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AfricaInteract: Enabling research-to-policy dialogue for adaptation to climate change in Africa

Review of Research and Policy for Climate Change Adaptation in Urban Areas in Central Africa

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About *AfricaInteract*

AfricaInteract (http://africainteract.coraf.org/en/) is a platform enabling research-to-policy dialogue for adaptation to climate change among a broad range of African stakeholders in sub-Saharan Africa. These include civil society, researchers, policy-makers, donors, and the private sector working on adaptation to climate change in the agriculture and health sectors as well as urban areas with water and gender as cross cutting issues. The overall objective of AfricaInteract is to develop a platform for the effective and efficient transfer of information to policy makers, with the ultimate aim of enhancing the resilience of vulnerable populations.

AfricaInteract is funded by the International Development Research Centre (IDRC) and coordinated by the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) under the auspices of the Forum for Agricultural Research in Africa (FARA). The regional focus of *AfricaInteract* is based on the Regional Economic Communities in the four sub regions of sub-Saharan Africa. Focal organizations coordinating regional activities are as follows: The Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) – East Africa; Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) – Southern Africa; Commission des Forets d'Afrique Centrale (COMIFAC) – Central Africa; and Energie-Environnement et Developpment (Enda) – West Africa.

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Abbreviations and Acronyms

ACPC	African Climate Policy Centre
AfDB	African Development Bank
AMCEN	African Ministerial Conference on Environment
CAR	Central African Republic
CBLT	Lake Chad Basin Commission
CDM	Clean Development Mechanism
COMIFAC	Commission des Forêts d'Afrique Centrale
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
CRMA	Climate risk management and adaptation
DRC	Democratic Republic of Congo
DRR	Disaster risk reduction
ECCAS	Economic Community of Central African States
EMP	Environmental Management Plan
GDP	Gross domestic product
GEF	Global Environment Facility
ICZM	Integrated coastal zone management
IDRC	International Development Research Centre
IPCC	Intergovernmental Panel on Climate Change
NAPA	National Adaptation Programme of Action
NGO	Non-governmental organization
PRODEBALT	Sustainable Development Programme of the Lake Chad Basin
REC	Regional economic community
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlements Programme

Executive Summary

Aim of and motivation for the review

The aim of this report is to synthesise research and enhance the knowledge base related to climate change adaptation and to support research-based policy formulation for climate change adaptation in urban areas in Central Africa.

Central African cities are highly vulnerable to climate change, which is one of the most important challenges facing cities across Africa and around the world today. Urban poor bear the brunt of its effects since they live and work mostly in informal settlements that are more exposed to hazards. This is being exacerbated by a combination of exposure to projected climate hazards and extreme events coupled with low or limited adaptive capacity. Against this backdrop, AfricaInteract, a project funded by the International Development Research Centre (IDRC) and coordinated by the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) in collaboration with regional partner organisations Forum for Agricultural Research in Africa (FARA), Association for Strengthening Agricultural Research in East and Central Africa (ASARECA), Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN), Commission des Forets d'Afrique Centrale (COMIFAC) and Enda Energie-Environnement-Développement, has been established as a forum for interaction among a broad range of African stakeholders to tackle the challenges of climate change.

Building resilience and adapting to climate change is increasingly a high priority for cities. Alongside mitigation, on which efforts have largely focused in the past decade, there is increasing recognition that more attention needs to be given to adaptation in cities. Adaptation efforts in Central African cities have so far been fragmented, lacking a strong link between national climate change strategies and plans, existing disaster risk reduction and other relevant policies. These shortcomings are partly due to lack of conceptual understanding about adaptation, which is not merely about building resilience to current climate variability, nor is it exclusively about attempting to forecast and address specific future impacts. It must be recognised that adaptation will require a suite of approaches that cover the development-adaptation continuum, with different approaches being required in different contexts.

Methodology and scope of the review

Focusing on three countries in the region (Cameroon, Gabon and the Republic of Congo), this review captures examples of research and policy related to climate change adaptation in urban areas. The review identifies gaps in research and policymaking for climate change adaptation in the above sector and proffers insights that can be used to improve evidence-based policymaking. The latter aims at enhancing the knowledge base and integrating climate change into national and regional urban planning, governance and policies, thereby enabling research-to-policy linkage for adaptation to climate change in Central Africa. Drawing on relevant sources including peer-reviewed journals, theses, grey literature, national policy documents, internet resources and materials gathered from international organisations such as the United Nations Human Settlements Programme (UN-Habitat), the World Bank and the United Nations Environment Programme (UNEP), a stock-taking and synthesis was made of research results on adaptation and the way they feed into and influence policies for climate change adaptation in urban areas.

Key findings from each of the report sections

This synthesis reveals that cities in the Central African region are experiencing considerable urban growth. This is due to 'pull factors' such as opportunities for employment, education and improved access to health care which have been intensifying rural-urban migration. Yet, in many urban areas rates of economic growth and infrastructural development have considerably lagged behind urbanisation rates, resulting in high levels of unemployment, inadequate standards of housing and services in unplanned settlements and impacts on human health. This situation is further aggravated by climate hazards such as coastal erosion and inundation that put many people and businesses at risk. To reverse these trends, more research will be needed to bring about: (i) coherent, integrated planning; (ii) development that is environmentally and socially sensitive; (iii) security of tenure and financing; (iv) sufficient investment in infrastructure to keep pace with the rate of growth of urban populations and their demands for essential services and security; and (v) rural development programmes to contribute to slowing the rate of urban population growth.

The review also found that scholarship on climate change adaptation is still in its infancy in the Central African region. Likewise, the review showed that policies related to urban issues with regard to climate change may exist in one way or another for each country, but the level of implementation is still very poor. This analysis also revealed that there are a number of gaps in knowledge, capacity and experience. These include a lack of information on climate change impacts in a region with a large coastline, as well as hotspots of climate variability and change because of sea level rise risks, as far as adaptation to climate change in urban areas is concerned. Furthermore, there is a lack of research and knowledge across a range of interconnected and cross-cutting issues including water resources and gender. Finally, the review highlighted that adaptation to climate change in the urban sector is a complex issue that can be viewed from various levels of governance involving sub-regional institutions, governmental agencies, municipalities and populations. It is therefore imperative that regional organisations, be they political, scientific or development-oriented, should in fact play an important role in achieving the goals of adaptation in the urban sector in Central Africa.

Overall conclusions and recommendations

Climatic extremes and variability pose a serious challenge to sustainable urban development in Central Africa, placing many cities and urban poor at risk. Faced with these challenges, city leaders and policymakers in Central Africa are in need of the following:

- **Investment in more research, capacity building and documentation of good practices**

  One of the major challenges and constraints this review revealed was a lack of useful documentation on adaptation research and practices. In order for this to happen, there is a need to increase investment in the skills of staff working in ministries and knowledge centres to enable them perform their work in a manner that promotes learning. Equally important is that government agencies involved in adaptation work should ensure the coordination of climate change research with research under the banners of sustainable development, green economy, biodiversity and deforestation. They should also take advantage of producing a yearly climate change report, in which they may highlight the successes and failures of past capacity building efforts and develop better structured options for capacity building that addresses critical issues including sustainability and legacy.

- **Improvement of living conditions in urban areas**

  Central African governments and city leaders need to plan urban development appropriately for sustainable development. They should promote 'win-win' options which will contribute to both climate change mitigation and adaptation and wider development objectives. These may include inter alia business opportunities from energy efficiency measures and the development of green energy strategy, sustainable water management and sanitation projects, etc. These constitute low-regret adaptation measures that would be justifiable with or without climate change. Other measures that deal with climate variability, for example long-term weather forecasting and early warning systems, may also fall into this category. Equally, Central African governments should fulfil their core obligations under the Habitat Agenda, and should prepare integrated waste management strategies and action plans, including integrated coastal zone management and zoning. Adaptation to climate variability and change in urban areas can thereby be treated as a development issue and addressed by various sector ministries as well as many actors. Researchers, educators, young scientists, policymakers, urban planners, government officials, development practitioners, donors, non-governmental and community-based organisations and businesses are relevant stakeholders to bring on board.

- **Monitoring and evaluation frameworks for adaptation**

  Monitoring, evaluating and learning are doubly important within climate change adaptation because climate change is taking communities, local and national governments and other stakeholders into greater uncertainties. Therefore a new institutional arrangement appears crucial to strengthen institutions working in the field of climate change in the urban sector.

1 Introduction

1.1 Background and motivation

Rapidly expanding urban settlements in Central African countries are facing severe climatic risks in light of the accelerating pace of change occasioned by urban processes and an arena of low socio-economic resilience. As such, climate change adaptation in urban areas in Central Africa is not only a set of actions for the future but also an imperative for today. The urban population of Central Africa has more than doubled from 23.7 million in 1990 to an estimated 55.6 million in 2010. This has meant that urban populations will increasingly be forced to cope with increased incidents of inundation, air and water pollution and vector-borne diseases (UN-Habitat 2010). Similar to the majority of cities in developing countries, urban centres in Central Africa are at risk due to (i) high density of populations; (ii) lack of adequate drainage channels; (iii) concentration of solid and liquid waste; and (iv) unplanned settlements which often lack access to basic services and are home to residents compelled to live in risky sites (Bull-Kamanga et al. 2003;). Thus, increased climate hazards coupled with rapid urbanisation are likely to put increased strain on the capacity of local governments as they attempt to respond to the vulnerabilities of the urban population, particularly the urban poor.

Against this backdrop, AfricaInteract, a project funded by the International Development Research Centre (IDRC) and coordinated by the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) in collaboration with regional partner organisations Forum for Agricultural Research in Africa (FARA), Association for Strengthening Agricultural Research in East and Central Africa (ASARECA), Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN), Commission des Forets d'Afrique Centrale (COMIFAC) and Enda Energie-Environnement-Développement, aims at providing an appropriate forum for interaction among a broad range of African stakeholders to tackle the challenges of climate change. These include civil society, researchers, policymakers, donors and private sector companies working on adaptation to climate change in the agriculture and health sectors as well as in urban areas, with water and gender as cross-cutting issues. The review commissioned by CORAF/WECARD through the AfricaInteract initiative provides a synthesis of research related to climate change adaptation in urban areas in Central Africa. This report involves a stock-taking, synthesis and review of research results and the way they feed into and influence policies. Gaps in research and policymaking for climate change adaptation in urban areas in Central Africa are also identified, and a summary of insights that are suitable to improve evidence-based policymaking aimed at enhancing the knowledge base and supporting research-based policy formulation for climate change adaptation in the region is proffered. This is being made regarding priority areas that CORAF/WECARD, via AfricaInteract, might target to foster climate change adaptation knowledge in urban areas in Central Africa.

1.2 Limitations, challenges and mitigation measures

Face-to-face meetings with key stakeholders in Gabon and the Republic of Congo were not an option. In order to mitigate this shortcoming, the review was able to collect most information from Cameroon at the Department of Geography of the University of Douala (who showed great responsiveness in facilitating access to literature on urban vulnerability), Department of Geography, Faculty of Social and Management Sciences, University of Buea,the Department of Agricultural Extension and Rural Sociology of the University of Dschang (for scholarship on urban agriculture) and to a lesser extent the Department of Sociology of the University of Yaounde I. A relevant body of research work has been produced at the University of Douala addressing issues such as uncontrolled urbanisation, water supply and sanitation provision and management of pollution and waste. These issues turned out to reflect similar impacts found in both the capital and other large cities in Central Africa in the context of climate variability and change. Unfortunately, the literature gap in adaptation research and practice in the region is still large. This meant that the author was only able to review research work and projects/programmes that have produced and published documentation. This has limited the review, given that many relevant activities and projects were lacking robust analysis or had not yet been documented.

1.3 Brief outline of the rest of the report

The review is divided into eight sections:

Section 1 provides an introduction to the report and includes information on the background of the assignment, as well as outlining the rationale, objective and outputs. It also describes the limitations and challenges faced during the assignment. It concludes by outlining the structure of the report.

Section 2 gives a conceptual definition of climate change adaptation in urban areas including an understanding of the notion of 'urban areas' in the context of a changing climate. It further elaborates the methodology used to undertake the review.

Section 3 presents an overview of the urbanisation profile of Central African countries, with particular emphasis on key facts for urban areas in Central Africa, including the role of climate change challenges. It further explores the state of knowledge of the implications of climate change vis-a-vis other key challenges including opportunities for urban areas in the Central African region.

Section 4 provides a stock-taking of research related to climate change adaptation in urban areas in the region, which focuses on, but is not limited to, Cameroon, Gabon and Congo Republic. In addition, this section examines the current state of knowledge on adaptation to climate change in urban areas in the region.

Section 5 covers policies related to climate change adaptation in urban areas in Central Africa, drawing from national policy documents and policies designed by the Regional Economic Community of Central African States (ECCAS). Furthermore, the section attempts to reach an understanding of the current state of knowledge on whether and how research findings are integrated in urban area policies in the region.

Section 6 identifies gaps in policy and research related to climate change adaptation in urban areas in the region. In this respect, it equally explores policy spaces and opportunities to maximise the likelihood that key research results get into high profile and influential arenas such as national or regional policy spheres.

Section 7 maps out key stakeholders to bring on board and identifies ways to shape and promote research-policy dialogues on adaptation in urban areas in the region.

The **final section** is the conclusion of the review. It identifies priority areas for action in addressing climate change adaptation in urban areas in the region. It does so through strengthening research into climate science, and also through coordinated actions on adaptation and mitigation. This last section makes a number of tentative recommendations regarding where AfricaInteract could target climate change via specific initiatives, interventions and partnerships in these contexts.

2 Background and methodology

2.1 Scope of the review

The Central African region comprises ten countries[1] making up the Economic Community of Central African States (ECCAS), but particular focus in this review is placed on Cameroon, Gabon and Congo Republic. As in the other parts of sub-Saharan Africa, the urban sector in Central African countries has experienced ever more rapid growth (Table 1).

The urban population of Central Africa has more than doubled from 23.7m in 1990 to an estimated 55.6m in 2010; the 100m mark could be reached around 2022, with further growth to 112.7m by 2030 (UN-Habitat 2010). As Central Africa rapidly becomes more urbanised, environmental change, including climate change, is becoming a leading development challenge. The impacts of climatic variability and change on cities and urban areas are many and complex. Major cities situated along the Atlantic coast, such as Douala, Limbe and in fact most of the largest urban areas in Central Africa, are likely to be or are already affected by some combination of sea level rise, increased storm flooding, inundation, coastal erosion, increased salinity in estuaries and coastal aquifers, rising coastal water tables and obstructed drainage. Displacement of people, especially the urban poor, destruction of property and loss of livelihoods are other common impacts. Low socio-economic resilience, institutional vulnerability and insufficient infrastructure, as for removal of liquid and solid waste materials

Table 1: Central Africa, National Urbanisation Trends, 1950-2030

Population	1950	1960	1970	1980	1990	2000	2010*	2020*	2030*
Angola	7.58	10.44	14.96	24.30	37.14	48.99	58.50	66.04	71.62
Cameroon	9.33	13.94	20.30	31.92	40.72	49.86	58.40	65.47	70.99
Central African Repablic	14.42	20.10	27.33	33.87	36.83	37.64	38.94	42.47	48.43
Chad	4.50	6.70	11.57	18.79	20.81	23.38	27.63	33.93	41.24
Congo	24.93	31.60	39.13	47.86	54.32	58.32	62.12	66.34	70.87
DR Congo	19.10	22.30	30.30	28.72	27.82	29.84	35.22	42.03	49.16
Equatorial Guinea	15.46	25.54	26.95	27.87	34.75	38.81	39.70	43.28	49.43
Gabon	11.40	17.40	32.00	54.68	69.14	80.15	86.03	88.77	90.62
São Tomé and Príncipe	13.49	16.07	29.52	33.48	43.65	53.42	62.23	69.02	74.05

*Projections
Source: WUP 2009

(domestic, business and industrial), compound the vulnerability of the urban milieu in Central Africa. Despite increased attention to and improved understanding of these issues in recent years, more knowledge is needed to prepare for and manage the multitude of risks associated with environmental and climate change in Central African cities. Rapid urbanisation, increasing vulnerability and an urgent need to enhance the capacity of African institutions to work together to manage risks and foster adaptation and resilience through informed decision-making motivated the launch of AfricaInteract.

2.2 *Framing climate change adaptation in urban areas: Key definitions*

Adaptation

Varying definitions of climate change adaptation exist and are used in different ways to best serve the purposes of different actors involved in climate change work and debates. One of the most influential definitions is that of the Intergovernmental Panel on Climate Change (IPCC), by which adaptation is considered an 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (IPCC 2007). Adaptation can be carried out in response to (ex post) or in anticipation of (ex ante) changes in climatic conditions. It entails a process by which measures and behaviours to prevent, moderate, cope with and take advantage of the consequences of climate events are planned, enhanced, developed and implemented (IPCC 2007). Within the realm of AfricaInteract, this implies actions that people and institutions take in anticipation of, or in response to, a changing environment, including a changing climate. That is, changes to the things they do, and/or the way they do them (IPCC 2007).

Hence the conceptualisation of adaptation is made easy by viewing adaptation in terms of a continuum of interventions ranging from generalised resilience-building and vulnerability reduction measures that do not require explicit consideration of climate projections at one extreme, and highly targeted interventions to address specific climate change impacts at the other (McGray et al. 2007). That is, different approaches will be required depending on the context, the nature of the intended outcomes, the availability and quality of climate forecasts and the resources available. To this effect climate risk assessment frameworks need to be developed further in order to inform adaptation decision-making. Thus it will be necessary for African countries to enhance their adaptive capacity to face both present and future climate change outside their experienced coping range (Adger et al. 2003).

Planned adaptation

Adaptation that 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 (IPCC 2007).

Autonomous adaptation

Adaptation that does not constitute a conscious response to climatic stimuli, but rather is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation (IPCC 2007).

Adaptation benefits

Avoided damage costs or accrued benefits following the adoption and implementation of adaptation measures (IPCC 2007).

Adaptation costs

Costs of planning, preparing for, facilitating and implementing adaptation measures, including transition costs (IPCC 2007).

Adaptation deficit

Failure to adapt adequately to existing climate risks largely accounts for the adaptation deficit. Controlling and eliminating this deficit in the course of development is a necessary, but not sufficient, step in the longer-term project of adapting to climate change. Development decisions that do not properly consider current climate risks add to the costs and increase the deficit. As climate change accelerates, the adaptation deficit has the potential to rise much higher unless a serious adaptation program is implemented. Parry et al. (2009) argue that African countries frequently experience the adverse effects of climate variability, and the continent suffers from an adaptation deficit that exacerbates vulnerability to both climate variability and change. Lots of existing adaptation projects in Africa place emphasis on current climate variability, and so are concerned with the adaptation deficit more than climate change *per se*.

Urban areas

In Africa, what constitutes an urban area may differ from one country to another. For example, in Uganda a settlement with a population of more than 100 is classified as urban, whereas in Nigeria and Mauritius an urban area has a population of more than 20,000 (UN-Habitat 2001b). There are also difficulties in defining a city, as cities are not only defined on the basis of population size but also of administrative or legislative functions. Large

cities, however, are generally those with populations over a million, and mega-cities have populations of more than ten million (UN-Habitat 2001b). Hence, 'urban areas' in this report refers to the largest cities in Central Africa, including but not limited to Kinshasa (5m) in DRC and Douala (1.6m) and Yaoundé (1.4m) in Cameroon (UN-Habitat 2001a).

2.3 Methodology used for review

The assignment began with a review of existing literature to understand the differing contexts and backgrounds to urban vulnerability in the region in a changing climate. This included covering grey literature, government and agency documents, placing emphasis on the challenges of urbanisation and development in Central African countries in the context of climate change adaptation and their analysis.

Literature search methodology

Using search engines and the IDRC research database collection[2], we searched for 'climate' AND 'urban' and then narrowed the search to 'climate' AND 'urban' AND 'resilience'. From the titles, and having added 'governance' to the search terms, we were able to select only a few relevant documents focused on cities, urban planning, resilience and the environment in a changing climate. This shortcoming was certainly due to the facts that scholarship on climate change adaptation in urban areas is still in its infancy, and that most of the written materials and documentation remain unpublished. To complement the above documentation, we travelled to Douala and Dschang, Cameroon in order to get access to the libraries of the Department of Geography of the University of Douala and the Department of Agricultural Extension and Rural Sociology of the University of Dschang. We also contacted the Departments of Geography of the Universities of Yaounde I (Cameroon), Omar Bongo of Libreville (Gabon) and the University of Brazzaville (Congo Republic). However, due to a low level of responsiveness, most of the materials reviewed were found at the University of Douala, University of Dschang and University of Buea to a lesser extent. In addition, documents from international agencies including IPCC, the United Nations Human Settlements Programme (UN-Habitat), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) and United Nations Framework Convention on Climate Change (UNFCCC) addressing cities and urban problems in a changing environment were also consulted. In reading the relevant articles that focused on climate change adaptation in urban areas, we paid particular attention to governance of climate change adaptation and resilience in urban areas.

This was followed by a visit to the documentation centres of the Ministry of Environment, Nature Protection and Sustainable Development and the Ministry of Housing and Urban Development in Yaoundé to explore the availability of knowledge products and policy documents relevant to the topic. We also explored websites, online databases and knowledge platforms where examples of climate change adaptation in urban areas could be found. Throughout the review, the focus was on collecting literature that captures a diversity of urban adaptation efforts in the region by location, scale, sector and strategic emphasis.

3. Overview of the region's urbanisation profile

3.1 Key facts for urban areas in the region

Although cities have become the main catalysts of economic growth in Central Africa, urbanisation has caused massive problems of poverty coupled with environmental degradation. Environmental impacts of the rapid urbanisation and urban population growth include intensifying pressures on natural habitats and resources to satisfy the ever growing demand for space, housing and water for drinking and sanitation. Municipalities and utility companies are unable to provide housing and infrastructure quickly enough to meet this demand and sub-standard services are therefore provided, with sub-optimal environmental standards and conditions. Dualism between customary and modern tenure laws is also apparent in urban centres in Central Africa and, together with high land and property prices, is one of the causes of unplanned settlement and illegal construction. Consequently, until tenure laws are well crafted and regulated, poor urban residents will continue to face difficulties in trying to settle in viable and less risky sites. Rapid development of informal settlements or slums, characterised by overcrowding, unstable and unhealthy housing, inadequate water supply and sanitation and lack of electricity supply and waste collection characterise urban vulnerability in Central Africa.

The total land area of the Central African region is 5.37bn km^2, or 17.7 percent of the land area of Africa as a whole. UN-Habitat reported that the average level of urbanisation in Central Africa in 2000 was 48 percent, ranging from 81 percent in Gabon, the most urbanised country in the region, to 24 percent in Chad, the least urbanised (UN-Habitat 2001a). This is the outcome of the accelerated growth that occurred over the last decade, during which economic growth favoured employment in urban areas. The urbanisation rate across all of Central Africa is over three percent annually, reaching five percent in Equatorial Guinea and Gabon. Yet it is worth noting that while the region remains the continent's least urbanised after Eastern Africa (23.6 percent), it is rapidly catching up with the more urbanised regions. The largest cities in Central Africa are Kinshasa (5m) in DRC and Douala (1.6m) and Yaoundé (1.4m) in Cameroon (UN-Habitat 2001a).

Central Africa has a long history of urbanisation. During the colonial era large urban centres stood along the Gulf of Guinea where access to trade, travel and international communications was enhanced. Libreville, the political and economic capital of Gabon, hosts about 50 percent of the population, 50 percent of employment and contributes to more than 80 percent of gross domestic product (GDP). Likewise the city of Douala, Cameroon's economic capital and major industrial centre, is home to 70 percent of the country's industry, including aluminium smelting, brewing, textile manufacture and processing of wood and cocoa. Kinshasa, a port bordering the Congo River estuary, serves as DRC's political, administrative and industrial capital (UN-Habitat 2001c).

In response to the challenges of adverse climatic change and variability, all countries in Central Africa have joined the international community in signing and ratifying the UNFCCC. At the national level, capacity building amongst stakeholder groups and revision of policies and legislation for enhanced environmental protection is underway, including protection of the region's important forest reserves. The Cameroonian government has embarked on a decentralisation process and there has been increased community participation, especially in implementation of projects aimed at improving living conditions (UN-Habitat 2001c). At the 25th Special Session of the UN General Assembly[3] and accompanying Istanbul+5 Conference in June 2001, Cameroon also stated that it had put in place an environmental management plan of action for urban development. A number of national programmes recently developed included a programme for poverty reduction strategy, environmental protection act and governance. Yet, at the time of carrying out this review, no assessment of the efficiency of these actions is available. In reference to Congo Republic, the government's human settlement development strategy rests on four pillars including (i) security of tenure, (ii) adequate housing for all, (iii) promotion of equality in access to credit and (iv) provision of basic social services (AEO 2005). However, there remains substantial work to be done in order to achieve the goals set for the strategy due to the drawbacks of post-war reconstruction. Gabon reported that a national Habitat Committee had been established, partnerships between national and local government and civil society had been forged and community infrastructure projects had been implemented with financial assistance from the World Bank.

3.2 The role of climate change challenges

According to the IPCC's Fourth Assessment Report, warming is projected across Africa in the range of 0.2°C (low scenario) to 0.5°C (high scenario) per decade up to the year 2100 (IPCC 2007). This implies an increase in climate-related shocks on the continent including droughts, storms, flooding, extremes of temperature and rising sea levels. Climatic extremes and variability pose a serious challenge to sustainable urban development, placing many Central African cities at risk. Policymakers and city leaders are increasingly facing the challenge of finding ways to include adaptation strategies in their work, although related knowledge and expertise are still scarce and fragmented. Current approaches are limited in scope and generally overlook local adaptation capacities of individuals, households and communities. Furthermore, the extent of the changing climatic conditions is reducing the capacity of urban institutions and associated governance systems to deal with climate variability and change. In fact, climate change is undermining the effectiveness of institutional responses which ought to be designed and applied in the event of known 'common' and more 'predictable' hazards and associated impacts.

New approaches for urban climate change adaptation are urgently needed. Against this background, the challenges of urbanisation and development in Central Africa in the context of a changing climate deserve increased attention. Without mitigating the causes of climate change and adapting to its inevitable impacts, cities in Central Africa with their massive populations, industrial activities, employment opportunities and contributions to GDP in the sub-region are likely to be severely impacted. The high vulnerability of urban areas in Central Africa to the impacts of climate variability and change is further exacerbated by low adaptive capacity. There is need for a clear distinction to be made between increased hazards from climate change and social vulnerability. The latter happens to be the result of a mixture of underlying processes that occur when the government fails to fulfil its core obligations in providing the basic social services that poor urban residents require and deserve.

3.3 Overview of the range of possible impacts of climate change in urban areas in the region

Despite the fact that greenhouse gas emissions are minimal in Central Africa and contributed just two percent of Africa's total emissions in 1996 (AfDB 2001), global atmospheric and climatic changes will impact on urban areas in Central African countries. It is projected that sea level rise and increased vulnerability to inundation and storm surges will render some of the coastal areas of Central Africa uninhabitable, displace millions of people and threaten low-lying urban areas, such as Douala in Cameroon (IPCC 2001; IPCC 1998). Furthermore, generic studies of urban air quality have linked pollutants arising from domestic combustion of traditional fuels to increased rates of respiratory diseases, particularly among children. Industrial emissions, although currently below international averages, must be considered a potential threat as the needs of economic development continue to exert a pressure for greater industrial output.

Of particular concern are the extensive oil and gas reserves in the sub-region which could be exploited for domestic energy production and export to other regions. Exploitation would involve clearing of forests and disturbance of marine ecosystems, as well as considerable increases in the region's contribution to emissions. Besides this, the World Bank (1997) reported that population densities in coastal urban centres in Central African countries are increasing under the dual pressure of population growth and migration. Major coastal cities include Douala in Cameroon (population 1.6m in 2000) (UN-Habitat 2001a), and Libreville in Gabon (population approximately 400,000 in 1993, around 50 percent of the total population of Gabon). Rural exodus to the coast is prompted by opportunities for agriculture (favourable agro-ecological conditions) and employment (a large number of industries based on the coast).

The resulting conversion of natural habitat to urban settlements and agricultural plantations, together with poor resource planning and management practices inland, has accelerated rates of coastal erosion and this is now an important problem in Central Africa. The rate of coastal erosion in Gabon, for example, is reported as having reached around 10m per year as a result of clearance of mangrove forests (ESA-ESRIN 1998). Erosion is accelerated by construction of dams upstream of the coastal zone. Dams reduce the sediment load in rivers reaching the coastal areas and control their flow patterns, thereby increasing their erosive potential.

Coastal erosion also renders Central Africa's coastal settlements and economic activities more vulnerable to sea level rise resulting from global climate change. Impacts include intrusion and contamination of freshwater sources by seawater, flooding, damage to infrastructure and displacement of populations. Cameroon and Gabon have low-lying lagoon coasts which support large and growing populations, as well as some unique habitats for fisheries and waterfowl. In this regard IPCC (1998) reported that sea level rise would aggravate existing problems of coastal erosion and increase the risk of saltwater intrusion into surface and groundwater resources.

3.4 Overview of the key causes of vulnerability in urban areas in the region

Unplanned settlement is on the rise in Central Africa

In Yaoundé, Cameroon, the majority of urban residents are squatters or tenants. There are conflicting pressures on residents to purchase properties and rents are high. However, property prices have also risen recently, while incomes have declined because of devaluation of the currency (UN-Habitat 2001c). The city of Libreville, Gabon is experiencing uncontrolled urban development resulting from a shortage of serviced plots, an absence of planning tools and instruments and a lack of urban space control. The demand for housing rises by approximately 6,000 units per year (in a city with a population of 500,000), and available land for development is minimal: there are only 14 hectares of 'green space' per 10,000 hectares (UN-Habitat 2001c). The results are that over half of the population lacks proper housing; there is rapid development of unplanned, inadequately serviced, and often unsafe settlements; and illegal occupation is as high as 85 percent (UN-Habitat 2001c).

Uncontrolled urbanisation

In Central Africa, uncontrolled urbanisation spreads into fragile ecosystems, including delicate or highly erodible slopes, natural drainage waterways or valleys and areas that are prone to flooding. For instance, the city of Yaoundé experiences uncontrolled expansion of informal settlements at its periphery (Rochegude and Plaçon 2010). Due to the intense competition for space in urban areas, green spaces are rapidly disappearing and areas usually deemed unsuitable for housing are the only refuges available for the urban poor, who are then vulnerable to flooding, landslides and outbreaks of pests and diseases. Although planning regulations are in place, they are poorly monitored and enforced (AEO 2005).

Inadequate water supply and sanitation

In Central Africa, water supply and sanitation provision has also fallen behind rates of urban growth largely due to lack of municipal funds and capacities. On average, 59 percent of the urban population have access to clean water (over 80 percent in Cameroon and DRC), whilst 54 percent have access to sanitation (but only 14 percent in Congo and 25 percent in Gabon) (WHO/UNICEF 2000). This poses a threat to human health via exposure to pathogens such as cholera and intestinal parasites. It also poses a threat to the surrounding environment if sewage and wastewater are discharged untreated. Untreated discharges contaminate soil and water bodies, creating a risk to human health via transmission of disease vectors or toxic elements. It also threatens biodiversity through effects on the ecosystem such as eutrophication and contamination with heavy metals and inorganic compounds. This has important implications depicting challenges of climate change to urban populations and the environment.

4. Research related to climate change adaptation in urban areas: Taking stock

This review covered seven research projects carried out at the University of Douala, University of Yaounde I and University of Buea, all in Cameroon, with a clear focus on adaptation efforts in urban settings. This was aimed at capturing research works which reflect climate change impacts in similar contexts to large cities in Central Africa.

4.1 Status of scientific evidence for implications of climate change for urban areas in a multi-stressor context (model projections of impacts of IPCC scenario projections on different crops)

In IPCC (2007) model outcomes displaying rainfall and temperature change for Central Africa, projections for the climate of the Congo Basin are highly restricted. This is due to the lack of observational data with which to evaluate the models and scarcity of knowledge of the climate mechanisms essential to the region. Therefore the climate of Central Africa is inadequately portrayed and understood with only very few papers published in recent decades addressing this region. This notwithstanding, Malhi and Wright (2004) reported that in the tropical rainforest zone declines in mean annual precipitation of around four percent in West Africa, three percent in North Congo and two percent in South Congo for the period 1960 to 1998 have been observed. Likewise, Washington et al. (2006) observed that Central African stream flow from Congo River gauge stations shows no long term trend. Instead the time series is dominated by multi-decadal variability with links to the Atlantic atmospheric circulation but not to the El Niño Southern Oscillation. Other IPCC scenarios projected that sea level rise and increased vulnerability to flood and storm surges will render some of the coastal areas of Central Africa uninhabitable, displace millions of people and threaten low-lying urban areas, such as Douala in Cameroon (IPCC 2001; IPCC 1998).

To feed the world's increasing population, agricultural production must be increased by 100 percent especially in developing countries (Dyson 1999). This goal must be achieved through the use of technologies that would increase agricultural productivity and provide substantial income to small scale farmers while protecting environment sustainability. Meeting this challenge is rendered more complicated by climate variability and change. The IPCC (2007) further stresses that such changes would translate into increasing incidence of climate shocks such as drought and flooding, depleting underground water, decreasing crop yield and/or crop suitability and proliferation of pests and diseases. In this scenario, semi-arid zones of Central Africa are particularly at risk and among the most vulnerable areas. For those regions, the IPCC has warned of a 50 percent reduction in yield of rain-fed crops by 2020; exposure of 75-250 million people to water stress by 2020; and an increase of 5-8 percent in arid and semi-arid lands by 2080. This will likely occur if no effectual adaptation of food production systems to climate variability and change takes place (IPCC 2007). Small scale farmers and resource-poor dependents, who rely on agriculture and who have a lower capacity to adapt, are the most at-risk groups of being severely hit by food and nutrition insecurity arising from climate variability and change (Kadi et al. 2011).

There is evidence of non-climate trends affecting vulnerability to climate variability and change in urban areas in Central Africa that deserves greater consideration. These include population growth amplified by rural-urban migration, rapid urbanisation and poverty which is becoming increasingly urbanised, as a growing proportion of the population suffering from absolute poverty live in urban and peri-urban areas in Central Africa. To illustrate this phenomenon, the United Nations Agency for Human Settlements report noted that in the city of Yaoundé, Cameroon, the majority of urban residents are squatters or tenants. The report further emphasised that there are conflicting pressures on residents to purchase properties; rents are high and property prices have also risen recently, while incomes have declined because of devaluation of the currency (UN-Habitat 2001c).

4.2 Causes of vulnerability

Central Africa hosts a variety of biophysical conditions. Much of the region has a humid tropical climate with dense rainforest cover, holding vast biodiversity and substantial timber reserves. Central Africa also features extensive savannahs north and south of the Congo Basin. The Atlantic coast is humid and warm and costal zones are rich in fish resources, while a semi-arid climate prevails in the northern part of Cameroon and Chad. Central Africa is expected to become predominantly urban (more than 50 percent of the population in urban areas) around 2022, and current rapid increases in urban populations have already altered the region's environment and urban settings (UN-Habitat 2010).

Urban areas of all sizes face increased risks from water scarcity and flooding. In the city of Douala, for example, Moutila (2011) established that coastal areas are threatened by sea level rise as urban demographic pressures mount. His findings brought to light the importance of increasing city-dwellers' understanding of coastal ecosystem protection to reduce pressure on mangrove forests. According to Bull-Kamanga et al. (2003), recurrent inundation in large cities across Central Africa is the result of multiple factors, not least coastal erosion that renders coastal settlements and economic activities more vulnerable to sea level rise resulting from global climate change. This is further aggravated by sustained demographic growth, high density populations and associated settlement in flood-prone areas.

As more people move to cities, unplanned and uncontrolled settlements cover large tracts of land with houses set on particularly risky sites, roads and other infrastructure which compound flooding as soils can no longer absorb runoff water. Concerning drainage systems in the city of Douala, Tchuikoua (2010) found that uncollected garbage, impermeable surfaces and concentrations of buildings disrupt natural drainage

channels, block stormwater drains and slow down runoff water flows that trigger inundation. He further stressed that the concentrations of solid and liquid wastes put Douala at particular risk from climate hazards. In terms of health and sanitation, Mbeugang (2013) characterised the whole of Logbessou II district (a peri-urban area of the city of Douala) as ranking lowest in access to drinkable water supply and sewerage. Furthermore, he pointed out that intense inundations cause latrines to run over thereby polluting drinking water wells and increasing the spread of waterborne diseases such as cholera.

4.3 Options for reducing vulnerability and strengthening adaptive capacity and supporting different groups of urban residents (physical exposure, reduced sensitivity, increased adaptive capacity)

With extreme weather events associated with climate change becoming more frequent, the urban poor are increasingly at risk. But options do exist to build the resilience of at-risk groups in urban areas. These options are elaborated next.

- ***Improve energy security in cities in support of enhanced productivity, job creation and poverty alleviation***

  One of the main contributors to climate change in Central Africa is the use of wood and charcoal for cooking, as this contributes significantly to deforestation and land degradation besides indoor air pollution. Urban energy security is critical for economic growth and poverty alleviation in the region. In sub-Saharan Africa, where wood, charcoal and other biomass meets about 80 percent of the domestic primary energy needs, over 550 million people lack access to modern energy supply. This will not change unless well crafted urban policy is applied. Repeated economic and other crises and general deterioration of urban electricity infrastructure has forced many urban households to use charcoal or fuel wood, on top of those that already do because they cannot afford electricity. Extensive fuel wood use is therefore not just a result of poverty but also a matter of widespread failure to give cities energy security.

- ***Build awareness around the issue of climate change in urban areas and understanding of the necessary responses among city-dwellers to help both autonomous as well as planned adaptation gain momentum***

  Although climate change in cities is a major threat to living conditions, poverty reduction initiatives and development in general, the majority of Central African city-dwellers are not familiar with the notion or its implications. These are mainly debated in political and scientific arenas or by the media and non-governmental organisations (NGOs). The majority of urban people only speak their local dialects and translation of climate change concepts does not always clearly convey their meaning. Public awareness-building gatherings, like town hall or community meetings, could help overcome these knowledge-sharing difficulties. Whereas many city-dwellers are aware of deforestation around their cities and have noticed changes in weather patterns, few realise the relationships between these events and the way each and everyone's behaviour can help mitigate the effects of climate variability and change. Currently, the debate on climate change is taking place mainly among a small number of intellectuals, politicians, scientists and, to a lesser extent, city leaders. As NGOs and the media increasingly share their knowledge, resources and ideas, more people are becoming aware of climate change and its effects, but much more needs to be done. In order to address local knowledge gaps, authorities at municipal, city and national levels should invest in building awareness of the problem and understanding of necessary responses through the media, scientists, schools, religious and community leaders at all levels.

- ***Make urban land markets pro-poor***

  In Central African countries, it has been reported that urban land is neither well managed nor well allocated (UN-Habitat 2010). Therefore it is crucial that urban land policies be improved to meet the needs of the majority of city-dwellers, including the poorest among them. The pressing task for city leaders is to harness innovative and affordable technologies available for urban land management and administration. This should be pooled with greater transparency

and better understanding of the interrelation between land distribution, population growth rate, climate variability and change and development. These technologies have an important role to play in improved welfare for all and the protection of the urban environment.

- ***Develop sustainable city environments***

  This is mainly about urban planning that takes into account efficient transport and communication infrastructure as well as adequate infrastructure with access to drinkable water, provision for sanitation and management of waste (solid waste and waste water) and job creation. Such an approach will require that city leaders invest to, for example, support mainstreaming of women and youths via cooperatives and common initiative groups in the information technology and communication sector.

4.4 Lessons from adaptation projects and interventions in urban areas in the region

Examples of adaptation to climate change in the urban sector in Central Africa that are presented below address urban vulnerability along the coastline of Cameroon (Douala and Limbe). Another example is a response to the adaptation deficit in the inland city of Yaoundé. These illustrations reflect risks from climate hazards faced by large cities along the coastline of the Gulf of Guinea and in inland Central Africa.

Before going on to elaborate further on the lessons from climate vulnerability and adaptation research projects in urban areas, it is important to place emphasis on the coastline of the Gulf of Guinea. Coastline areas are very sensitive to environmental change and have long been desirable locations for human settlement and development. Box 1 highlights broad development processes and their associated environmental excesses that have taken place around cities on the coast of Cameroon.

Box 1: Rapid urbanisation on Cameroon's coastline(Napi and Tamo, 2007)

The colonial influence on development resulted in many of Central Africa's urban centres and national capitals being located on the coast, maximizing access to trade, international travel, and development; but also contributing to many social challenges associated with urbanization, such as the influx into urban areas of people attracted to cities in the hope of employment and greater financial security. For instance a country like Cameroon has witnessed substantial industrial development during the last five decades, which led to considerable national economic growth and partial contribution to negative environmental impacts (Alemagi 2006). After independence in the early 1960s, one of the national development objectives to promote economic growth was based on the development of a resource-based industrial sector e.g. agro-processing industry, textiles and accessories, paper and pulp, wood processing and establishment of large scale agro-industrial companies set in along the Cameroon coastline. The outcome of said industrial policy led to a high concentration of industrial firms in the coastal zone, also favoured by favorable biophysical, ecological and climatic conditions including demographic and socio-economic infrastructures (Konings, 1990). UNIDO reported that the Atlantic coast of Cameroon (which includes some of the major industrial centres such as Douala, Limbe, Tiko or Kribi) hosts about 80 percent of the nation's industries, among which are some export-oriented companies (UNIDO 2002). The industrial sector has made a considerable contribution to the country's GDP through revenue generation from agricultural raw materials exports and employment. Agricultural raw materials in 2003 accounted for nearly 19.5 percent of total exports from Cameroon valued at US$ 2,246 million. Equally important is that this contribution of industrial production is associated with its negative environmental impact along the Atlantic coast of Cameroon. In fact cases of Aluminum and heavy metals pollutants - Mercury, Zinc, Copper and organic pollutants - emanating from industrial production systems have been reported in aquatic organisms along the marine ecosystem of the Atlantic coast of Cameroon, which is the discharge point of effluent from most of these industrial firms (Angwe and Gabche, 1997).

Reproduced from Napi and Tamo (2007)

Because of unplanned settlements, rapid urbanisation and industrialisation, people and businesses along the coastline are at risk from gradual inundation associated with a variety of other potential impacts. Such sensitive and vulnerable areas, which are subject to threats by coastal erosion, flooding and storm disasters, are considered as climate change 'hot spots'. According to Nicholls and Cazenave (2010: 1519), roughly the whole of Africa's coastline is 'vulnerable to coastal flooding caused by future relative or climate-induced sea-level rise'. As Brooks et al. (2006) point out, low-lying coastal areas in the Gulf of Guinea are particularly at risk from sea level rise. Likewise, UN-Habitat's Global Urban Observatory (2008) indicates that cities in the low elevation coastal zone of the Gulf of Guinea are potentially at risk from sea level rise, reporting that every year, one or more disasters affect people's lives in this coastal zone. Flooding in particular has been a recurring phenomenon in the city of Douala and this is set to increase in frequency and severity as a result of climate change, along with sea level rise. Consequently, Douala's poor and marginalised people are at risk of falling deeper into poverty. The threats are particularly acute for those living in low-lying areas, where a significant rise in sea level would directly affect thousands of people. Hence, adaptation to address sea level rise along the coastline should be foreseen now and will also be required over the medium to long term future. In this context, the research work carried out by Olinga (2012) could be very informative to city leaders. The author examined successes and failures of the City Development Strategy Paper towards building the resilience of the city of Douala vis-à-vis recurrent hazards. With the findings derived from the analysis, the author argues that city leaders of the city of Douala can gain more insights on (i) what, why and how measures or instruments are chosen to optimise risk management more effectively; and (ii) what, why and how certain measures or instruments provide or fail to provide solutions to enhance urban resilience in the context of environmental change including climate variability and change. Equally important to consider is that vulnerability in the context of climate variability and change is being exacerbated by demographic changes and changes in settlement patterns. This is so as poverty compels many people to live in dangerous places. In his research work on urbanisation and the landscape of urban areas, using the case of Bepanda district in Douala, Cheteu (2012) noted that Douala has witnessed a rapid increase of populations settled in flood prone areas, which makes society much more sensitive to a change in rainfall patterns.

Cases of urban adaptation projects have been reported in the city of Limbe, which offers important lessons on giving adaptation in the cities the importance it deserves in the vulnerable coastal zone of the Gulf of Guinea. The research activities on vulnerability of Limbe's urban settlement undertaken by Kometa (2012) are particularly illustrative in this respect. Box 2 is a clear expression of urban maladaptation in the context of climate variability and change, which has further increased adaptation costs to appropriately address the adaptation deficit of a road infrastructure exposed to the destructive effects of sea level rise. That is, the initial engineering design of the road overlooked proven and best engineering practices to withstand the likely threats associated with climate induced hazards in the coastline area.

The above description calls on city leaders and planners for urgent corrective measures to anticipate maladaptive interventions that increase vulnerability to climate-change-induced risks, especially in coastal areas. Moreover, it reveals that maladaptive actions

Box 2: The main road at Down Beach, Limbe eroded by oceanic waves in June 2001 (and rehabilitated in 2004), a typical picture of maladaptation urban infrastructure initially poorly designed to deliver long term gains

The underlying bedrock of Limbe is generally overlain by recent pyroclastic deposits which are extremely susceptible to coastal erosion. The exposure of this coast to prevailing winds and to the open sea, is thus of vital importance. Such exposure means that the coast is open to attack by powerful sea waves. During heavy rains in June 2001, the level of the sea rose and huge masses of water were forced to crash on the coast. The foundation of the building housing the Red Cross as well as part of the main road linking this area to the rest of the town especially around the BEAC (Bank of Central African Region) junction were eroded. The intensity was so strong that both the building and the road collapsed. The engineering company which constructed the road did not take the local geology into consideration. Since this area is made up of mostly volcanic scoria which is easily weathered, chemical weathering took place and rendered the rocks susceptible to erosion. No supporting embankment existed and those there today only came after the 2001 disaster. Throughout history, floods have shaped the landscape, provided habitat for some wildlife and created rich soils. Equally, floods have constituted some of the greatest examples of disaster, disrupting lives and often causing significant economic losses. In the last decades, the consequences of flood events have been devastating for Limbe, especially the poor. These urban poor have fewer resources available and their livelihoods are more vulnerable to the risk associated with flooding and are more susceptible to disruption. Generally, women within this community take much of the responsibility as they do not only deal with the economic devastation but are also left to cope with the social and emotional upheavals that come from dealing with death, disease and food shortage that invariably occur in the aftermath of floods.

Reproduced from Kometa (2012)

and processes often include low analytically informed development policies and measures that fail to provide long-term economic benefits, but lead to aggravated vulnerability. Because of this, addressing adaptation deficits is bound to increase adaptation costs.

On the other hand, Central Africa is also home to a number of landlocked countries including Chad, CAR and Burundi. Here too capital cities are confronted with urban vulnerabilities and climate challenges. Box 3 below presents the example of the Yaoundé Sanitation Project in the inland capital city of Cameroon. This case could equally be reflective of major cities of Central Africa's landlocked countries. The Yaoundé Sanitation project is an illustration of controlling and removing the deficit in the way municipality and government attempt to cope with climate variability. Large cities in Central Africa suffer from an adaptation deficit that increases vulnerability to both climate variability and change. The Yaoundé Sanitation Project shows the evidence that the adaptation deficit is particularly critical in Central Africa, with many capital cities already experiencing regular and severe disruption and economic losses as a result of climate variability. In this context, Parry et al. (2009) argue that the adaptation deficit needs to be addressed as a first step in confronting climate change, before adaptation to new and evolving climate change hazards can be addressed effectively.

Overall, the Yaoundé Sanitation Project is an adaptation style of intervention that goes beyond delivering short-term benefits. It is a climate resilient development project that aims to reduce vulnerability and increase livelihood resilience of city-dwellers and businesses in the face of climatic variability. Moreover, it is a project that places emphasis on high-value, long-lived infrastructure in an area where climate change impacts are likely to be significant. As such, the Yaoundé Sanitation Project has involved planning for potential future climate change risks and designing of infrastructure to withstand very specific future climate change hazards. Insofar as Central Africa is concerned, such targeted adaptation actions than can address both current and future hazards will need to be scaled up and out and supported by climate information. With this, city planners will be able to determine ranges of likely future conditions within which urban development interventions will have to be viable and sustainable. Such an approach will require the development of climate risk assessment frameworks, including methodologies for integrating climate change considerations into development and, where feasible and appropriate, efforts to lessen uncertainty regarding future conditions.

Box 3: Yaoundé Sanitation Project, an example of long-lived infrastructure designed to remove an adaption deficit and deliver long term benefits (AfDB, 2005)

Since the early nineties, the population of Yaoundé, capital of Cameroon, has increased by 6 percent every year and today stands at nearly 1.5 million as a result of rural migration and the high birth rate. The Survey on the Living Environment of Yaoundé population (CAVIE), carried out in 2002, highlights the predominance of the so-called squatter areas which cover about 62.4 percent of Yaoundé City's area. The main rainwater drainage systems are regularly blocked by all types of solid waste. As a result, during the rainy season floods (15 to 20 major floods per annum) totally disrupt the town's socio-economic activities and especially those of the squatter areas. Indeed, about 53,000 people (or about 9,000 households are regularly flooded and 243,000 persons (or around 40,000 households) occasionally. Thus, quality of life is very adversely affected during the floods because dwellers sometimes move away temporarily or continue to live in the humid, filthy and unhygienic surroundings.

In addition to the discomfort caused by these floods, their effects on health, the environment and the economy are enormous. In terms of health, not only do floods cause latrines to overflow thus polluting drinking water wells, breeding sites for larvae form and waste carried by the rain water accumulates, thereby increasing the spread of waterborne diseases. Concerning the environment, floods cause the pollution of the water treatment station of Akomnyanda which supplies the town of Yaoundé with drinking water, soil erosion, land subsidence and slides. With regard to the economy, the floods cause the destruction of houses and businesses, loss of incomes for traders, etc. In short, the lack of rainwater drainage in a town like Yaoundé, where rainfall is considerable (nearly 2000 mm a year) has far-reaching impact on the population most of who already live in poverty.

In order to control flooding in the City of Yaoundé and address the difficulties inherent in its increasing filth, the Government prepared a Yaoundé City Sanitation Master Plan (PDA), which was financed by the Bank Group. This plan was completed in July 1996 and served as the basis for preparing a project to conduct works on the emergency phase of Yaoundé City Rainwater Drainage which mainly comprises the re-calibration of the Mfoundi and the cleaning of the collectors. An update of the project engineering designs was also financed by the Bank in 2002 out of the PPF funds.

The overall objective of the Yaoundé Sanitation Project was to contribute to poverty reduction in the urban areas by limiting the effects of floods that disrupt the city's socioeconomic activities and more so of the poor squatter areas that cover about 62.4 percent of the area of Yaoundé City.

Reproduced from AfDB (2006)

4.5 Key documented barriers to adaptation in urban areas

In light of the materials reviewed, a number of key hurdles to adaptation in urban areas are identified as follows.

- ***Lack of capacity and funding***

  Capacity building happened to be a major issue found through empirical work on climate vulnerability and adaptation in urban areas in Central Africa. In the case of the main road at Down Beach, Limbe eroded by oceanic waves in June 2001 and rehabilitated in 2004, Kometa (2012) ascertained that the engineering company which constructed the road did not take the local geology into consideration. He went further to emphasise that since the area is made up of mostly volcanic scoria which is easily weathered, chemical weathering took place and rendered the rocks susceptible to erosion. Such details would have been foreseen and integrated into the design of road infrastructure if Limbe municipality had qualified staff equipped with adequate expertise in civil engineering for areas prone to risks from sea level rise. From this perspective there remains a major need for further capacity building in the area of adaptation of cities in the context of a changing climate. Not only are capacity limitations inhibiting municipalities' and central governments' access to available funds, but attention to capacity building also needs to be complemented with adequate strategies regarding the manner of use of these funds.

- ***Institutional vulnerability***

  Given the accelerating pace of change occasioned by biophysical processes in an arena of low socio-economic resilience, urban areas in Central Africa are at the mercy of the negative impacts of climate change and natural hazards. This is certainly due to the absence of strong local, national and regional institutions capable of creating an enabling environment and providing a foundation for capacity development. Recurrent floods are among major factors increasing the vulnerability of poor people in urban areas. The Yaoundé Sanitation Project is a good example of long-lived infrastructure built to withstand flooding.. The demand for similar infrastructures is very high given the magnitude of flood-prone areas in the largest cities of Central Africa such as Yaoundé. Looking at the equation 'Risk = Hazard x Vulnerability / Coping Capacities', It has been argued that "coping capacities" are the dimension in which institutions are crucial, for example in flood control. Furthermore, many environment related institutions in Central Africa were created some 40 years ago with specific stand-alone mandates – food security, desertification, water resources – and tended not to be well-equipped for the myriad complex changes of which climate variability and change is only one. In this regard, formal national and regional institutions can play an essential role in supporting and guiding local informal institutions and civic society in the uptake of adaptation actions in the cities. As such, climate change will mean new institutional arrangement and management that will support resilience intervention in urban areas.

- ***Climate change cannot be dealt with in isolation***

  Residents of large cities live in a milieu shaped by cultural, social, environmental and economic factors, and climate change needs to be couched in these terms. Climate change is usually not the only explanation for local problems. Environmental degradation, overpopulation, poor governance and deficit in urban planning are usually also present and responses should consider this; for example strategically linking climate change adaptation interventions to a disaster risk reduction framework already in place – and vice versa (Napi COP 18, 2012).

- ***Lack of availability, control and access over material resources matters in large cities***

  In his research work on urban agriculture, an induced activity in the city of Yaoundé, Tohnain (2008) found that there are many social challenges associated with the intensification of migration to urban areas, such as the influx into urban areas of people who come to cities in the hope of employment and greater income security. However, a UN-Habitat report (2010) indicated that in large cities in Central Africa such as Douala, Yaoundé and Kinshasa, rates of economic growth and infrastructure development have lagged far behind urbanisation rates. The report emphasised that this situation has resulted in high levels of unemployment, inadequate standards of housing and services and impacts on human health and development. This suggests that the urban poor have not commonly been considered as priorities in adaptation planning interventions, despite the fact that they are vulnerable due to their dependence

on faulty infrastructure such as substandard housing.

- ***Local government unable to facilitate local adaptation***

  The research projects reviewed laid much emphasis on working with municipal authorities and recommending better services to help poor people adapt. The case of the city of Limbe has demonstrated that it is a cruel paradox that plantation agriculture has taken over some of the best land while the greater population is squeezed out into risk prone zones (Kometa 2012). Equally worthy of note is the exploratory work carried by Olinga (2012) to get an appreciation of the level of implementation of the City Development Strategy Paper of Douala. The aim of said policy document was to integrate environmental and socio-economic concerns in the planning of the city of Douala. His findings proved how challenging it is for Douala municipality (with a very limited budget to operate) to effectively optimise risk management and build a resilient city in the context of climate-change-induced hazards.

5. Policies related to urban issues with regard to climate change

5.1 State of knowledge on policies and strategies for climate change adaptation in urban areas

In Central Africa the countries that have submitted a National Adaptation Programme of Action (NAPA) include Chad, CAR, DRC and Burundi. It should be noted that NAPAs vary in quality and scale, with for example cost estimates ranging from less than US$4m in CAR to several hundred million dollars in Ethiopia, one of the rare countries to include extensive infrastructure investments. The climate change NAPA is a mechanism within the UNFCCC, specific to the Least Developed Countries (LDCs) and designed to assist the latter in identifying priority options of adaptations to face the adverse impacts of climate change. NAPAs also help development partners identify financing priority options in relevant socio-economic sectors. These include *inter alia*: water resources, agriculture, health, energy, landscape and natural ecosystems. From this perspective, the preparation of NAPAs appears essential in order to evaluate the vulnerability of the country and put forward priority measures and activities aiming to reduce the adverse effects of climate variability and change. As such, NAPAs can give a rough indication of what the initial sectoral priorities may be as the global adaptation effort is being pursued. The format of the NAPAs is similar – a national level consultation, using a specifically created body, plus stakeholder participation to identify key adaptation needs, which are then drawn up into a plan containing the key projects, which are costed out.[4]

Beyond the fact that NAPAs are poor indicators of the ultimate adaptation expenditures in vulnerable countries, present climate change adaptation related projects still largely ignore urban areas in favour of rural livelihood-focused activities. It is a fact that rural livelihoods in Central Africa largely depend on climate sensitive natural resources, and rural areas tend to have little or no safety net against climate extremes. The downside of this is that poor urban populations have not commonly been considered as priorities in adaptation planning interventions (Tanner et al. 2009). Tanner et al. further argue that the urban poor are overlooked in adaptation planning interventions despite the fact that they often do not benefit from cities' infrastructural investments or are made vulnerable due to their reliance on faulty infrastructure such as substandard housing. It is against this backdrop that recent research highlights an urgent need to improve our understanding and action on climate vulnerability and adaptation in urban areas, particularly where poverty levels and population growth rates are highest (Huq et al. 2007).

Beside NAPAs, there exist other policies of particular relevance to urban areas and how they relate to climate variability and change. These policies gained prominence at the 25th Special Session of the United Nations General Assembly and Istanbul+5 Conference in June 2001. At this event Cameroon stated that it had put in place an environmental management plan including a strategy for urban development. Additional national programmes recently developed include a programme for poverty reduction strategy, environmental protection, governance, health and nutrition. However, no assessment of the performance of these actions was available at the time of this review.

During the same event, the Congolese delegation stated that the human settlement development strategy of Congo encompasses four major components, namely security of tenure, adequate housing for all, promotion of equality in access to credit and provision of basic social services. However, attention so far has been focused on reconstruction and post-conflict development, and there is still significant work to do to achieve the goals of this strategy. Gabon noted that a national Habitat committee had been established, partnerships between national and local government and civil society had been forged and community infrastructure projects had been implemented with financial assistance from the World Bank.

5.2 Review of key arguments for policies on adaptation to climate change in urban areas

The facts presented below focus on adaptation policies targeting the coastline of the Gulf of Guinea.

Cameroon was part of the Accra Declaration and has approved the Declaration for Environmentally Sustainable Development of the Large Marine Ecosystem of the Gulf of Guinea (AEO 2005).[5] The Declaration pledged political commitment to environmentally sustainable development in the Gulf of Guinea. The Declaration noted that one way of enhancing environmental conditions in the Gulf of Guinea was to develop integrated coastal zone management (ICZM) plans and relevant institutions to implement policy at the national level. Another means was to increase existing efforts to prevent and mitigate the effects of coastal erosion and sea level rise, funded by international donor agencies and to be implemented within the framework of the Gulf of Guinea Large Marine Ecosystem Programme. The Accra Declaration calls for improved sharing of information and coordination of activities between member countries including Cameroon and the West African States of Benin, Côte d'Ivoire, Ghana, Nigeria and Togo. Gabon and Congo have also designed ICZM plans to take into account issues of coastal erosion and sea level rise in every socioeconomic development scheme taking place in the coastline. This is crucial since the coastal zone along the gulf of Guinea is home to major cities and industries which need to be protected from floods and the disruption of the city's socioeconomic activities.

5.3 Review of key policy actors and networks involved with adaptation to climate change in urban areas

Key policy actors

The New Partnership for Africa's Development (NEPAD) is an African-led partnership for sustainable development and poverty reduction in Africa. African heads of state are looking for support from the international community and donors to achieve these goals. NEPAD is a long-term agenda for Africa adopted as a programme of the African Union. The NEPAD Secretariat is developing an implementation plan and building linkages with existing regional economic communities (RECs) such as ECCAS, the Economic Community of West African States (ECOWAS) and the Southern African Development Community (SADC).

The African Ministerial Conference on the Environment (AMCEN) is the supreme continental forum responsible for articulating authoritative perspectives on Africa's environment and its place in the global arena. AMCEN was established against a backdrop of the continent's deteriorating environmental state and the impacts of increasing social and economic inequality on the environment. From the outset the African Union and the United Nations Economic Commission for Africa (ECA) have been particularly supportive of the work of AMCEN as the environmental voice of conscience of the region, thereby highlighting the interdependence of environment, social and economic issues and the political commitment to work in concert in the interest of the wellbeing of the people of Africa. Despite the achievements registered since its establishment, AMCEN still faces daunting challenges, such as harmonisation of sub-regional and regional environmental issues to receive equal attention at all levels.

Economic Community of Central African States (ECCAS): At a summit meeting in December 1981, the leaders of the Central African Customs and Economic Union (UDEAC) agreed in principle to form a wider economic community of Central African states. ECCAS was established on 18 October 1983 by the UDEAC members and the members of the Economic Community of the Great Lakes States (CEPGL) (Burundi, Rwanda and the then Zaire) as well as São Tomé and Príncipe. Angola remained an observer until 1999, when it became a full member. ECCAS began functioning in 1985, but was inactive for several years because of financial difficulties (non-payment of membership fees) and the conflict in the Great Lakes area. ECCAS's technical wing is the Commission des Forêts d'Afrique Centrale (COMIFAC).

Networks involved in adaptation to climate change in urban areas

During the last decade municipalities of capital cities in Central Africa have issued rules and regulations to address the impacts of climate variability and change in urban

Table 2: Typology of ECCAS

ECCAS	**Technical wing:** Commission des Forêts d'Afrique Centrale (COMIFAC)	Activities: Support Central African countries to establish NAPAs and point persons Potential: to influence decision-makers; work closely with the interim secretariat of the environment component of NEPAD (SINEPAD) and the parliamentary network for sustainable management of forestry and ecosystem of the Central Africa Region Gaps: Too much focus on mitigation and clean development mechanism (CDM); shortcoming in resources mobilisation

areas. In Yaoundé, Libreville, Brazzaville, Kinshasa, Luanda and Bangui policy documents such as Environmental Management Plans and other instruments have provided the legal frameworks needed to address climate change (AEO 2005). Important improvements have already been realised with the involvement of businesses operating under the scrutiny or supervision of public agencies and international NGOs (UN-Habitat 2010).

It has been reported that most city leaders in Central Africa have devised emergency policies to deal with climate variability and change in urban areas. The rationale behind this World Bank initiative is mostly to halt environmental degradation and to secure city-dwellers' lives and livelihoods. As such, the initiative is in keeping with Central African governments' poverty reduction strategies. Currently, city leaders in urban areas of the Atlantic coast are working with NGOs and local communities to reduce vulnerability to the social and economic effects of climate variability and change. Yet, although many municipalities have some climate change portfolios in place, most are not effective and implementation is hindered by lack of urban planning and local financial resources (World Bank 2013).

5.4 State of knowledge on funding streams for policies and strategies on adaptation in urban areas at national and regional levels

UNDP Adaptation Projects and Planning

In July 2010, UNDP planned a country-driven, multi-stakeholder climate finance framework to assist developing countries to scale up efforts to address climate change in a way that strengthens and advances national development priorities. Below are four of the key challenges that have been identified to raise and deliver climate finance where it is most needed. These challenges form the tenets on which UNDP's proposed climate finance framework is based.

- National ownership and synergies between development and climate finance is the key requisite for effective action to combat climate change. An effective climate change finance framework should be able to support a country-driven, development-oriented transformation of the economy in the face of great climate uncertainty. The end objective is to create a double dividend of both climate and development impacts. In practice, this equates to the internalisation of climate change response into national development processes.

- Catalytic use of international public finance: A key objective of an international climate change finance framework should be to enable countries to establish the optimal mix of policy and financing tools to reduce regulatory uncertainty and investment risks, thereby making climate change investments more attractive to project developers and investors. In this way, international public finance can be used in the most catalytic manner.

- Balanced and fair access to finance: An effective climate change framework will need to be able to accommodate both equitable governance and specific market conditions and absorption capacities of developing countries in the design of market-based and innovative financing mechanisms.

- Coordinated implementation and reporting mechanisms: The proposed UNDP climate finance framework will need to encourage coordinated, effective implementation and reporting to (i) avoid duplication and fragmentation; (ii) inform the formulation of several generations of strategies, programmes and projects; and (iii) optimise the use of international finance. This means that Central African countries will need to foster their absorptive capacity.

African Development Bank (AfDB) Adaptation Projects and Planning

Recognising that African countries face a number of challenges in mainstreaming climate risk management and adaptation (CRMA) into development policy, planning and public and private investments, AfDB has been rolling out a program and framework for the institutional support of climate change adaptation. Within this context, the overall objective of the AfDB through CRMA is to ensure significant progress towards alleviation of poverty and contribute to sustainable improvement in people's livelihoods. To this end, the CRMA supports three main areas of intervention:

- 'Climate Proofing' investments: This mechanism includes actions to ensure that development gains are protected from negative impacts of climate variability and change and extremes, and to make sure that climate-friendly development strategies are pursued to delay and reduce damages caused by climate change.

- Policy, legal and regulatory reforms that can address additional climate change related risks as well as strengthen legal and regulatory reforms to create an enabling environment for the implementation of climate risk management and adaptation.

- Knowledge generation and capacity building: Lack of climate relevant information

and historical data and the limited capacity within the continent to mainstream climate change is a key hurdle to managing climate risks. The AfDB proposes to use available global financial resources as well as its own investment windows to address the specific CRMA related activities in its operations.

In order to comply with the eligibility criteria of AfDB, countries need to implement three responses concurrently. First, they must build adequate capacities to manage present climate risks. Second, societies need to adapt themselves to a changing climate. Third, the international community needs to renew its commitment to implementing effective measures to curb GHG emissions towards *mitigation* of climate change and its impacts in the longer run. The strategy takes the position that the most effective approach is the integration of management options of present climate risks emanating from extreme events into long-term adaptation strategies in order to build long term resilience to withstand future changes in climate-related risks.

UNFCCC Adaptation Projects and Planning

Unlike the above organisation's adaptation projects and planning, the main activity under the UNFCCC itself has been the development of NAPAs followed by Global Environment Facility (GEF) funding of explicit adaptation projects. Though adaptation appears critical for Africa, to date it is still hard to say that adaptation has sat entirely comfortably under the UNFCCC, which was planned around mitigating climate change through controlling greenhouse gas emissions. Moreover, the Nairobi Work Programme is a mechanism created to assist developing countries with regard to climate change in terms rather broader than just adaptation. It is noted that few submissions to this Work Programme from African governments and organisations were made under the 'Adaptation Planning and Practices' line. Equally, it is too early to assess African involvement with the recently commissioned Kyoto Protocol Adaptation Fund.

Overall, with the establishment of the Adaptation Fund and new monies going to adaptation, it is important that the capacities of current institutions are strengthened to take on the challenge of handling the delivery mechanisms of adaptation management as well as supporting stakeholders' action towards viable adaptation strategies. Formal national and regional institutions can play an essential role in supporting and guiding local informal institutions and civil society in the uptake of adaptation actions. Climate change will mean new institutional arrangements and management that will support adaptation action.

Though a number of funding streams for policies and strategies on adaptation exist (see Appendix 1), only a few (e.g. GEF funding projects) pertain to adaptation in urban areas in Central Africa (see Table 3).

5.5 Review of key barriers to adaptation integration into policy and planning

Although integrating adaptation to climate variability and change into policy and planning processes is a prerequisite for sustainable development over the long run, in Central African countries there still exist difficulties in incorporating adaptation concerns into national policies. As such many hurdles prevent uptake of research evidence for policy formulation and implementation and successful policy implementation for adaptation in urban areas to effectively address issues such as flooding and spreadW of disease, to name a few. These impediments include:

- Low staff capacity for planning;
- Lack of monitoring and evaluation;
- Data scarcity on effectual adaptation options and lack of mechanisms for information sharing (e.g. on what works and what doesn't) and management across sectors;
- Limited awareness of adaptation in the urban sector among stakeholders and the public; and
- Lack of cooperation among ministries and weak intergovernmental co-operation (see Box 4).

Table 3: List of some funding institutions in adaptation to climate change in Central Africa

Organisation	Online source
UNDP	http://www.undp.org/climatechange/library.shtml
AfDB	http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/FRAMEWORK%20DOCUMENT%20FOR%20THE%20ESTABLISHMENT%20OF%20THE%20CLIMDEV-AFRICA%20SPECIAL%20FUND%20(CDSF).pdf
UNFCCC	http://unfccc.int/resource/docs/2009/tp/02r01.pdf http://www.adaptationlearning.net/ (GEF funding projects)

Box 4: Effective cooperation among ministries: an unfilled gap that limit progress on adaptation to climate change in Central Africa – Case of Cameroon (Napi COP 18, 2012)

Climate change adaptation (CCA) and disaster risk reduction (DRR) typically have separate institutional 'homes' in Cameroon – the Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED) for CCA, and Ministry of Territorial Administration and Decentralization (MINATD) for DRR – each with their own inter-sectoral coordination groups, each with their own channels of funding, and each with separate entry points in different international agreements (Hyogo Framework for Action for 2005-2015 for DRR and UNFCCC for CCA). While sharing very similar objectives as to the protection of development gains through effective planning and programming, and similar challenges in raising the profile of their agendas, the two Ministries typically fail to coordinate among themselves. Such duplication of efforts – coupled with administrative inefficiencies and even competition among various actors – not only hampers DRR and CCA efforts, but also compromises the overall efficiency of use of already limited resources in the implementation of development strategies and policies aiming to achieve the Millennium Development Goals (MDGs). Findings revealed that disaster management systems in Cameroon mostly focus on response and relief that later turns out to be inadequate, whereas a culture of prevention, which could take due account of the cost of inaction, is yet to emerge. This puts new and heavy demands on decision-making linked to environmental planning, but also reflects the difficulty in articulating cost-effectiveness associated to saving human, social, physical and financial capitals from natural disasters before they occur.

Reproduced from Napi Wouapi's contribution

Source: http://www.stakeholderforum.org/sf/outreach/index.php/component/content/article/166-cop18day11-disasters/1296-institutional-vulnerability-adaptation-in-the-semi-arid-floodplain-of-cameroon

6. Gaps in climate change adaptation research and policy in urban areas

By examining the literature and assessing case study examples of adaptation research in urban areas in Central Africa, it is apparent that there are a number of gaps in knowledge, capacity and experience as far as adaptation to climate change in urban areas is concerned. Also, there is a lack of research and knowledge across a range of interconnected/cross-cutting issues including water resources and gender bias. Capacity-building within and among different stakeholders; better ways to monitor and evaluate climate change adaptation work; and improved knowledge management, including the documentation of good adaptation practices, are crucial requirements.

6.1 Key research gaps: what knowledge are we lacking on adaptation to climate change in urban areas in the region?

Among the many gaps identified in terms of research, the following provides a general overview:

- *General lack of research.* Cities located along the Atlantic coast are major climate variability and change 'hotspots' in Central Africa where large populations live in vulnerable areas. These cities require substantial research work to better understand how they are likely to be affected and how they can adapt.
- *Inadequate tools, knowledge and financial resources.* There is currently a lack of information and statistical analysis related to climate and hydro-geological changes in the region. This is compounded by poor connection between decision-makers and the scientific community, inadequate climate risk assessment methods and scarcity and inadequacy of technical instruments.
- *Research on climate-induced migration* is urgently required, given that rural-urban migration is already putting a strain on resource-poor local municipalities, peri-urban centres and crowded cities. As a result, autonomous adaptation is likely to become more common and widespread. Tohnain's (2008) work is an illustration of documented adaptation by farmers in Yaoundé, with gender

Box 5: Indicators of city dwellers involved in urban farming across subdivisions of Yaoundé

In the city Yaoundé, the following indicators have been recorded, showing the percentage of city dwellers involved in urban agriculture across six subdivisions:

- >65% in Yaoundé I, Yaoundé III and Yaoundé IV
- 60% in Yaoundé II
- 75% in Yaoundé V
- 70% in Yaoundé VI

Reproduced from: Tohnain (2008)

implications as a greater number of those involved are women and notably housewives. Box 5 below highlights the magnitude of urban agriculture in the city of Yaoundé.

The study revealed that urban farming in Yaoundé is chiefly induced by factors such as economic hardship. The latter appears to be one of the roots of general food insecurity in the city, as nearly all food items are bought. Tohnain (2008) finds that urban agriculture has become a common practice in Yaoundé city and is a continuation of rural practices by rural-urban migrants. More importantly, Tohnain (2008) proved that urban farming turned out to become a better option and survival strategy to reduce the impact of city life on the urban poor. Hence, urban agriculture here is an autonomous or spontaneous adaptation response to the inability of urban poor to purchase foodstuffs because of insufficient financial resources. This notwithstanding, most research and policy dialogues have placed emphasis on planned adaptation through NAPAs. Though NAPAs exhibit high variability in quality and in their treatment of climate change issues, they share similarities in the identification of key (chiefly adaptation) issues and priority projects. To better understand the drivers of autonomous adaptation in urban areas, research across a number of related areas would benefit Central Africa, including:

– Research on economic diversification at household level and how this reduces the impacts of climate change.

– Research to examine the links between access to essential services such as energy, water, transport, finance, health and education and how these affect a community's ability to adapt.

– Research to identify opportunities for encouraging the spread of low-carbon technologies to support diversification and mobility in areas such as coastal zones undergoing rapid economic development.

– Research on use of financial institutions. As pressure keeps mounting on traditional risk-sharing strategies (borrowing from family, friends and social networks) so too does the unfair nature of moneylenders, predominantly during disasters. How people access financial institutions for micro-credit, insurance and financial services requires further research and documentation. This could include micro-finance research to better capture how micro-finance can be linked to larger social support systems that strengthen livelihoods and increase disaster risk resilience rather than increase the risk and debt burden for the urban poor.

6.2 *Key policy gaps: what is missing with regard to climate change adaptation in urban areas in national policy frameworks?*

- Lack of integration among adaptation strategies in urban sector and development strategies. NAPAs so far have placed emphasis on climate sensitive natural resource-based livelihoods.

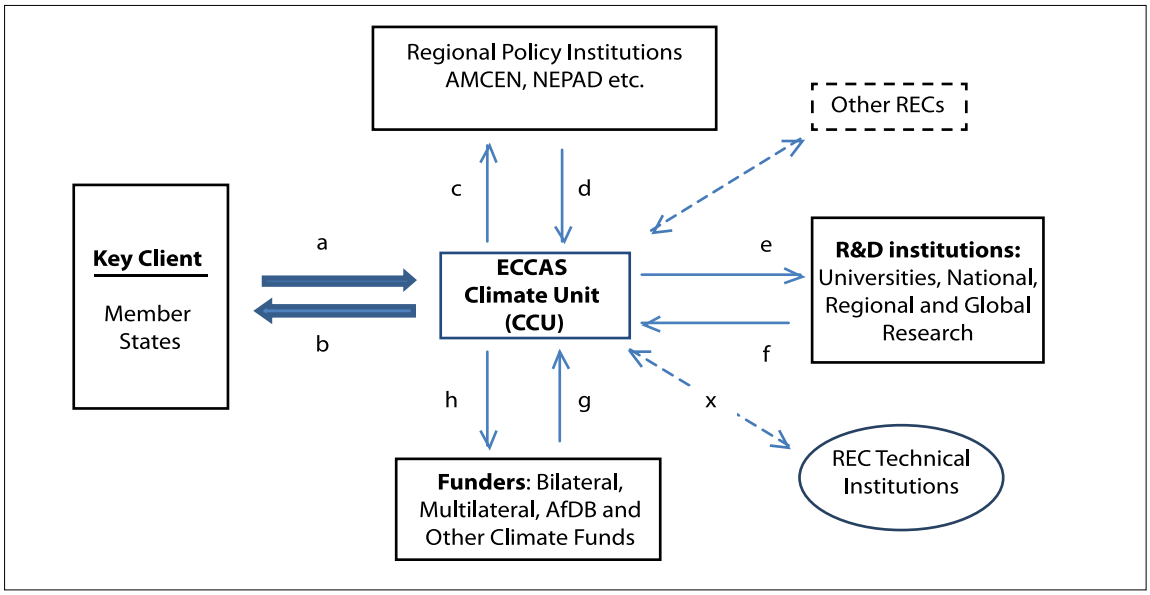
- Issues related to communicating what climate change actually is to different groups living in cities.

- Insufficient long-term perspective, aggravated by short-term funding cycles; and insufficient integration between institutions.

6.3 *Key research-policy gaps: what are the identified challenges to uptake and integration of research findings in policies (climate change, urban area policies)?*

Policy and development planners require effective tools and frameworks for developing, disseminating and building capacity for adaptation in urban areas in Central Africa and incorporating it into policy at all levels. In this context it is crucial to recognise the prominent role of universities, knowledge centres of excellence and technical institutions. Enhanced support is needed for institutional capacity building in Central Africa, climate science and applications.. Such a dynamic network would serve as repository of knowledge and climate change adaptation issues in urban areas and help in building capacities of individual countries and National Meteorological and Hydrological Services in Central Africa. In addition, training for city leaders and relevant actors dealing with urbanisation challenges in a changing climate is likely to help the development of specialised tools for planning and implementing adaptation activities and thus promote action by urban residents, municipalities and central governments.

Figure 1. Proposed institutional arrangement for strengthening the role of RECs



6.4 *Options and possible policy spaces or opportunities for improved uptake of research findings*

Given the challenges posed by rapid urbanisation and development in Central Africa and the need for research to feed into national and regional policies, this analysis finds that regional organisations, whether political, scientific or development-oriented, can and should in fact play an important role in achieving the goals of adaptation in urban sector. ECCAS, which is mandated by the AU to implement the regional integration agenda on economic development in Central Africa, has an important role to play in addressing adaptation to climate variability and change in urban areas of Central Africa. From this perspective, ECCAS is regarded as important power broker in leveraging local and national policies and programmes to support collective adaptation and in making trade-offs between different policy areas. This potential has been recognised by AMCEN, which has pledged full support for RECs in pursuit of their climate change agendas. In fact the RECs can capitalise on their vast experience in negotiations in areas such as trade and agriculture to manage this challenge.

The political recognition of climate change as a key item on each of the RECs' development agendas is an important first step that has already been achieved with little effort. The key next steps must entail efforts by ECCAS to put in place new institutional arrangements[6] (see Figure 1) for climate change leadership. Through consultative processes, these frameworks should be able to not only design and implement strategies and innovative adaptation programmes that are context specific but also attract available resources locally and abroad, foster knowledge and engage member states and other stakeholders including research and policy networks. It will, finally, be important to remove key institutional and structural barriers that may obstruct effective delivery by this institutional framework built on burden-sharing premise.

Figure 1 has been proposed as a viable institutional arrangement that could enable ECCAS to assume its potential leadership roles in climate change management in Central Africa. The strategy proposes the establishment and strengthening of a climate change unit (CCU) within the ECCAS secretariat. The proposed CCU would take the form of a department that would interact with all directorates established within the REC's organisational structure and preferably reporting to the Executive Secretary or the REC's governing body. Of note, the bottom line is not to anchor it in any sectoral department, where it would receive less cooperation from other units that would feel alienated. In this framework, the Member States are the key clients of the inter-relationships between ECCAS and strategic stakeholders. These would include key regional policy institutions (e.g. African Climate Policy Center[ACPC], AMCEN), research and development actors (e.g. Center for International Forestry Research [CIFOR], policy think-tanks), funding agencies for climate programmes (e.g. Climate Green Fund, Adaptation Fund, UNDP, AfDB) and technical bodies established by the REC (e.g. COMIFAC).

Table 4 lists the value-added elements and feedbacks underpinning each of the envisaged inter-relationships between ECCAS and strategic stakeholders. The initial[7] step towards establishing a CCU entails the appreciation by a sub-region's political leadership and secretariat's top management of the need for a coordinating entity specifically for climate change issues to be located within the secretariat. This step has already been overtaken by recent events following the political endorsement by all

Table 4: An elaboration of the innovative institutional arrangement proposed for ECCAS		
Arrow	**Elaboration**	**Assumption**
x	CCU and the out-posted technical arm of the REC interact and exchange knowledge	Both institutions appreciate the need and facilitate such interaction
a	Country office (relevant one) sends new data and emerging information or requests specific advice or assistance	National focal point dealing with climate change adaptation (CCA) issues exists
b	CCU co-ordinates regional climate change initiative at country level, provides strategic advice for local-national level action	National focal point dealing with CCA issues exists
c	ECCAS feeds Central African Negotiators, ACPC or regional level expert groups with its positions on a common issue	CCU officer up to date with calendar of events and processes
d	Strategic information requests, sharing down strategies for sub-regional intervention, etc.	The continental bodies and processes recognise the CCU
e	CCU requests for data, new findings or contracts strategic studies	CCU has database of R&D institutions, their expertise and lead researchers
f	Research and Development institutions submit research results, new findings for consideration at sub-regional or regional policy level	Sub-regional research agenda and priorities for CCA are well known
g	Donors, grant makers provide finance for CCA projects in e.g. the urban sector	CCU meets all requirements for funding
h	CCU advises donors on priority areas of investment, submits funding requests	Donors accept and have confidence in advisory from ECCAS

Ministers of Environment of Africa through AMCEN at its 12th Special Session in 2008 in Johannesburg of the need for all countries to give full support to efforts to mitigate or adapt to climate change, and by their calling upon the RECs to take this leadership role in guiding implementation of related activities.

7 An analysis of stakeholders and opportunities for collaboration

7.1 Synthesis of key institutional actors involved with research and policymaking on climate change adaptation in urban areas

Adaptation to climate change, be it in urban or rural sectors, is a complex issue that can be viewed from a various level of governance involving sub-regional institutions, government agencies, municipalities and populations. Adaptation to climate variability and change in urban areas is also a development issue and hence should be addressed by various sector ministries as well as many actors. These may include businesses, NGOs, common initiative groups, etc. Adaptation to climate change in the urban sector is also crosscutting in other sectors.

In Central Africa, the key institutions working in areas related to adaptation to climate variability and change in the urban setting belong to at least one of four broad categories: economic and political institutions (ECCAS, UDEAC), river basin organisations (Sustainable Development Programme of the Lake Chad Basin [PRODEBALT], Lake Chad Basin Commission [CBLT], Congo Basin Commission), knowledge centres and international organisations (UNDP, UN-Habitat).

7.2 Lessons from efforts to promote research-policy dialogues on adaptation in urban areas

Here the issue of communication between the various actors and stakeholders matters. It is believed that lack of action or involvement or slow responsiveness is often linked to problems of communication between different actors. To remedy this situation, it is important to take account of a number of factors. As for capacity building, it appears important to reinforce the scientific capacity of Central African organisations working in the fields linked to climate-induced hazards and urban development. This will help pave the way for the establishment of dynamic interfaces between those structures, policymakers, city leaders and urban residents.

Equally worthy of note is the creation of a regional framework for consultation involving various actors who can then share knowledge on topical issues related to adaptation to climate variability and change in the urban sector. In addition, it will be rewarding to develop

fact sheets intended for policymakers in order to assist them in their decision-making tasks. Concomitantly, it will make sense to organise a series of information and communication events that will provide decision-makers with adequate information needed to understand the advantages and disadvantages of implementing climate change adaptation in urban areas. AfricaInteract can play a huge role in fostering such collaboration at both the regional level and at the continental level. Every effort should be made to sustain this initiative to serve as a rallying forum as well as a mode of channelling crucial information to inform policymaking.

In terms of visibility of institutions working on climate adaptation in urban areas, it will be of great benefit to identify and promote champions of adaptation. Given that adaptation issues cut across many sectors, urban planning, finance, transport, energy, ecosystem services, water resource agencies, businesses and NGOs should be involved in the decision-making processes (World Bank 2013). To better facilitate these processes, organisations such as UN-Habitat play an important role in bringing together communities with different levels of government and a diverse set of other actors. They also play important roles in advocacy and in putting practical adaptation to test in cities.

8 Conclusions and recommendations

Climatic extremes and variability pose a serious challenge to sustainable urban development, placing many cities along the coastline of Central Africa at risk. City authorities are increasingly facing the challenge of finding ways to include adaptation strategies in their work, although relevant knowledge and expertise remain scarce and fragmented. Current approaches are limited in scope and generally overlook local adaptation capacities of individuals and households. Furthermore, the extent of changing climatic conditions coupled with rapid urbanisation are reducing the capacity of urban institutions and associated governance systems to deal with climate hazards and urban development. In fact, climate variability and change is undermining the effectiveness of institutional responses which were designed to be applied in the event of climate hazards and associated effects. Innovative approaches for urban climate change adaptation are urgently needed.

This review has found that the coastline of Central Africa, which is home to most capital cities, is experiencing a massive phenomenon of urban growth. This is due to 'pull factors' such as opportunities for employment, education and improved access to health care which intensify rural-urban migration. Yet, in many urban areas rates of economic growth and infrastructural development have considerably lagged behind urbanisation rates, resulting in high levels of unemployment, inadequate standards of housing and services in unplanned settlements and impacts on human health and development. This situation is further aggravated by climate hazards such as coastal erosion and inundation that put many people at risk. To reverse these trends, more research will be needed to trigger: (i) coherent, integrated planning; (ii) development that is environmentally and socially sensitive; (iii) security of tenure and financing; (iv) sufficient investment in infrastructure to keep pace with the rate of growth of urban populations and their demands for essential services and security; and (v) rural development programmes to assist in slowing the rate of urban population growth.

The review also found that scholarship on climate change adaptation is still in its infancy in the Central African region. Cities located along the Atlantic coast are major climate variability and change 'hotspots' in Central Africa where large populations live in vulnerable areas. These cities require substantial research work to better understand how they are likely to be affected and how they can adapt, including establishment of ICZM and zoning. Likewise, the review has shown that policies related to urban issues with regard to climate change exist for each country, but the level of implementation is still very poor. To remedy this situation, it appears crucial to strengthen institutions working in the field of climate change in the urban sector.

This analysis also found that there are a number of gaps in knowledge, capacity and experience. These include a lack of information on climate impacts in a region with a large coastline and significant hotspots of climate variability and change. Furthermore, there is a lack of research and knowledge across a range of interconnected and cross-cutting issues including water resources and gender bias. Besides this, the review showed that regional organisations, whether political, scientific or development-oriented, can and should play an important role in achieving the goals of adaptation in the urban sector in Central Africa. Capacity-building within and among different stakeholders; better ways to monitor and evaluate climate change adaptation work; and improved knowledge management including the documentation of good adaptation practices are needed. Finally, the review notes that adaptation to climate change in the urban sector is a complex issue that can be viewed from various levels of governance involving sub-regional institutions, governmental agencies, municipalities and populations. Adaptation to climate variability and change in urban areas is also a development issue and hence should be addressed by various sector ministries as well as many actors: researchers, educators, young scientists, policymakers, urban planners, government officials, development practitioners, donors, non-governmental and community-based organisations and businesses.

As for recommendations, the analysis suggests the following:

- ***Investing in more research, capacity building and documenting good practice.***

  One of the major challenges and constraints this review faced was a lack of useful documentation on adaptation research and practice. While we are all still learning about adaptation, and its practice is in the early stages, documentation and shared learning becomes especially important. This includes not only documentation of the 'what' but more importantly documentation that goes into details about the 'how' in order to explain the process of working with at-risk groups and other stakeholders. In order for this to happen, there is a need to increase investment in the skills of staff working in ministries and knowledge centres, thereby enabling them to draft their work in a manner that promotes learning.

- ***Improvement of living conditions in urban areas.***

  Central African governments need to plan urban development appropriately for sustainable development. They should support 'win-win' options which will contribute to both climate change mitigation and adaptation and wider development objectives. These may include business opportunities from energy efficiency measures, sustainable water management and sanitation projects, etc. These constitute low-regret adaptation measures that would be justifiable with or without climate change. Other measures that deal with climate variability (e.g. long-term weather forecasting and early warning systems) may also fall into this category. Furthermore, they need to formulate appropriate human settlement and waste management policies, laws and regulations, and to promote private sector participation in improving urban infrastructure and the provision of municipal services. Central African governments should also fulfil their core obligations under the Habitat Agenda, and should prepare integrated water and waste management strategies and action plans, ICZM and zoning.

- ***Providing an enabling environment for the implementation of policies and uptake of research to inform policymaking.***

- ***Monitoring and evaluation frameworks for adaptation.***

  Monitoring, evaluating and learning are doubly important within climate change adaptation because climate change is taking communities, local and national governments, and other stakeholders into uncertainties. This means that all stakeholders will need to learn what does and does not work, and build upon successful strategies. The other reason is that donors place emphasis on monitoring, evaluation and learning to demonstrate the difference and impact of adaptation processes and actions.

End Notes

1 The ten countries of ECCAS are Angola, Burundi, Cameroon, Central African Republic (CAR), Chad, Republic of Congo, Democratic Republic of Congo (DRC), Equatorial Guinea, Gabon and São Tomé and Príncipe.

2 - Available for the duration of Project 106533 – Platform for Exchange between African Research Scientists and Policymakers on Climate Change Adaptation: http://ezproxy.idrc.ca/login

- Research Databases: http://www.idrc.ca/EN/Resources/ResearchDBs/Pages/default.aspx

- Guide for IDRC-Funded Researchers http://web.idrc.ca/en/ev-146190-201-1-DO_TOPIC.html

3 In reference to the implementation of the outcome of the UN Conference on Human Settlements (Habitat II)

4 An exhaustive list of NAPAs is available here: http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php

5 The Gulf of Guinea Large Marine Ecosystem Programme is a jointly funded, regional cooperative programme for improving environmental quality and productivity in the Gulf of Guinea. Benin, Côte d'Ivoire, Ghana, Nigeria, and Togo from Western Africa and Cameroon in Central Africa have participated in the programme which has established a framework for sub-regional cooperation and national level ICZM plans. It also facilitated the adoption of the Accra Declaration (Declaration for Environmentally Sustainable Development of the Large Marine Ecosystem of the Gulf of Guinea) in 1998.

6 In this it is informed by the experiences of Climate Change Adaptation in Africa (CCAA) partners and the Programme Management Unit from working with some of the RECs.

[7] The next logical step would be the proactive establishment of the CCU as an integral part of ECCAS's organizational flowchart.

[8] REDD is the UN mechanism for reducing emissions from deforestation and forest degradation.

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Appendix 1: A matrix of all research projects/scientific articles, including a brief description of their main components

Research Project	Sector	Distinctive feature	Author, institutional affiliation and online source
Peer reviewed papers and theses			
Ensuring Human Safety in the Disaster Prone Coastal Town of Limbe, Cameroon. Received: **28 February 2012** Accepted: **23 March 2012** Online Published: **28 May 2012**	Disaster risk management, vulnerability, coastal erosion and urban development	The paper urges for the evacuation of people from high risk zones, careful policy planning and rigorous implementation of the strategic master plan of the coastal city of Limbe. In addition, the research project showcases some adaptation options including a dyke road rehabilitation project to withstand coastal erosion.	**Sunday Shende Kometa** Department of Geography, Faculty of Social and Management Sciences, University of Buea, Cameroon URL: http://dx.doi.org/10.5539/jgg.v4n2p156
Urban agriculture: An Induced Activity in Yaounde. Received and accepted: **May 2008**	Urban agriculture, rural-urban migration, urban poor, food insecurity, informal activities	This PhD thesis examines why urban agriculture has become a common practice in Yaoundé city, and whether this practice is merely a continuation of the rural practice in the urban centres by rural-urban migrants. It makes the point that a better option to reduce the impact of city life on residents is urban farming induced by many factors. The thesis concludes that urban agriculture as it is done in the city of Yaoundé is an induced activity in all its forms.	**Norbert Tohnain Lengha** Lecturer and senior researcher at the Department of Agricultural Extension and Rural Sociology (VSR), Faculty of Agronomy and Agricultural Sciences (FASA), University of Dschang (UDs), Cameroon Specialisation: Rural Sociology, Department of Sociology, Faculty of Arts, Letters and Social Sciences, University of Yaounde I
Vulnerabilité des espaces urbains et stratégies locales de développement durable: étude du cas de la ville de douala (Cameroun). Received and accepted: **22 March 2012**	Urban vulnerability, resilience, risks and sustainable development	The Masters thesis evaluates and ascertains the mainstreaming of strategies relating to Douala's urban policy vis-à-vis environmental degradation and sustainable city development. Through in-depth analysis of Douala's urban policy and associated objectives, means of action and mechanisms, important issues on potential success and/or failure factors of said policy were scrutinised with a view to increase urban resilience to natural disasters and risks.	**Joseph Magloire Olinga Olinga** Department of Geography, Faculty of Letters and Social Sciences, University of Douala
Pression Sociale et Dynamique de l'Espace Côtier à Youpwe (Douala). Received and accepted: **2011**	Population pressure, rapid urbanization, urban infrastructure, mangrove degradation	This Masters thesis project places emphasis on the importance to increase the perception of urban populations towards coastal protection.	**Beni Luc Moutila** Department of Geography, Faculty of Letters and Social Sciences, University of Douala
Urbanisation et Nomenclature des Places Urbaines au Cameroun: Cas du Quartier Bepanda à Douala. Received and accepted: **February 2012**	Rapid urbanization, unplanned settlements	This research project examines the issue of high rate of growth of urban population in one of the largest slums of the economic city of Douala. The report seeks to draw the attention of government and municipality to put in place adequate measures in order to meet the challenges that urbanization creates.	**Marcel Cheteu** Department of Geography, Faculty of Letters and Social Sciences, University of Douala
Gestion des déchets solides ménagers à Douala au Cameroun: opportunité ou menace pour l'environnement et la population. Received and accepted: **12 March 2010**	Domestic wastes, ecological risks, environmental management, human behaviour, waste valorisation, public health risk and urban environment	This PhD thesis examines the issue of management of waste in the city of Douala, Cameroon. It makes the point that roughly 60 percent of households benefit from solid waste collection service. The thesis concludes that the city of Douala is at particular risk from climate hazards as concentration of solid waste disrupts drainage channels.	**Louis Bernard Tchuikoua** Thèse présentée en cotutelle en vue d'obtenir le grade de docteur/Ph.D de l'Université de Douala et de Docteur de l'Université Bordeaux III, France Specialisation: Géographie Humaine (Écologie-Aménagement-Développement)

Les problèmes d'Approvisionnement en Eau Potable dans les Quartiers Périphériques de la Ville de Douala - Cas de Logbessou II. Received and accepted: **2013**	Peri-urban vulnerability, access to drinkable water, water-borne disease, urban planning, population growth rate and rapid urbanization	This research work places emphasis on the issue of water provision and sanitation in peri-urban districts of the city of Douala. It points out that access to water supply and sewerage in the district of Logbessou II ranks the lowest in the urban centre of Douala. Women and youngsters are the ones bearing the burden when it comes to fetching water for domestic purposes.	**Clément Mbeugang** Department of Geography, Faculty of Letters and Social Sciences, University of Douala Specialisation: Homme / Milieu Field: Urban Planning and Sustainable Development
Towards a comprehensive analysis of cleaner technology potentials to address industrial pollution arising from natural rubber processing industry: A case study of Cameroon Development Corporation - Rubber Factories Received and accepted: **2007**	Environmental Modernization, Environmental Innovation, Environmental Regulation, Industrial pollution, Environmental Excesses and agroprocessing industries	The findings of this research project indicate that adoption of cleaner technology in agro processing industries in Cameroon remains a serious challenge to environmental policy makers. Whilst research has shown that the rubber industry can play an important role in strengthening a nation's economic development; its negative environmental impacts arising from poor effluent treatments present a serious threat to the costal ecosystem. This is further exacerbated by the lack of research to generate knowledge and better management practices. Overall, the research suggests that environmental policies (only grounded on environmental demands with less consideration of the company's business view) aimed at ecological industrial transformation need to be supplemented with more innovative instruments embedded in "second generation" regulation.	**Napi Wouapi and Tamo V. Maimo** International Master of Science Program in Technological and Socio-Economic Planning - Environmental Policy and the Global Challenge, Department of Environmental, Social and Spatial Change (ENSPAC), Roskilde University, Denmark.

Appendix 2: Climate fund profiles outlining funds tracked by Climate Funds Update

A list of funds tracked by Climate Funds Update, and links to fund profile pages, can be found below. Each fund page offers an overview of key details on each of the funds, including (i) a general fund description, (ii) fund governance and (iii) relationship with official development assistance (ODA).

Fund	Type	Administered by	Area of focus	Date operational
Adaptation Fund	Multilateral	Adaptation Fund Board	Adaptation	2009
GEF Trust Fund – Climate Change focal area (GEF 4)	Multilateral	The Global Environment Facility (GEF)	Adaptation, Mitigation - general	2006
GEF Trust Fund – Climate Change focal area (GEF 5)	Multilateral	The Global Environment Facility (GEF)	Adaptation, Mitigation - general	2010
Global Climate Change Alliance	Multilateral	The European Commission	Adaptation, Mitigation - general, Mitigation - REDD[8]	2008
UK's International Climate Fund	Bilateral	Government of the United Kingdom	Adaptation, Mitigation - general, Mitigation - REDD	2011
Germany's International Climate Initiative	Bilateral	Government of Germany	Adaptation, Mitigation - general, Mitigation - REDD	2008
Japan's Fast Start Finance – private sources	Bilateral	Government of Japan	Adaptation, Mitigation - general, Mitigation - REDD	2008
Japan's Fast Start Finance – public sources	Bilateral	Government of Japan	Adaptation, Mitigation - general, Mitigation - REDD	2008
Least Developed Countries Fund	Multilateral	The Global Environment Facility (GEF)	Adaptation	2002
MDG Achievement Fund – Environment and Climate Change thematic window	Multilateral	UNDP	Adaptation, Mitigation - general	2007
Pilot Program for Climate Resilience	Multilateral	The World Bank	Adaptation	2008
Special Climate Change Fund	Multilateral	The Global Environment Facility (GEF)	Adaptation	2002
Strategic Climate Fund	Multilateral	The World Bank	Adaptation, Mitigation - general, Mitigation - REDD	2008
Strategic Priority on Adaptation	Multilateral	The Global Environment Facility (GEF)	Adaptation	2004

Source: http://www.climatefundsupdate.org/

Future Agricultures

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