measures needs to be monitored.[58] These measures do not take account of different flood risks in different areas, while they are regarded as an important first step to reduce flood risks through land development control. Areas identified as retention/detention ponds remain small, except that a large area just upstream (north) of the coastal conservation zone in Bang Khun Thien District has been newly designated as a retention area. Effective conveyance systems such as floodways to smooth the water flow from upstream to downstream without causing overflow into city centers, are not designated. The CLUP has been prepared within the BMA's administrative boundary, and coherence with neighboring provinces is another concern.

Legend for Figures 5-4 and 5-5

	Yellow: residential – low density Orange: residential – medium density Brown: residential – high density Red: commercial Purple: industrial Violet: warehouse Green (mesh): Rural/agricultural conservation area Green: Rural/agricultural Light brown: Thai art and cultural conservation area Blue: government institutions, infrastructure

[58] 1 m^3 of water storage for 50 m^2 means collecting 0.02 m (or 20 mm) of rainfall only.

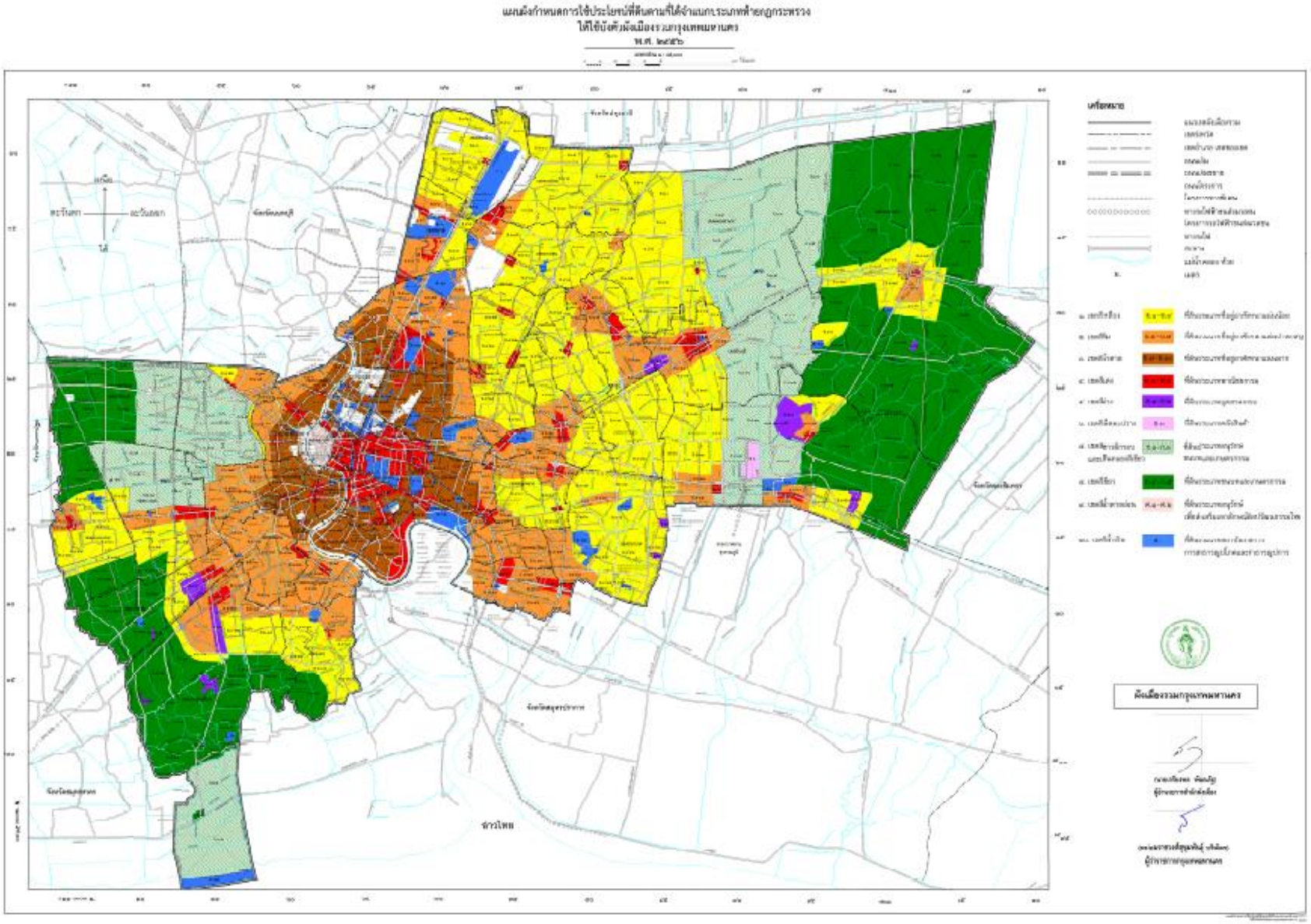

Figure 5-4: Bangkok's Comprehensive Land Use Plan 2013

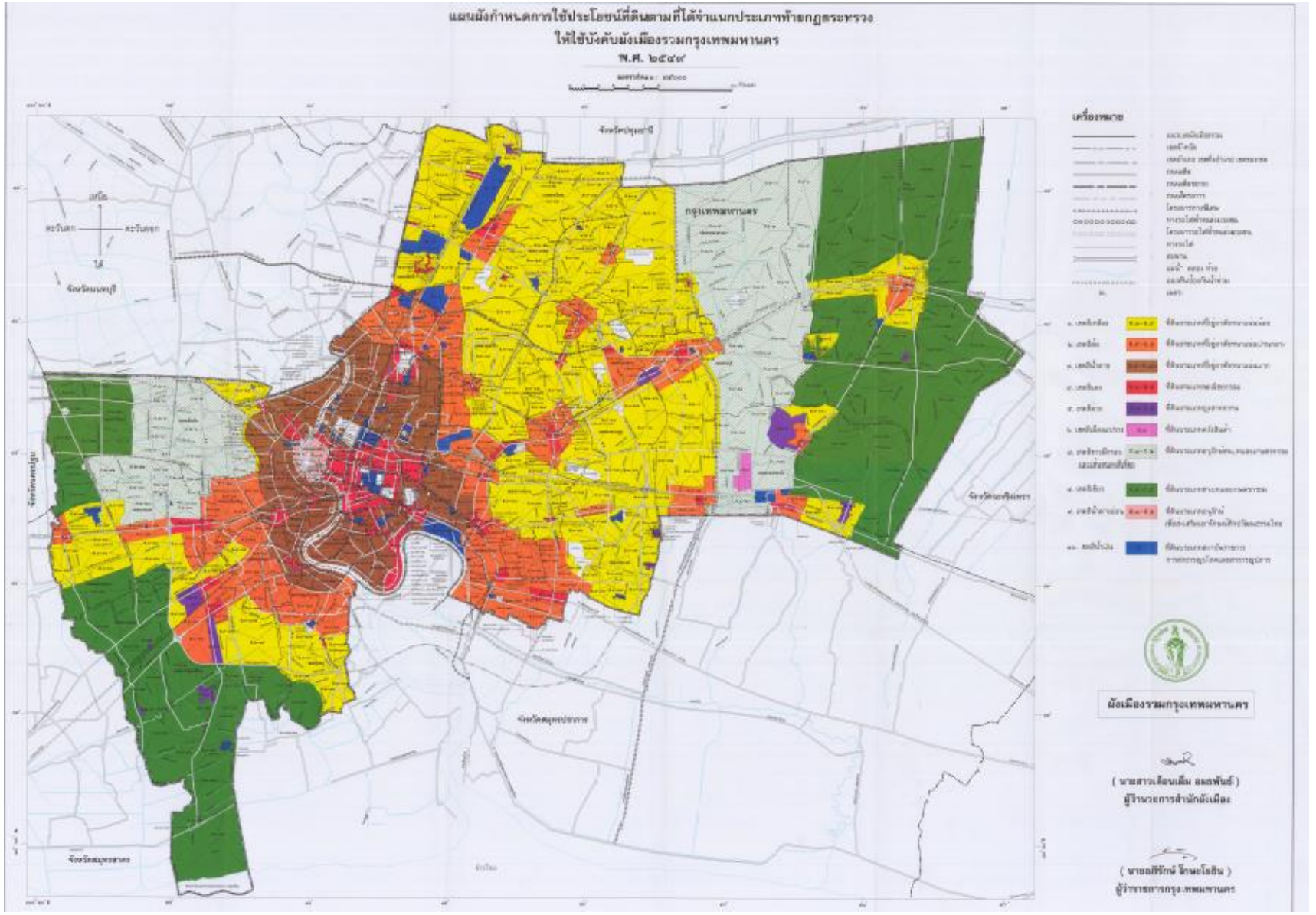

Figure 5-5: Bangkok's Comprehensive Land Use Plan 2006

(vi) Building codes

The Thai Ministerial Regulations on Building Control are laid down under the Building Control Act by several Ministries. There are currently over 200 ministerial regulations related to building control. The most important ones are those outlining requirements for: structural design and construction; fire protection, sanitary, lighting and ventilation; water and waste treatment; and earthquake resistance. Local administration agencies may issue local ordinances with stricter requirements. BMA for example issued the Bangkok Ordinances on Building Control, providing additional details on issues including drainage, water, and waste treatment (ESCAP and AIT, 2012). However, there have been no changes in the ordinances in recent years,[59] and building codes are not discussed either in the context of flood management or climate change.

(vii) Early warning systems

The flood control center of BMA, supported by JICA, has been in operation in Bangkok since 1990. The center has one master station with a weather radar which is located in DDS office, and 75 remote terminal units scattered around Bangkok connected on-line to the master station. The center monitors and collects hydrological data (rainfall and water level) inside BMA. In addition, there are 52 weather stations, 71 flood detectors on major roads, and 40 stations to monitor water flow of canals in BMA. Data are disseminated through websites, facebook, and twitter. The systems are operated in cooperation with the Thai Meteorological Department and Royal Irrigation Department. DDS plans to install additional two radars in the near future.

(viii) Emergency planning and rescue

In accordance with the Public Disaster Prevention and Mitigation Act 2007 and National Public Disaster Prevention and Mitigation Plan 2010-2014, BMA formulated a Bangkok Public Disaster Prevention and Mitigation Plan 2010-2014. The Governor of BMA served as chairperson of a committee formulating the plan, which the Bangkok Fire and Rescue Department (BFRD) took the lead in drafting (BMA 2010). Its vision is “Bangkok has preparedness in prevention and mitigation of public disasters to ensure safety of life, and assets of people and the public.” The plan specified operations that need to be accomplished and procedures that need to be adopted to provide a clear-cut framework and well-integrated operations before, during, and after a disaster including a flood (BMA 2012b). It has four strategies, i.e., (i) prevention and mitigation, (ii) preparedness, (iii) emergency management, and (iv) post-disaster management, and measures and activities are specified under each strategy. The plan identifies 14 types of natural and anthropogenic disasters including flooding and tropical storms, and three additional security threats that cause public hazards in Bangkok (BMA 2012c).[60]

In the 2011 floods, BMA established an ad-hoc flood solution and prevention operation center in October 2011. When parts of Bangkok became flooded, BFRD dispatched rescue

[59] An interview with a BMA official in June 2013.
[60] More than 90% of disasters in normal years are fires.

teams to repair fortifications (such as sandbag walls), and evacuate community members, especially children, sick and elderly people. All households including LICs were entitled to financial support of 5,000 Baht ($160) per house after floods. In addition, additional support up to 30,000 Baht ($1,000) was provided per house for the repair of damage, depending on the level of damage. Up to 10,000 Baht per house was also provided to damaged domestic appliances and utensils (BMA 2012b). In LICs, financial support of 30,000-50,000 Baht was provided to communities if they were waterlogged with a depth of 80 cm or higher.[61]

(ix) Awareness campaigns

Various awareness programs are being implemented for the public to be better prepared for, cope with, and recover from, floods. For example, DSD of BMA has a brochure entitled "restore your house for building happiness" (in Thai), which includes "20 points to prepare before flooding." BFRD also distributes information to the public on procedures before, during, and after a disaster through brochures, seminars, and training programs, although its focus is on fire.

5.5.4 Discussion

5.5.4.1 Adaptation measures

Various departments of BMA are taking actions with a view to preventing and mitigating flood problems in Bangkok. However, none of the measures have explicitly taken climate change into account in their analyses or the design of the interventions. Therefore, the third question in the analysis –whether climate considerations are incorporated appropriately – is not yet relevant in Bangkok. Only the measures implemented by DDS, i.e., flood management and drainage infrastructure improvement, natural buffers, and early warning systems, are intended to improve flood management systems. Land use planning and rescue operations address flood management to a limited extent. Other measures are being implemented as stand-alone interventions by other departments without considering implications to flood management.

The existing flood management measures are assessed in terms of two sets of evaluation criteria, and the results of assessment are summarized in Table 5-13. Due to lack of detailed data, it is difficult to conclude if these measures are efficient and equitable. But no evidence was obtained to prove that equity issues are incorporated into the design of interventions. Legitimacy was not confirmed either, except for CLUP which has gone through a series of consultations with stakeholders. In terms of robustness, on the other hand, consolidated measures (i.e., measures that are implemented holistically) could satisfy the four criteria of no-regret, reversible and flexible, safety margin, and synergy among measures, although a safety margin is not practiced in any measure. With only DDS striving to improve flood management systems, current practices focusing on structural (mostly engineering) options are not robust to uncertainties, and thus not very effective.

[61] An interview with a BMA official in June 2013.

Table 5-13: Review of adaptation options by the use of project-level criteria

Efficiency		Due to lack of financial data (benefits/costs), efficiency cannot be adequately evaluated.
Equity		Lack of detailed design, equity cannot be readily assessed.
Legitimacy		Some measures (notably CLUP) have gone through consultative processes.
Effectiveness = robustness to uncertainty	No regret	Since Bangkok suffers from recurrent flood problems, these measures are no-regret.
	Reversible/Flexible	There are reversible/flexible measures as presented in Table 5-11.
	Safety margin	Though possible, current measures do not incorporate a safety margin.
	Synergies	All measures are complementary and do not conflict with each other.

The implementation plan of DDS clearly indicates its emphasis on structural measures. BMA (2013) discusses that structural measures will be mainly used in densely-populated areas, while non-structural measures will be mostly used in under-populated and agricultural areas. In densely-populated areas, measures are discussed for preventing water from outside flowing into the polder system, draining water out of the polder, and drainage inside the polder. Non-structural measures clarified for the latter areas include (i) city planning and land use control, (ii) building control, (iii) public relations for flood details, (iv) establishing flood forecast and warning systems, (v) establishing an emergency operation unit, and (vi) establishing a supervisory and management organization to strengthen relevant units and manage the work. These are highly consistent with the measures discussed in this analysis. However, a right approach must be structural 'and' non-structural, not structural 'or' non-structural to make flood-management effective and robust to uncertainty, either in densely-populated areas or in less populated areas. It is important to acknowledge that totally protecting urban areas from floods is impossible even with massive structural measures, and that implementation of non-structural measures will have a great potential to reduce damage and losses with the same level of floods.

There is increasing recognition that transformational adaptation, rather than incremental adaptation, may be necessary in order to prepare for climate impacts. While incremental adaptation refers to extensions of actions and behaviors that already reduce losses or enhance the benefits of natural variations in climate and extreme events, transformational adaptation seeks to change the fundamental attributes of systems in response to actual or expected climate and its effects. Kates et al (2012) describe three classes of adaptations as transformational: (i) those that are adopted on a much larger scale or with greater intensity; (ii) those that are truly new to a particular region or resource system; and (iii) those that transform places and shift locations. As they point out, the difference between incremental and transformational adaptation is not always clear-cut (particularly with regard to class (i) above). However, there is no evidence yet that transformative adaptation is a must in reducing the flood risks in Bangkok to an acceptable level, as there is still large room for improvement in formulating more effective and robust adaptation options by extending the scale and intensity of actions that have been already practiced.

Incremental adaptation options may be further classified into two categories: the first category is for those actions in which delineating the "increment" to address climate change is possible, termed 'quantitatively-incremental adaptation'; the second category is for those where such distinction is not practical, termed 'qualitatively-incremental adaptation.' Out of the nine measures, (i) infrastructure improvement, (ii) natural buffers, (iii) land use planning and zoning, and (iv) building codes, can be included in the first category. Additional height of flood barriers or additional drainage and pumping capacity for infrastructure improvement; additional retention capacity for natural buffers; additional development control measures for land use planning; and additional drainage requirements for infrastructure and buildings in building codes; all above the level required under the historical and current climate, is considered incremental to address climate change, although drawing a clear-cut line to distinguish increments would be rather subjective. Such a distinction would normally require a simulation study with hydro-dynamic models without and with climate change. Bangkok was one of the cities that undertook such simulations, as reviewed in Chapter 4. However, the relationship between measures proposed in the simulation study (discussed in Chapter 4), and those currently taken and planned by BMA, is not clear. Increased risks of floods due to more intensive and frequent rainfall, sea-level rise, and possible increase in storm surges caused by climate change are not explicitly taken into account in any of these measures. However, BMA's plan to increase drainage and pumping capacity, and heighten the flood barrier to cope with a flood equivalent to or worse than the 2011 flood, implicitly addresses climate change and can be regarded as an adaptation measure.

The remaining measures, namely (i) groundwater management/rainwater harvesting, (ii) reducing social vulnerability, (iii) early warning systems, (iv) emergency planning and rescue, and (v) awareness-raising, fall under the second category of qualitatively-incremental adaptation. Considering that potential flood impacts are higher with climate change, these actions have to be 'strengthened' with more effective planning and implementation, but it is not practical to define what is incremental and what is not. The difference can be described only qualitatively at best, due to the soft (non-structural) nature of these measures.

Climate considerations can be incorporated either through a 'predict and act' approach, or 'vulnerability-threshold' approach (discussed in Chapter 4). But neither approach is currently used in the flood management planning in Bangkok. As a result, the approach being adopted is conventional with a focus on structural measures, such as infrastructure improvement and strengthening natural buffers, led by DDS. Reliance on structural measures is not robust to future uncertainties because of lack of flexibility in these options. Bangkok's urbanization will continue over the next few decades or longer, and land use change and increase in impermeable surface will make flooding inside the polder system more serious. A major shift in ways proposing adaptation measures would be required. The World Bank (2013a) suggests that cities ought to adopt a robust approach to uncertainty and unknown risks that uses a balance of ecosystem measures and land use options, thus incorporating more flexibility into engineering designs and taking account of potential weak spots and failures, and that cities must continuously improve their risk communication, early warning systems, emergency contingency, evacuation and recovery planning, rather than focusing on optimal engineering design. This requires much better internal coordination in BMA, which is discussed next.

5.5.4.2 Institutional arrangements

The current institutional arrangement of BMA is depicted in Figure 5-6. There is no systematic coordination among departments, and the lack of coordination makes it impossible to develop a comprehensive, coherent, and cost-effective plan. Each department potentially relevant to flood management measures is working in 'silo,' and DDS is leading flood management with limited and indirect involvement of BFRD and CPD.

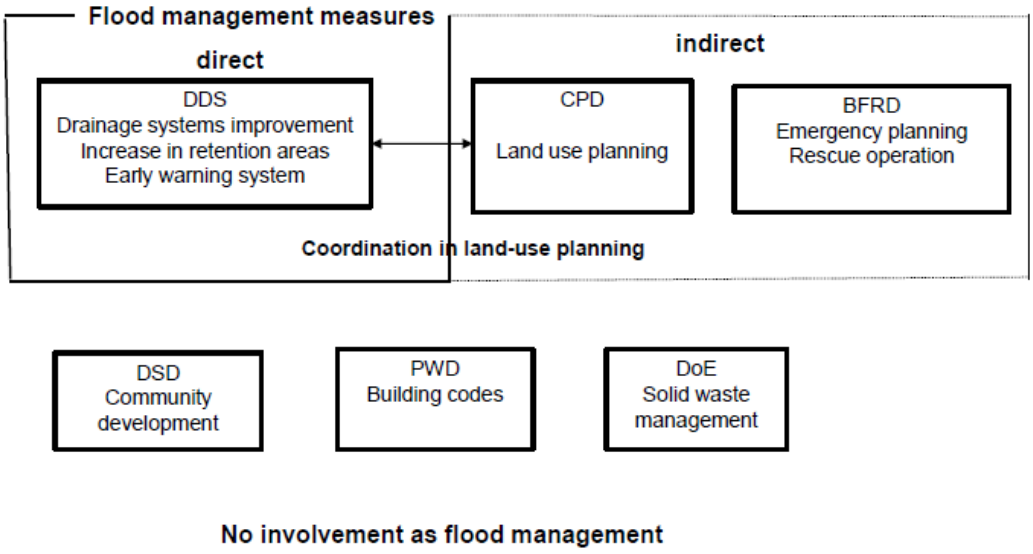

Figure 5-6: Current arrangement for flood management in Bangkok

As urban flood management is a highly cross-sectoral issue, higher involvement of many departments and agencies is required. An appropriate institutional coordination arrangement, with due consideration to climate change, would be described as Figure 5-7 below:[62]

[62] Many officials of BMA stated that significant challenges are anticipated in bringing in the proposed changes. They are generally of the view that emergency operations can be handled with cross-departmental cooperation, commanded by the top management of BMA, but that each department is responsible only for its mandates during normal operation. The author considers that the collaborative institutional arrangements proposed here do not contradict the mandates of each department, and instead fosters more efficient operation of each department for achieving mutually beneficial goals (e.g., reducing loss and damages from urban floods).

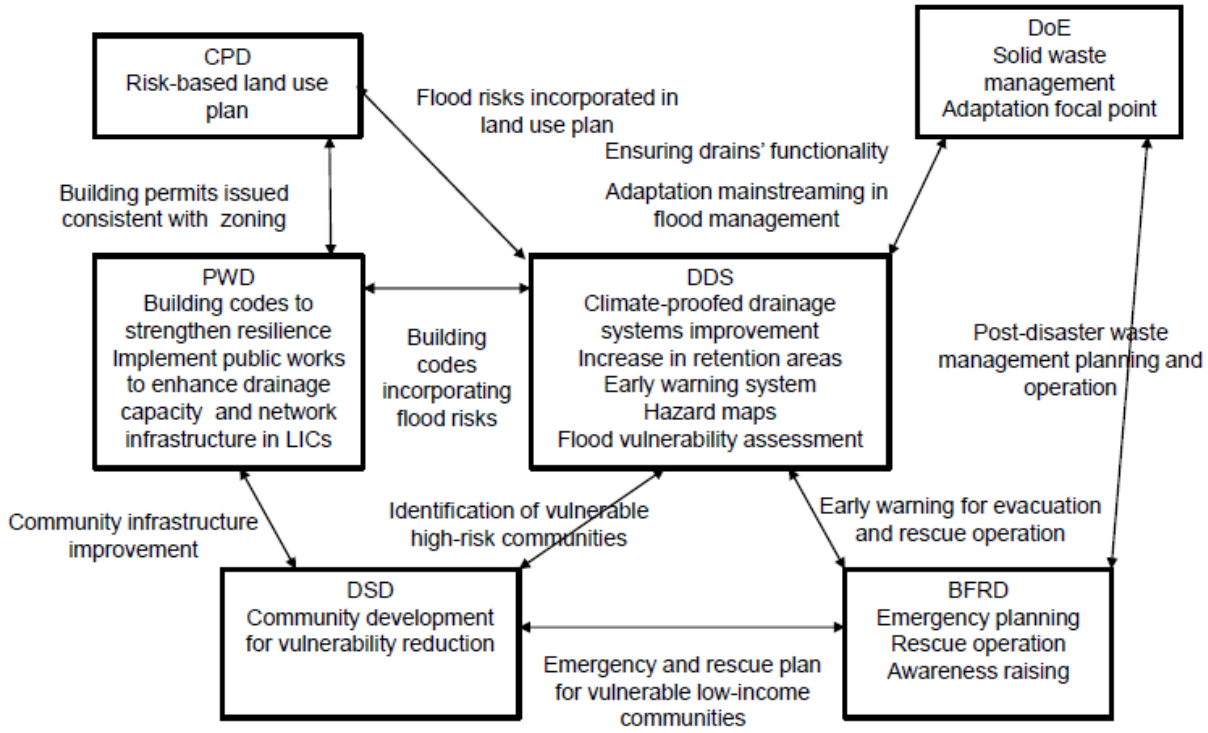

Figure 5-7: Appropriate arrangement for flood management in Bangkok

This arrangement does not suggest organizational reforms involving consolidation and/or division of existing departments or establishment of new departments, but requires fundamental changes in the way departments operate.[63] Applying the five determinants and the framework in Figure 3-1 provides insights on the steps to be taken for mainstreaming. The change could start with a risk assessment of the city with regard to floods by integrating hazard, exposure, and vulnerability assessments, led by DDS and joined by members from other departments. Information on LICs should come from DSD. Based on a flood risk assessment, BMA can formulate an integrated flood management plan that addresses particular risks that would be exacerbated by climate change. The planning should not depend upon ad-hoc coordination of limited departments, but be led by a high-level, inter-departmental steering committee which is authorized to make decisions and mandate concerned departments to take action on cross-departmental issues. This needs to be chaired by top-level management of BMA, such as the Vice Governor or Permanent Secretary, if not the Governor himself. Then, each department needs to translate the overall plan into their own plans and programs: CPD should formulate a risk-based land use plan; DSD needs to implement community development programs to address the needs of climate-vulnerable poor; PWD will revisit the building codes to

[63] Reorganization of BMA may be proposed to foster mainstreaming of climate change adaptation. However, adaptation is inherently multidisciplinary and cross-sectoral, as discussed in various Chapters of this paper. Therefore, reorganization from the viewpoint of climate adaptation (or mainstreaming) would be difficult, as other problems would likely emerge.

reduce flood risks and strengthen resilience, and implement infrastructure improvement in LICs to reduce their vulnerability; DDS should design drainage systems that take account of climate change and variability, and improve early warning systems; BFRD will develop an emergency and rescue operation plan focused on flood disasters; and DoE should ensure functionality of the drains through regular cleaning of solid waste, particularly in areas with limited drainage capacity, and monitor adaptation mainstreaming in each department's work plan, with support from the Strategy and Evaluation Department. Coordination among departments should be strengthened, for example in the following areas: DSD and PWD can work together to improve infrastructure (e.g., roads and drains) in LICs; BFRD and DSD can jointly organize public awareness programs in LICs so that residents of LICs are better informed about emergency and rescue operations; effectiveness of the land use plan developed by CPD can be further enhanced by PWD by enforcing more resilient building codes; DDS and BFRD, moreover, need to agree on an arrangement with regard to early warning, evacuation, and rescue operations in the event of flooding. Transparency and meaningful consultation need to be ensured in both the assessment and subsequent planning processes to make them equitable and legitimate. This way, the five key factors at the city level that are important in promoting mainstreaming would be fulfilled: (i) solid knowledge base through a risk assessment; (ii) leadership and championship through a high-level coordination committee chaired by a top leader with authority to make decisions; (iii) good governance by ensuring transparency and consultative processes; (iv) internal collaboration through the coordination committee; and (v) existing problems with climate, as a starting point for more effective flood management planning. In case of Bangkok, coordination with external agencies such as local governments located upstream/downstream, and central government agencies responsible for water resource management (e.g., Department of Water Resources, Royal Irrigation Department), is no less important, as many flood management measures, such as drainage systems improvement, land-use plan, and early warning systems, can be made more effective if relevant agencies take coherent actions.

Turning the existing 'silo' arrangement into a new, integrated and holistic one described above will be beyond 'incremental' to what is being practiced, and require a transformative change in the way each department operates. This arrangement can be developed even without mainstreaming climate adaptation, but adaptation mainstreaming does require this arrangement. Climate adaptation, or adaptation mainstreaming, is an entry point to strengthen inter-departmental collaboration, as it requires innovative thinking, and a more comprehensive and holistic strategy. Therefore, while specific measures may be incremental, institutional arrangement would need transformational adaptation. This echoes a key message of a World Bank publication (World Bank 2013b), which stresses that the most important challenges in integrating climate risks into development continue to be institutional.

5.6 Conclusion

This Chapter assessed climate adaptation mainstreaming in Thailand and Bangkok, with a detailed analysis of flood management systems in Bangkok. Applying the framework for assessing the level of mainstreaming climate change adaptation into national development

plans, as outlined in Chapter 2, mainstreaming in Thailand was found to be limited. The level is comparable to Lao PDR, the Maldives, and Nepal, but not as advanced as Bangladesh. However, Thailand is currently developing a long-term climate change master plan, and finalization and implementation of the master plan could contribute to promotion of mainstreaming. The current weaknesses are observed in the areas of lack of involvement of the Ministry of Finance, and lack of recognition of the need for mainstreaming. A clearly-defined M&E mechanism should be formulated in the master plan. In order to address the issue of time compatibility, a long-term master plan needs to be translated into medium-term priority actions, and the planning process should be harmonized with development planning. Too much emphasis on soft measures such as enhancing knowledge and capacity-building, and handling climate adaptation as an environmental issue, as observed in the NSCCM, needs to be rectified.

Climate adaptation mainstreaming has not been adequately recognized in Bangkok. BMA does not have a specific policy, plan, or strategy on climate change (either mitigation or adaptation), but has started to develop a climate change master plan with JICA's assistance. This process and implementation of the plan will provide a great opportunity for BMA to further mainstreaming. Applying the five key factors for adaptation mainstreaming to Bangkok's status, the following aspects will need further attention: (i) preparing a risk assessment by integrating hazard, exposure, and vulnerability assessments to serve as a solid knowledge base; (ii) involving the public in consultations to solicit public support, ensure equity, and enhance legitimacy in the output; (iii) establish an effective internal collaboration system; and (iv) top-level support and commitment to climate change adaptation. To ensure coherence between the development plan and climate change master plan, it is important to recognize the need for mainstreaming, and more specifically, translate plans and projects identified in the master plan into sector-specific development plans and projects with a harmonized time horizon.

As witnessed by the unprecedented 2011 floods, the largest risk Bangkok faces with regard to climate change is flooding of the city. Although Bangkok has significantly improved flood management systems over the last several decades, floods continue to be, and will be, a major risk that cannot be fully mitigated. Therefore, flood management systems in Bangkok are analyzed in detail as to the extent of mainstreaming climate change adaptation. First, while nine major measures that are common in flood management are mostly being practiced in Bangkok, the analysis revealed that many of them are not being implemented in the context of flood management. Moreover, even the measures that are being practiced to improve the systems are not explicitly taking climate change into account; i.e, they are not climate-proof. The current practice emphasizes structural options such as heightening flood walls and strengthening drainage and pumping capacity, which fall under the jurisdiction of DDS. Reducing flood risks under uncertainty requires putting more non-structural options in place that are compatible with structural options, such as land-use planning, building codes, and early warning systems, to make the overall intervention more robust to various future scenarios. Although adaptation measures that BMA should take can generally be 'incremental' to what is being practiced, institutional arrangements to achieve such objectives will require a transformational change, by establishing a collaborative mechanism among relevant departments in BMA, which needs to be guided by top-leadership.

Chapter 6: Conclusion

6.1 Key conclusions of the research

This research intended to address the following four questions, the answers to which can be summarized as follows:

(1) To what extent are South and Southeast Asian countries successful in mainstreaming? What framework is appropriate to measure the success of mainstreaming, and what are the key factors that affect the level of mainstreaming?

An analytical framework has been developed to assess the level of mainstreaming at country level. Based on the characteristics of climate change adaptation and literature review, nine factors that could affect the success of mainstreaming were identified, and six of them relevant to the evaluation were selected in the analysis. Two perspectives, namely, integration of climate change adaptation consideration into development priorities, and a country's own initiatives, were also identified to measure the level of mainstreaming. Applying the framework to six LDCs in the region demonstrated that they have different levels of climate adaptation mainstreaming. Bangladesh is considered successful in mainstreaming, with their adaptation priorities well integrated into development plans, and development priorities being discussed in the context of climate change adaptation. However, the level of mainstreaming in other countries is still limited (Lao PDR, Maldives, and Nepal), or minimal (Bhutan and Cambodia). The analysis also revealed that four factors (among the six) have high relevance to the success of mainstreaming: coordination among relevant agencies, particularly between the environment ministry and finance and/or planning ministries, supported by the highest levels of government, is most relevant to the level of mainstreaming. Recognition of the need for mainstreaming, and time compatibility are other areas that affect the level of mainstreaming if a stand-alone adaptation plan such as NAPA or NAP is prepared. The M&E is another factor. The implementation progress of SPCR is encouraging in all three countries (Bangladesh, Cambodia, and Nepal), which implies the need to involve potential financiers (development partners) from the planning process, as these developing countries do not have adequate resources to implement mainstreamed adaptation projects on their own. Additionally, the level of mainstreaming was assessed for Thailand in Chapter 5 by applying the same framework. The level of mainstreaming in Thailand is found to be limited. The framework can be applied to assess the level of and bottlenecks in mainstreaming in other countries as well.

(2) What is the progress of mainstreaming at city level? What are the key determinants in promoting mainstreaming? What are the commonalities and differences between the key factors at country level and those at city level?

At city level, no comprehensive data are available to permit a comparative analysis on the level of mainstreaming, particularly for developing country cities, but the relevant literature is rapidly growing. Some pioneer cities such as Durban, South Africa, initiated adaptation planning and implementation on their own, but many others, some of which are being supported by

development partners, are still in an early stage of planning or implementation of climate change adaptation. Constrained with infrastructure and basic service deficits and increasing urbanization, cities in developing countries need to mainstream climate change adaptation in their development planning. Experience, albeit limited, suggests difficulty in implementing a stand-alone adaptation plan as it tends to become peripheral to development. Cities are provided with a great opportunity to formulate a medium-term development plan that incorporates climate change considerations.

Review of the literature identified important determinants to promote mainstreaming, which include (i) a solid knowledge base on climate impact and vulnerability; (ii) leadership and championship; (iii) good governance of local governments; (iv) internal collaboration; and (v) existing problems linked with climate, though they are not exhaustive. These factors are quite coherent with the four factors identified in Chapter 2, while reflecting differences in focus areas (i.e., national vs. local scale) and approaches (parallel planning vs. possible integrated planning).

(3) How is mainstreaming at project level taking place? What are the advantages and challenges of mainstreaming at project level? What considerations are needed to make the proposed adaptation measures robust under uncertainties?

Mainstreaming at project level is often termed ‘climate-proofing,’ referring to the explicit consideration and internalization of climate change to deliver intended services of a proposed intervention at acceptable levels over the expected life of the intervention. Climate-proofing does not only mean adjustments in infrastructure design, but also includes non-structural measures such as institutional and social interventions to ensure long-term service delivery. A review of the seven studies of climate-proofing confirmed that quantitative assessments based on downscaled climate projections and an impacts assessment could help identify adaptation measures that incorporate future climate impacts with quantitative information on costs and benefits, which would be useful for decision-making. Among the four criteria of effectiveness, efficiency, equity, and legitimacy proposed by Adger et al (2005) to evaluate successful adaptation, effectiveness and efficiency have been addressed well in the seven cases, while the assessments are generally weak in terms of consideration to equity and legitimacy. Moreover, the optimal engineering design derived from the assessment may not be robust to deep uncertainties, so an additional analysis became necessary.

To further verify effectiveness particularly among the four criteria, another set of four criteria is derived from Hallegatte (2009): (i) no-regret, (ii) reversible and flexible, (iii) safety margins, and (iv) synergies among options. The proposed adaptation options for the improvement of water supply and urban drainage systems in Khulna, Bangladesh (two cases among the seven) were further analyzed to see if they meet these four criteria. While each adaptation option does not always meet all the four criteria, consolidated measures as a whole meet all the criteria and are evaluated as robust to uncertainty. This highlights the need to review not only each option individually, but compatibility between options. Consolidated measures include core engineering options to achieve main objectives of the intervention (water supply or flood control), and other hard and soft measures that are flexible, compatible and mostly no- or low-regret. A review of the current status in Khulna in light of the five factors

identified for the city level points to the need of putting institutional arrangements in place for ensuring collaboration among agencies concerned, with strong leadership and championship.

(4) What is the level of mainstreaming in a particular city in this region? Is adaptation to climate change taken into account in development planning and design of development projects? If so, are the proposed measures and designs appropriate? How can the city make its development projects more effective and sustainable through mainstreaming?

Bangkok was selected as a case study. The level of mainstreaming in Bangkok is still limited, although improvement is observed in its development plan. It experienced devastating floods in 2011, and initiated the process for developing a climate change master plan. Applying the five key factors for adaptation mainstreaming to Bangkok's status, the following aspects will need further attention: (i) preparing a risk assessment by integrating hazard, exposure, and vulnerability assessments to serve as a solid knowledge base; (ii) involving the public in consultations to solicit public support, ensure equity, and enhance legitimacy in the output; (iii) establish an effective internal collaboration system; and (iv) top-level support and commitment to climate change adaptation. If these issues are adequately addressed, the development of a master plan could be a game changer in promoting mainstreaming in Bangkok.

Since Bangkok is at high risk of urban floods that could be exacerbated by climate change, Bangkok's flood management systems were assessed in depth. The assessment revealed that BMA is mostly implementing key risk mitigation measures, and that it intends to strengthen the flood management and drainage infrastructure to manage a flood equivalent to the 2011 flood. However, no measures explicitly consider climate change, so there is a need to identify increments to each measure, either quantitatively or qualitatively, and carry out such measures. Furthermore, there is an unbalanced focus on structural options. Reducing flood risks under uncertainty requires putting more non-structural options in place that are compatible with structural options, such as land-use planning, building codes, and early warning systems. Institutional arrangements will require transformational adaptation by establishing a collaborative mechanism among relevant departments in BMA under strong leadership. The change may be initiated with a vulnerability and risk assessment to develop a solid knowledge base, followed by formulation of a development plan that incorporates the results of risk assessment, translated into sector-specific projects and programs that should be run by the respective departments. The planning and implementation should involve participation and inclusiveness. Since floods in Bangkok are significantly influenced by runoff from the upstream Chao Phraya River Basin, external coordination with central government agencies and local governments located upstream/downstream is no less important.

The study proved the close interrelationship of mainstreaming in the three layers. Key factors that affect the level of mainstreaming at country level are overall coherent with those at city level. Differences of scale and approaches result in differences in focus, but the importance of inter-ministerial/departmental collaboration, leadership, evidence base, and inclusiveness holds true at both levels. These factors are also important in ensuring mainstreaming at project level. While successful adaptation is judged from the viewpoints of effectiveness, efficiency, equity, and legitimacy (Section 4.4.2), a solid knowledge base and internal collaboration lead to

effective and efficient interventions, and good governance is needed to achieve equity and legitimacy. Without leadership or championship, these processes will not be completed, or not lead to implementation. In order to satisfy the four criteria of no-regret, reversible and flexible, safety margin, and synergies among options (Section 4.5.1), a broad range of measures that are beyond the sphere of any one department/agency is generally required. This is made possible through a holistic approach that is based on solid knowledge of climate impacts and vulnerability, and requires strong leadership and internal collaboration.

6.2 Policy Implications

6.2.1 Implications for developing countries

Mainstreaming requires making the time-horizon of adaptation plans compatible with that of national development plans, or incorporating adaptation plans, programs, and projects into national development plans. Handling climate adaptation as an environmental issue, and placing it under the jurisdiction of environmental ministries, involves the risk that the climate adaptation agenda may be marginalized, unless more powerful ministries such as finance and planning are meaningfully involved in the planning process supported by strong political leadership. An effective M&E framework will help ensure implementation of a mainstreamed plan.

National governments have an important role to play in facilitating climate adaptation by local governments. While the planning and actions for climate adaptation should be location-specific depending upon the impacts, resources available, and people's preference, local governments will not be able to take effective and timely adaptation measures alone. Policy and enabling legislative framework, coupled with provision of resources for implementation, will help local governments drive local-level action. As observed in Bangkok, lack of a collaborative mechanism between central government agencies and local governments, as well as among local governments, hinders effective climate change adaptation and mainstreaming. Since climate adaptation often requires coordination beyond a single entity, the central government needs to take a lead in institutionalizing coordination among different entities. In order to make it meaningful, a high-level committee should be authorized to make and endorse decisions, and monitor their implementation. Moreover, climate adaptation finance from development partners, particularly when it comes to concessional lending, requires commitment and support from the central government. National governments need to bridge development partners and local governments. This should take place early in the project planning process so that project plans can meet the requirements of and match the priorities/expertise of development partners, which will significantly heighten the likelihood of obtaining support for such projects (as observed in the SPCR).

6.2.2 Implications for developing country cities

City (local) governments are a critical player in climate adaptation. Unlike climate change mitigation, adaptation is often cross-sectoral, cross-institutional, and complex, thereby requiring

involvement of larger stakeholders. The existing sector-specific 'silo' operation needs a transformational change to reduce risks related to climate change. Climate adaptation will serve as an entry point to facilitate this change. Vertical coordination, in addition to horizontal coordination, is also essential. Local governments need to enhance dialogue with the central government for soliciting additional support from the central government as well as development partners. The general lack of technical and financial capacity of local governments underscores the importance of linking to community-based adaptation. Community-based adaptation can be more effective if linked with city-level adaptation interventions. For example, the benefits of local drains and roads improved through community-based adaptation are greater if connected to trunk infrastructure that local governments improve.

Poverty and vulnerability to climate change are interlinked. People in informal settlements generally face inadequate provision of infrastructure and basic services such as piped water supply, sewers or other forms of sanitation, drains, all-weather roads and electricity, and solid waste collection, most of which (except for electricity in many countries) are within jurisdictions of local governments. The poor often have no choice but live in high-risk areas, and have low adaptive capacity. Good quality and affordable housing for the entire population provides a base to reduce vulnerability. Improvement of infrastructure, services, and housing needs to be implemented in tandem with more effective land-use planning and regulation to control development in flood-prone and other climate-related risk areas. Insecure land tenure needs more attention so as to provide incentives for communities to invest in housing and household-led adaptation. As the poor tend to have the least voice in decision-making, good governance featured by participatory and inclusive planning, transparency, and accountability is highly required. These are the areas where many developing country cities are particularly weak, requiring technical and financial support from the central government and/or development partners.

As many urban areas have long experience of disasters that could be exacerbated by climate change, such as storm surges and urban floods, disaster risk management forms a strong foundation around which urban climate resilience can be built. A solid assessment of climate impacts, vulnerability, and risks will be the basis of sound adaptation planning.

6.2.3 Implications for development partners

Due to lack of technical and financial resources in developing country cities, the role of development partners is of paramount importance. A number of guidelines, manuals, and methodologies have been developed to address climate adaptation at city level, but their application would need extra direct support for individual cities. However, local ownership is essential, and the process and outcome should not be driven by the needs and priorities of development partners, but led by local governments themselves with community participation. While support for adaptation planning is increasingly observed, the focus needs to shift from planning to implementation.

Some development partners seem to prefer to label their support as 'climate change adaptation,' rather than as a part of development assistance. But as discussed in this paper, climate adaptation is more effective when mainstreamed at each level, from policy and planning,

to project. Carving out an ‘adaptation component’ may not be meaningful or necessary. They should rather make an assessment of the proposed interventions to ensure that climate change considerations have been incorporated (e.g., climate-proofing). Inclusiveness in the design is also critical, so that vulnerability of the poor does not remain unaddressed. More work is needed to develop indicators for monitoring and evaluation that measure achievement of the objectives of adaptation measures implemented.

6.3 Direction for further research

Mainstreaming climate adaptation, or integrating climate change adaptation into development planning, policies, strategies, and projects, is not an end in itself. It is a means to an end to make development efforts by developing countries and their cities more effective and sustainable. Therefore, a research question that naturally arises after assessing the level of mainstreaming, is whether the success of mainstreaming is actually leading to more effective and sustainable development. Theoretically, if development plans take climate change considerations into account appropriately, the plans can be implemented more effectively (achieve higher benefits with the same costs), more efficiently (less cost to achieve the same outcome), or more sustainably (longer service life of infrastructure/intervention). More specifically, urban areas should be less vulnerable to and more resilient to climate change and variability. This may be measured by reduction in loss and damages from climate-related disasters (e.g., floods and droughts), or higher economic activities.

At project level, the life cycle costs of a project should be less, or higher benefits (e.g., higher reduction in loss and damages from urban floods) can be attained by a project. However, it is a major challenge to answer this question due mainly to two reasons. First, climate adaptation requires a long-term horizon. The actions taken today may not yield high benefits tomorrow, and the difference with or without mainstreaming will be more significant over time. Second, in many developing countries and their cities, adaptation mainstreaming is still either in the planning stage or in an early stage of implementation, so meaningful post-evaluation is yet to be carried out. This again underlines the importance of an M&E framework, with which useful insights can be obtained about the benefits of mainstreaming.

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