INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT

HUMAN SETTLEMENTS WORKING PAPER No.33
RURAL-URBAN INTERACTIONS AND LIVELIHOOD STRATEGIES

Climate change, adaptation strategies and mobility: evidence from four settlements in Senegal

by Dr. MOHAMADOU SALL, AL ASSANE SAMB,
Dr. SERIGNE MANSOUR TALL and Dr. ALY TANDIAN

NOVEMBER 2011

iied

HUMAN SETTLEMENTS AND SUSTAINABLE AGRICULTURE AND RURAL LIVELIHOODS PROGRAMMES

ACKNOWLEDGEMENTS

This paper and the research on which it draws were prepared with financial support from the German Federal Ministry for Economic Cooperation and Development (BMZ). Additional funding was provided by the Swedish International Development Cooperation (Sida) and the Ministry of Foreign Affairs of Denmark (Danida). Technical support from the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) is also gratefully acknowledged. The opinions expressed in this paper are the sole responsibility of the author and do not necessarily reflect those of the funding agencies.

On 1 January 2011, GIZ was formed. It brings together the long-standing expertise of DED, GTZ and Inwent. For further information, go to www.giz.de.

AUTHOR'S CONTACT

Dr. Mohamadou Sall, Université Cheikh Anta Diop de Dakar.
Email: sallmoham@yahoo.fr

Dr. Serigne Mansour Tall, ONU-Habitat.
Email: mansour.tall@undp.org

Dr. Aly Tandian, Université Gaston Berger de Saint-Louis.
Email: aly.tandian@gmail.com

Al Assane Samb, Consultant.

Human Settlements Group
International Institute for Environment and Development (IIED)
80-86 Gray's Inn Road
London WC1X 8NH, UK
Tel: 44 20 3463 7399 (international); 020 3463 7399 (UK)
Fax: 44 20 3514 9055 (international); 020 3514 9055 (UK)

ISBN 978-1-84369-832-6

This paper can be downloaded free of charge from http://pubs.iied.org/10598IIED.html. A printed version of this paper is also available from Earthprint for US$20 (www.earthprint.com).

CONTENTS

Acronyms and abbreviations

ANAMS	Agence Nationale de la Météorologie du Sénégal National Meteorological Agency of Senegal
ASESCAW	Amicale Socioéconomique Sportive et Culturelle des Agriculteurs du Waalo Waalo Farmers Socio-Economic, Sports and Cultural Association
CADL	Centre d'Appui au Développement Local Local Development Support Centre
UNFCCC	United Nations Framework Convention on Climate Change
CESV	Community Engagement Volunteer Service
CILSS	Permanent Inter-State Committee for Drought Control in the Sahel
COMNAC	National Committee on Climate Change
CSE	Centre de Suivi Ecologique
DEEC	Office for the Environment and Classified Buildings
PRSP	Poverty Reduction Strategy Paper
GEF	Global Environment Facility
FSSA	Support Fund for Local Adaptation Strategies
EIG	Economic Interest Group
GPF	Women's Producer Group
ISE	Institut des Sciences de l'Environnement
TFR	Total Fertility Rate
ISRA	Institut Sénégalais de Recherche Agricole
LNRPV	Laboratoire National de Recherche sur les Productions Végétales
NAPA	National Adaptation Programme of Action
PAMECAS	Partenariat pour la Mobilisation de l'Epargne et le Crédit au Sénégal
ITCP	Integrated Territorial Climate Plan
UNEP	United Nations Environment Programme
RADI	Réseau Africain pour le Développement Intégré African network for Integrated Development
SAED	Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal National Society of Planning and Land Use in the Senegal River Delta
IDSS	Information and Decision Support System
SNMO	National Implementation Strategy
URAPD	Union Régionale des Associations Paysannes de Diourbel
ZSP	Sylvo-Pastoral Zone

Executive summary

This research investigates the impact of climate change on the mobility of people in four settlements in Senegal: Nguèye Nguèye, Gandiole, the Senegal River delta and Ourossogui. A qualitative approach involving semi-structured interviews and focus groups was used to determine how daily life in these communities is being affected by environmental change.

Some migrants spend long periods as far afield as Mauritania, the Gambia or Spain, while others stay closer to home, going to places like Saint-Louis, Dakar and Mbour for short periods. Mobility is an opportunity for migrants to generate funds and send money home. It is a key factor in adaptation to climate change, as a strategy for survival and for diversifying incomes. The problems encountered in the ecological study zones are not entirely due to climate change, for migration is also triggered by factors such as the opening of the breach in Saint-Louis or lack of support for rural development. However, climate change is certainly accelerating disruptions and transformations in the study sites.

Moreover, while migrants' financial transfers help improve daily life for some families, they also increase socio-economic inequalities between households that include migrants and those that do not.

People are moving away from (but not necessarily abandoning) purely agricultural livelihoods and seeking to diversify their sources of income. This may come from migration, or from artisanal activities undertaken in the locality – such as metalwork, woodwork, sewing or hairdressing. Another option that many women have taken is using micro-credit facilities to start processing local produce, crushing groundnuts and preparing cereals to sell at the weekly markets.

Other adaptation strategies are developed and adopted through technical innovations or awareness-raising and educational activities. These activities often require institutional support from the State or from NGOs involved in implementing projects and helping communities institutionalise and appropriate adaptation strategies. Although the Senegalese government has shown its political commitment by ratifying various international conventions, the implementation of policies is compromised by a lack of communication and public information on relevant programmes, which therefore have a very limited impact on those most affected by the ongoing socio-economic and environmental changes. Furthermore, policies relating to climate change take little account of the mobility of these communities.

Introduction

The Earth Summit in Rio de Janeiro in June 1992 marked the start of a growing awareness of climate change, its global repercussions and a shared political desire to limit the risks associated with it. This has led to the development of frameworks for scientific consultation such as the Intergovernmental Panel on Climate Change *(*IPCC), the promotion of the precautionary principle and the formulation of programmes like the Kyoto Protocol, whose arrangements include a carbon emissions market. Human activities in various domains (industry, agriculture, livestock rearing, transport and so on) contribute to the production of greenhouse gases. Giri (1989: 161) notes that "*global warming is due to human causes: increased carbon dioxide in the atmosphere caused by heavy use of fossil fuels and the presence of CFCs in the upper atmosphere are amplifying the greenhouse effect around our planet*". The human causes of global warming have been established, and a temperature increase of about 0.74°C over the last 100 years has been observed.

We know that climate change is a global phenomenon that impacts on people's lives in different ways and to varying degrees. Its effects vary from one society and country to another according to their political, economic and social vulnerabilities, with multiple responses shaped by the technological and social capital of the communities concerned and the strength of their local and political institutions. This is why it is essential to take account of local specificities when selecting strategies to adapt to and mitigate the effects of climate change.

More research on adaptation to climate change in sub-Saharan Africa is needed, as the region's vulnerability is increased by factors such as political crises, degraded ecosystems and natural resources, susceptibility to health risks, weak economies and marginalization in international trade. The lack of recent data makes it difficult to take action to reduce the inevitable effects that climate change will have on already vulnerable communities, and there is a risk that its impact will undermine previous development efforts. But while there is no denying the threat posed by the spread and scope of the impacts of climate change, this is also an opportunity to frame development actions in a more global and long-term perspective.

Senegal has been particularly affected by the climatic disturbances and disrupted weather patterns seen across the Sahel since 1973, with unseasonal heatwaves and rains causing recurrent droughts in rural areas and flooding in cities. Declining agricultural yields have further eroded the fragile balance of household economies and local ecosystems struggling to deal with such calamities. People's capacity to adapt to this new situation – or more exactly, to the worsening situation – depends on their strategies for reconciling their interests and needs with available resources. A growing number of households and individuals are using mobility as a strategy to cope with deteriorating living conditions, adjusting the distance and duration of their movements to their needs. This study describes the role of migration as a strategy for adaptation to climate change and its interrelation with other strategies developed locally in four selected settlements: Nguèye Nguèye, Gandiole, the Senegal River Delta and Ourossogui.

It is also important to see mobility as a strategy for adapting to other socio-economic, political and cultural transformations. In areas such as Ourossogui and the Senegal River valley in general, migration is effectively a means of challenging social inequalities based on status, gender and generation.

This paper is divided into four sections, as follows:

- the issues, research questions and methodology;
- description of the context and study sites;
- strategies for adapting to climate change in the study sites;
- a review of policies on adaptation to climate change in Senegal.

I. The main issues, research questions, study objectives and methodology

1.1. The main issues and research questions

The three key elements in the concept of adaptation to climate change at the local level are:

- awareness of the impact of climate change on livelihoods and production systems;
- understanding the extent of its effects;
- the existence of endogenous adaptation strategies.

First, there is a growing awareness that the climate is changing and that this has a perceptible effect on local livelihoods and production systems. The adaptation strategies adopted reflect the particular history of each community. From this perspective, mobility is reinvented as a strategy for adaptation to climate change and used in conjunction with existing strategies.

It can be difficult to provide evidence of climate change, especially in developing countries where scientific expertise and climate data are not readily available:

> "*Climate change is an issue for which there is still limited experience in many countries, hence the need for a careful assessment phase, with its round of studies and analytical exercises. A strong analytical capacity needs to be built to address uncertainties in the science of climate change, to assess national circumstances with regard to climate change and to formulate long term strategies*" (Willems, Baumert, 2003: 14).

The premise that human activity has an impact on climate change has been established after a certain amount of scientific argument. It is now acknowledged that rising temperatures are largely due to the production of greenhouse gases (carbon dioxide, methane, nitric oxide, etc.), and are thus the result of human activities. But our knowledge of climatic upheavals and their effects on communities is still patchy. Rabourdin (2005: 22) notes that "*This disturbance is obvious at the local level. And although it is very difficult to accurately predict local weather conditions over several years, clear trends are emerging*".

Like other continents, Africa has been hard hit by the impacts of climate change. In his analysis, Terdiman states (2007: 142):

> *"The impact of climate change has already been felt in Africa, and we can expect its effects to become even more marked. In general, this will mean that areas which already had substantial rainfall – like the equatorial and sub-polar rain belts – will receive even more, while dry areas – such as arid sub-tropical areas – will get even less. The dry and semi-arid areas of northern, western, eastern and some of southern Africa will consequently become even drier, while equatorial Africa and the rest of the south will get wetter".*

Terdiman (2007: 142) refers to an article in the International Journal of Climatology in which Aiguo, Lamb, Trenberth, Hulme and Pinping show that the significant volumes of precipitation recorded in the Sahel in the 1950s and the droughts of the 1970s can be ascribed to climate change, as can the irregular alternation of floods and droughts (Desanker, 2002). The effects of climate change vary from one geographic area to another. According to Woodfine (2009:15):

> "*The severity of the effects of climate change on a given farm, locality, agro-ecosystem, country or region in sub-Saharan Africa vary according to a huge range of local, regional and international factors (FAO 2007a), including the extent of the change, the probability of change, the speed and duration of the change, and the tolerance and capacities of the system (ability to adapt). Because of the multitude of geographic, environmental, social and economic conditions across the continent, an effect could be beneficial for one social group but detrimental to another."*

Adaptation strategies are shaped by local economic and social conditions:

> "*The capacity to adapt is closely related to the level of development, and to every aspect of this development: the diversity of economic resources, technological capacities and human, financial and cultural resources, but also to social cohesion and the stability of institutions and political regimes* (Kergomard, 2009: 38).

Adaptation to climate change is also shaped by cultural factors. Willems and Baumert (2003) argue that certain cultural values make people more aware of long-term environmental threats. We need to identify those factors that have the most influence on adaptation strategies, such as poverty levels. In 2005, some 50.8 per cent of individuals and 42.6 per cent of households in Senegal were below the poverty line – or one in two people, and four out of every 101 households.[1] Many people in Senegal are still very dependent on primary sector activities like agriculture, livestock rearing and fishing, which are highly susceptible to climate change, and urban areas along its coast are threatened by sea level rise. Furthermore, the effects of climate change are also jeopardising the fragile achievements of poverty reduction strategies.

There is a relatively high risk that we will see significant proportions of the population tip into chronic poverty as a result of climate change. Our aim in this research is to answer the following questions: Which political, economic and social changes can be ascribed to climate change? And, where does mobility fit into the portfolio of strategies for adaptation to climate change?

[1] Republic of Senegal, 'Situation des OMD en 2008 et orientations stratégiques pour 2015', Final report, Ministry of the Economy and Finance, November 2009.

1.2. Study objectives

1.2.1 General objective

The general objective of this research is to analyse how, in conjunction with social, economic and cultural factors, the impacts of climate change can influence migration and mobility. The need for scientific clarification is clearly expressed in the preamble to the United Nations Framework Convention on Climate Change (UNFCCC), which reminds us that:

> "*The measures to help us understand and tackle climate change will have the greatest environmental, social and economic effects if they are based on appropriate scientific, technical and economic considerations, and are constantly re-evaluated in the light of new progress made in these domains*".[2]

It should also be noted that work in key sectors such as agriculture and the management of water, forest and fishing resources has shown that national and sub-regional institutions need to have databases on successful adaptations to climate change.[3]

1.2.2 Specific objectives

The specific objectives of this study are to:

- Identify the impacts of climate change on local people's lives, and the links between climate change and political, socio-economic and cultural transformations.
- Identify the mechanisms and adaptation strategies developed at the grassroots level.
- Evaluate the place and role of migration in different adaptation strategies.
- Determine the extent to which migration reduces or increases vulnerability to climate change and variability.

1.3. Study approach and methodology

This study is based on an empirical procedure that uses case studies in several regions of Senegal where climate change has had different impacts. This approach allows us to show how people's daily lives are influenced by climatic and environmental changes, and how local perceptions of climate change and its impacts are shaped by the political, economic, socio-historical and environmental context. This methodological approach enabled us to establish a link between specific adaptation strategies and specific local contexts.

Site selection criteria included the length of time since migration began, the extent and types of vulnerability to climate change, and the impacts of certain types of environmental decisions on changing ecosystems and ways of life (such as the opening of the breach on the Barbary Spit in the Senegal River delta to control flooding in Saint-Louis). This study covers the following sites: Gandiole, the delta in the Saint-Louis region, Ourossogui in Matam region, and Nguèye Nguèye in the region of Diourbel.

---

[2] Extract from the preamble to the United Nations Framework Convention on Climate Change, drawn up in New York on 9th May 1992.

[3] IDRC-CCAA, 2007, Workshop Report: Towards a Regional Strategy in Climate Change Adaptation: Sharing Knowledge on Climate Risks and Adaptation Options. UNECA/CCAA, Addis Ababa, April 16-20.

Data were collected through semi-structured interviews, life histories and focus group discussions. All were organised in the same way, with a general focus on local communities, leaders of women's associations, farmers' unions, village associations, women's groups, and sports, cultural and youth associations. Elected local officials, actors in the educational system, members of deconcentrated State services such as the heads of local development support centres (CADLs), veterinary staff, members of the forestry services and head nurses at district health posts were also interviewed. We used multiple sources of information in order to diversify and triangulate the data by comparing local people's views with those of other respondents, such as members of the deconcentrated and technical State services.

We also gathered information from national structures, international institutions, NGOs and local associations. These included the following: in Nguèye Nguèye, the Union Régionale des Associations Paysannes de Diourbel (URAPD), two EIGs, Jambaar and Deggo, and the Ndef Leng Association; in Ourossogui, a branch of the microfinance organisation PAMECAS, the milk-producing and processing EIG Kedam Sogui Montigny, and the Ballal Allah women's producer group (GPF); and in the River Senegal delta, the Amicale Socioéconomique Sportive et Culturelle des Agriculteurs du Waalo (ASESCAW). We were able to discuss and analyse local perceptions of ongoing changes and the formulation and execution of policies and programmes on adaptation to climate change with the people concerned during the data collection exercises.

All these data were supported by a literature review.

II. Study context

2.1. General context

Like many francophone African countries, Senegal faced a number of major challenges when it became independent in 1960. The first was building a nation-state despite the various institutional crises that threatened the political and social stability of the country in the early days of independence.[4] These troubled times were followed by a long period of political stability, until the rise of irredentism in the Casamance in the early 1980s.

Building a State raises the difficult question of governance in general, and natural resource governance in particular, as this largely determines the way that power is distributed and managed at the local level. In contexts of vulnerability and intense competition over access to and control of natural resources, sustainable development has emerged as an invaluable approach to resource management.

One of the key elements of this approach is reducing vulnerability, which entails taking social and political issues into account and making difficult choices in order to balance current requirements against the needs of future generations. The path to sustainable development requires the capacity to reconcile different interests, needs and opportunities for extraction with the need for renewal. The imperative to manage resources sustainably is no less important than the state of the resources themselves.

The second challenge for countries whose economies used to – and still do – depend on the primary sector was the need to maintain an acceptable level of agricultural productivity in the midst of changing climatic and environmental conditions. The droughts of the 1970s triggered a series of cyclical crises in Senegalese agriculture and weakened the national economy.

These droughts undermined the bases of food production (cereals), cash crops (groundnuts) and livestock rearing, with disastrous results for household economies; while the poor performance of groundnut crops contributed to the crisis in the national economy. According to Daffé and Diop (2004: 101)

> *"The crisis that gripped the Senegalese economy at the end of the 1970s was already perceptible in the faltering levels of groundnut production from the second half of the 1960s to the mid-1970s, and the closure of the West African market for the domestic economy. The decline in groundnut production and ensuing financial difficulties slowed the growth of GDP, which fell from 2.5 per cent between 1960 and 1970 to 1.8 per cent between 1975 and 1980. Taking the high level of demographic growth into account, growth in per capita GDP fell to less than 1 per cent".*

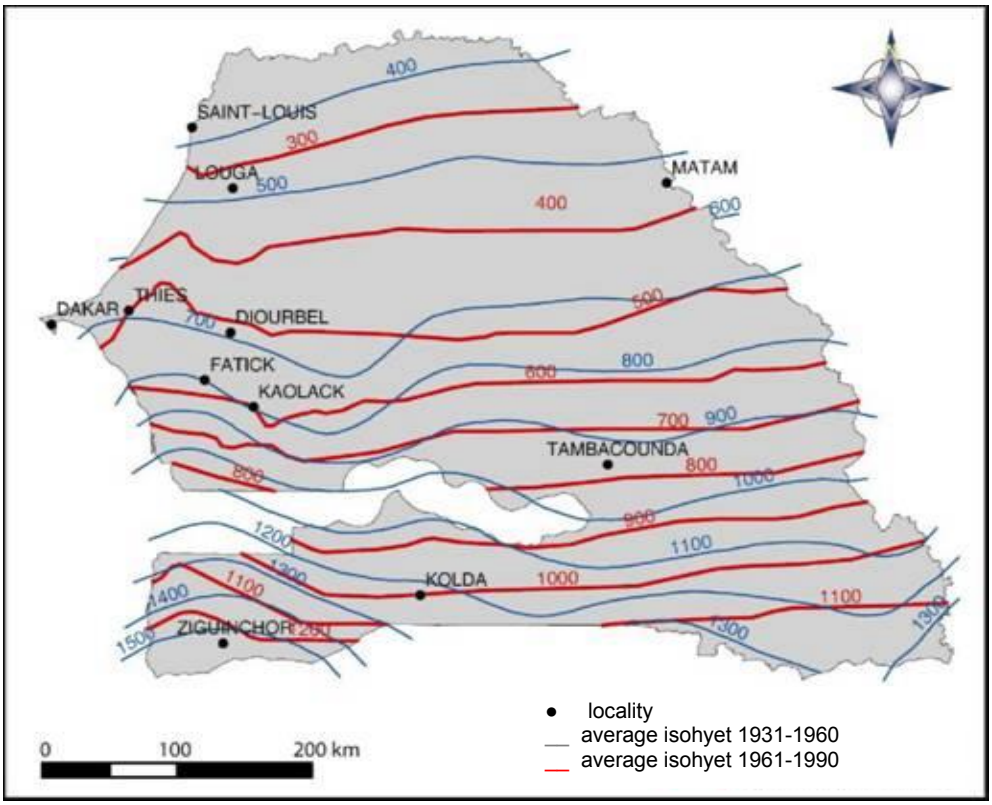
The increasing lack of rainfall during the drought years is illustrated in Map 1 below, which shows the evolution of isohyets over Senegal between 1931 and 1990. Overall rainfall has fallen by about 30 to 40 per cent in the last few decades as the isohyets have shifted from north to south, with particularly acute droughts in 1970, 1983 and 1984.

---

[4] The break-up of the Federation of Mali on August 20th 1960, and the constitutional crisis in December 1962 that led to the arrest of the head of government, Mamadou Dia.

The climate has become much more unpredictable in recent years, and alternating cycles of insufficient and excessive rainfall causing water stress and flooding have impacted on local livelihoods.

Map 1 : Evolution of isohyets between 1931 and 1990



Source: Saint-Louis Meteorological Office

The 1980s proved a difficult period for Senegal as it endeavoured to implement the stabilisation and structural adjustment policies advocated by the Bretton Woods institutions (International Monetary Fund and World Bank) as a means of rebalancing its macro-economic aggregates. However, as Diagne shows (2004:74), the drought of 1984 triggered a 40 per cent drop in revenues from groundnut production and compromised the efficient implementation of these policies, which did not help to improve the competitiveness the of Senegalese economy.

While Senegal's economy was slowing, its population was booming. The gradual decline in the total fertility rate (TFR) between the 1970s and the 1990s did not have a significant impact on demographic growth. The Senegalese fertility survey shows a TFR of just over seven children per woman, and the demographic and health surveys conducted in 1986 (I), 1992 (II) and 1997 (III) respectively show a TFR of 6.6, 6.0 and 5.7 children per woman. Combined with a progressive decline in mortality rates, this slight drop in fertility actually led to a significant natural population increase, and if the Senegalese population continues to grow at the last estimated intercensal growth rate of 2.4 children per woman, it will double every 30 years. This surge in demographic growth explains the relative youth of the Senegalese population as a whole, and the need for massive investments in social arenas like health and education.

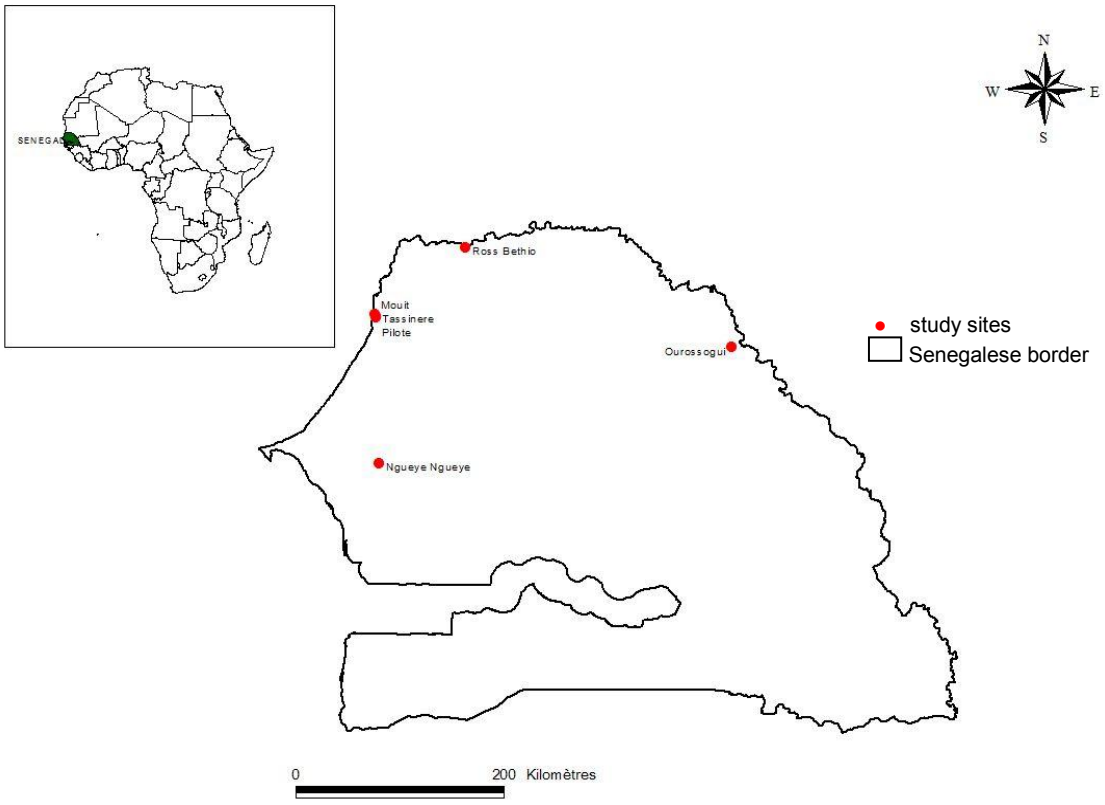
In short, Senegal has been in a difficult environmental, economic and social situation since the 1970s, characterised by changing climatic conditions, a troubled agricultural sector, a weak national economy and dislocated household economies. The general population initially used limited mobility to deal with these conditions, leaving rural areas for Dakar and secondary urban centres. The rate of urbanisation rose from 36 per cent in 1960 to 41 per cent in 2002, with most rural migrants naturally gravitating to shantytowns and unregulated residential areas. In the space of 15 years Dakar's population density nearly doubled from 2,707 inhabitants/km² in 1988 to 4,147 inhabitants/km² in 2002. The Dakar agglomeration now accounts for 0.3 per cent of the national territory, and is home to one fifth of the Senegalese population (RGPH, 2002).

Various policies regarding the creation of development poles, regional rural development agencies and a national land use plan have had a limited impact on the dynamics of internal migration. In fact, it is believed that rather than settling populations, development poles have helped accelerate internal mobility and contributed to the primacy of Dakar. On this point, Antoine (1995) confirms that "*contrary to what was hoped, it has been extremely difficult to redirect migratory flows into secondary towns*". Rural people seeking work outside the agricultural sector head for the national and regional capitals or to urban centres like Touba, "*looking to make money that they can invest back home*" (Philippe Antoine, 1995:6). Some migrants have made a strategic decision to settle in urban centres or spend extended periods outside Senegal. In the 1970s most stayed on the continent (in West and Central Africa) or went to Europe (especially France), but recent years have seen increasing numbers heading for southern Europe (Spain, Italy and Portugal) and the United States (Tall, 2009). Clandestine emigration has increased dramatically since 2006, with much of it aiming for the Canary Islands. Operating outside the law, this form of migration highlights the power of exploitative networks as well as the involvement of households, families and communities in migratory projects. Theories of the new economics of labour migration and of the 'social contract' of migration have been substantiated by the way that the resources needed to travel are mobilized. In a context of adaptation to climate change, it makes good sense for Senegalese households to send one or more members on migration (Tall and Tandian, 2010). According to World Bank estimates, Senegalese migrants transferred 310 billion francs FCA ($US 633 million) in 2004, a sum equivalent to 15.1 per cent of GDP - although the 2009 Human Development Report reduces this figure slightly to between 10.0 and 14.9 per cent. Most of this money is sent by migrants who have settled in Europe and the United States, which are now the top destinations for Senegalese migrants, especially women (Daffé, 2008:111).

2.2 The specific context of the study sites

The study sites were chosen to represent a range of ecological and geographic situations, which are affected by climate change in different ways.

Map 2 : Location of the study sites



Source: Report authors

2.2.1 Nguèye Nguèye, in the heart of the groundnut basin

The village of Nguèye Nguèye lies among the plains and plateaux of the rural community of Ngoye, 8 kilometres south of the main departmental town of Bambey. This is one of Senegal's most heavily populated rural areas, with a population density of 180 p/km². The Sérère are by far the largest ethnic group here (80 per cent), with a much smaller proportion of Wolof and Pulaar (20 per cent). The main activities are agriculture and livestock rearing.

The Sudano-Sahelian climate is dry, with a four-month rainy season. There are no major forest formations in the area, which is dotted with residual patches of thorny shrubs and some grass cover. This provides grazing until the end of the rainy season, when it disappears. Vegetation is poor and highly degraded due to agricultural and domestic activities, and there are a number of ongoing local initiatives to protect and regenerate ligneous resources to improve the situation.

There are some groundwater sources in the wetlands where livestock drink at certain periods. Most water in the locality comes from underground and is captured in boreholes, or the traditional wells still used in Nguèye Nguèye and many other villages in the territory. The main economic activities and sources of income are agriculture and extensive livestock rearing. Some households are able to boost their income through a niche market in cattle fattening, but most agricultural activity is subsistence farming, producing crops like millet,

cowpea and groundnuts for domestic consumption or sale in the weekly markets (*loumas*). Over 70 per cent of the land under crops is sown with millet.

2.2.2 Gandiole: an aquatic equilibrium disturbed by the impacts of the breach and climate change

Gandiole is a geographic area that includes several villages in the Niayes, a large swathe of the northern coast of Senegal known as the '*Grande côte*', which covers about 2,760 km² between Dakar and Saint-Louis. Located 10 kilometres south of the city of Saint-Louis, on the left bank of the Senegal River several kilometres from its opening into the Atlantic Ocean, Gandiole is bounded to the west by the Atlantic Ocean, to the south by the department of Louga, and to the north and east by the rural community of Gandon. It was part of Gandon until 2009, when it became a rural community itself. This study covers three villages in Gandiole: Mouyt, Tassinère and Pilote.

In physical and climatic terms, Gandiole is representative of the Niayes as a whole, composed of sand dunes interspersed with the depressions left by former valley beds. As in the rest of the country, there are two alternating seasons: a rainy season from July to September, and a dry season from October to June. Annual precipitation in this part of northern Senegal rarely exceeds 350mm, and this has declined as a result of climatic disturbances.

The microclimate in Gandiole differs from other areas in the same climatic zone in several respects. Trade winds and its proximity to the sea keep temperatures relatively low and within a moderate range, hitting a maximum of around 28°C in July and August and a minimum of 18°C from November to February.

Market gardening and fishing are the main sources of income in this community, which is predominantly Wolof. Until recently these complementary activities had huge potential and provided employment for 80 per cent of the active population. Most were active in both sectors, producing quite varied crops in their market gardens (onions, tomatoes, potatoes, aubergines, turnips and cabbage) and availing themselves of the freshwater and sea fishing opportunities on offer in the locality. However, the water has become saline since the opening of a breach in Saint-Louis, compromising both agriculture and freshwater fishing.

This is the result of emergency measures taken in 2003 to regulate water levels in Saint-Louis after good rains in the Senegal River basin generated huge volumes of floodwater. The authorities decided to open a breach in the Barbary Spit and dug a channel 100 metres long and 4 metres wide 7 kilometres south of the city to allow water from the river to flow into the sea. The breach has widened considerably since then, partly because the intensity of the swell and force of floodwater from the river has strengthened coastal currents, changing hydro-sedimentation and eroding the bed at the ends of the 'runoff canal'. The median segment was retained to create a channel in the bay where the currents are strong and the spit was 100m wide. When the breach was first opened on the night of Friday October 3rd 2003 it was 4 metres wide and 1.5 metres deep; by October 6th it was 200m wide. On October 8th, the level of the river dropped by 100cm, taking the water level in Saint-Louis to 94cm. By October 23rd the water was receding by an average of 17 metres per day, with 2,020m³/s discharged through a 329 metre-wide opening at Diama. Continued and substantial erosion to the south is accelerating the disappearance of *filaos* and dunes, and the breach is now estimated to be some 1,500 metres wide. The site of the 'runoff canal' is known as '*Beulbi*', which is also the name of the former opening in Taré up in Potou.

2.2.3 The Senegal River delta

The Senegal River delta is a typical delta ecosystem, characterised by very low topography and the ever-present influence of the ocean. The selected study zone includes the commune of Ross Béthio, which lies in the heart of the delta at the crossroads between the depressions of Djoudj and Ndiaël, in the transitional space between the floodplain and the drylands (*jejengol*). Ross Béthio was elevated to a commune in March 2009, and owes its socio-economic development to irrigated farming and agribusiness in the delta.

The delta is made up of sand dunes along the Walo and depressions that have been developed for irrigated agriculture (rice, tomatoes and sugar cane). Land in the *walo* is becoming progressively degraded due to salination and dwindling vegetative cover. Areas that are not seasonally flooded are particularly affected by the abrasive action of the winds. Known as Aeolian deflation, this removes the mineral-rich topsoil left exposed by the deteriorating vegetative cover (Sy, B.A., 2002).

Socio-economic development in the area is geared to irrigated agriculture and agricultural services. The State agricultural development company, the Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal (SAED), has undertaken several major hydro-agricultural development projects, promoting agricultural supply chains and intensive agriculture in order to shield agriculture from climatic risks and help local people adapt to climate change. The diversification of economic activities from the primary to the tertiary sectors, linking production, processing and marketing is part of this effort to make the economy less vulnerable to climatic risks. However, the growth of irrigated farming is detrimental to livestock rearing, since agricultural developments often obstruct grazing areas, and the use of pesticides makes it unsafe for livestock to drink from the canals.

2.2.4 Ourossogui: urban development in a harsh climatic context

The town of Ourossogui is located in the Matam region in northern Senegal, 420 kilometres from Saint-Louis and 693 kilometres from Dakar. "*The site on which it was established lies at the edge of the major bed of the Senegal River, which acts as a border between Senegal and Mauritania, and opens onto the vast expanse of 'diéri' drylands* (*poor quality sandy lands traditionally used by herders in the rainy season*)".[5]

Local soils (*dior*) at the foot of the plateau are favourable for rain-fed crops such as *féla* (a variety of sorghum), pearl millet and cowpea. Cowpea and sorghum are also grown as recession crops, and are particularly highly valued as they grow on the most sought-after silty soils. The cycles of drought that began in the 1970s have resulted in a dramatic fall in agricultural yields, forcing local people to move to other countries in order to increase their incomes.

Internal and international migration is a determining social factor in Ourossogui. Virtually every household has members scattered across western, central and southern Africa or Europe and the United States.

The population of Ourossogui is predominantly Halpulaar (about 88 per cent). They live alongside the second largest ethnic group, the Soninké, and a large number of Wolof who

[5] Sall M., Tall S.M., Tandian A. *et al.*, 2010, International migration, social change and local governance in Ourossogui and Louga, two small urban centres in Senegal**,** London, IIED.

have come in search of business opportunities or work in the services sector. Non-agricultural activities in the area have developed largely as a result of investment by migrants, especially those who have made money trading precious stones (diamonds and emeralds).

The local society is very hierarchical, with high-caste nobles at the top of the social scale, followed by free men, artisans and servant castes. This social hierarchy is reflected in land occupancy, with the most fertile agricultural land in settlement basins occupied by nobles, and less fertile land in the floodplain used by people lower down the social scale. These links determine people's varying degrees of vulnerability to the deteriorating agro-ecological conditions, and shape the adaptation strategies they develop in response to them.

III. Strategies for adaptation to climate change in the study sites

It is assumed that certain phenomena observed in the study sites – such as declining, irregular and erratic rainfall, changing temperature gradients and floods – are associated with climate change. All these phenomena increase the vulnerability of people who lack the ability to predict them or the resources to deal with them.

3.1 Environmental changes in the groundnut basin of Senegal

As its name suggests, the groundnut basin has long been the principal area for producing groundnuts, a cash crop that has been pivotal to the Senegalese economy. In recent decades this area has also been affected by deteriorating climatic conditions that have disrupted local livelihoods and led to the emergence of new adaptation strategies.

3.1.1 Perceptions of climate change and adaptation strategies in Nguèye Nguèye

Groundnut production is the main activity in the village of Nguèye Nguèye, which lies in the Diourbel region at the heart of Senegal's old groundnut basin. It has not escaped the agro-economic crisis in the basin, as degraded soils, dwindling pastures and declining rainfall have reduced the productivity of crops and livestock. The following extracts from focus group discussions and interviews with various actors from the village show that local people see a close relationship between these environmental changes and agro-pastoral production:

> "*Soil degradation has caused farmer incomes to fall and is compromising agricultural yields. And over-exploitation of soils and deforestation mean that there is no longer enough fodder or water in the area*" (T., second vice-president of Ngoye rural *council, member of the Diourbel Union Régionale des Associations Paysannes).*
>
> *"Resources used to be relatively plentiful. We had good harvests and no one had to leave the countryside at the end of the rainy season. There were lots of activities and cultural events. But we can't carry on living in the villages any more, and people who used to live off the land have to consider migration as an option." (P., vice-president of the Diourbel Union Régionale des Associations Paysannes, member of the Jambaar association in Nguèye Nguèye, and rural councillor for the rural community of Ngoye).*

Another phenomenon ascribed to climate change is the resurgence of certain epizootic diseases, which increases the vulnerability of local economies.

> "*Excessive rainfall encourages the spread of diseases like rinderpest, pasteurellosis and botulsim (….).*" (A., technical livestock officer and Head of the veterinary post in Ngoye).

> "*There's less fodder because of climate change, which means that herds can't spend more than four months grazing in the area. And too much rainfall causes more livestock disease. Although it was supposed to have been eradicated, we had cases of lumpy skin disease again last rainy season, which the animals must have caught on transhumance.*" (M., herder).

Local people are using a wide range of strategies to tackle these problems. Trade and livestock rearing seem to be helpful in reducing their vulnerability, and the latter is seen as an adaptation strategy in Nguèye Nguèye. Some people are trying to intensify their livestock-rearing activities by using modern techniques like artificial insemination.

> "*Everyone's trying to get by. We still grow crops and rear livestock, and the women run small businesses. Young people who are able to migrate are leaving, and those who stay behind work on agricultural activities, but there's nothing for them to do during the dry season*" (N., resident of Ngodjlème).

Some people are responding to climate change by switching to new activities like metalwork, woodwork, sewing or hairdressing; and women are obtaining micro-credit so that they can process local produce, making groundnut paste or preparing cereals sold on the weekly markets (*loumas*). The proliferation and development of these weekly markets has boosted foodcrop sales and changed the pattern of human movement and settlement in rural areas.

> "*A lot of young farmers stay in their village and supplement their income with some kind of trade; others move to Dakar in order to support their family back home…*" (T., second vice-president of Ngoye rural council, member of Diourbel Union Régionale des Associations Paysannes).

It seems that mobility is a strategy that is developed within the family. This form of adaptation has already been described by theoreticians on the new economics of labour migration like Stark and Bloom (1985), who demonstrated that sending certain family members on migration was part of a strategy to reduce the vulnerability of households. In the most extreme cases, this may empty the home:

> "*Sometimes everyone apart from the head of household moves away, in order to optimise the benefits of migration.*" (A., director of the school in Nguèye Nguèye).

Whatever form it takes, mobility fulfils several combined functions, making this strategy a powerful means of adapting to the impacts of climate change. Its first function is to mobilize additional or supplementary income to offset any shortfalls in agro-pastoral production. Its second function is to support income-generating activities developed at the local level (using some of the migrants' remittances), demonstrating the links and positive synergy between different forms of adaptation to the impacts of climate change. Its third function is to reduce the number of people in the households concerned, simultaneously increasing remittances and making it easier to manage domestic expenditure and reducing dependency ratios.

> "*Many families depend on transfers from members who have gone on internal or international migration to cover their food costs, build or modernise their homes, and help develop income-generating activities like livestock fattening*" (M. N., farmer).

"*Migrants help the families that have stayed behind in the village. But this help is often limited, and may amount to no more than a sack of rice every quarter. Very little money is sent back. However, their absence reduces the load on those who are left behind, which is why parents are keen for both their sons and daughters to migrate*" (B., founder member of the Jambaar association).

Like the transfers that they generate, adaptation strategies are selective. The wider community will only feel the expected effects of mobility as an adaptation strategy if there is interaction between the different households. As Ensor and Berger (2009: 27) show, social networks are crucial in linking the different elements of adaptation to climate change. Therefore, while mobility can improve the daily lives of certain households by enabling them to deal with situations caused by climate change, it can also increase socio-economic inequalities – and thus the level of vulnerability – between households with one or more migrants and those with none. This confirms the view that the impacts of climate change are unevenly distributed (Tanner and Mitchell, 2008: 8).

Other actors that we interviewed lamented the lack of structures that would enable them to better articulate strategies based on mobility with those pursued at the local level.

"*Migrants' contributions only go to their families. There's no association to harness their strengths and carry forward initiatives that would benefit the whole village*" (A., President of the Nguèye Nguèye ASC Deggo, and President of Goorgorlou EIG).

Certain strategies for adaptation to climate change involve technological innovations and awareness-raising and educational activities. These actions to improve educational and technological capacities at the grassroots level require institutional support from actors like the State, or NGOs that implement projects and assist local communities in institutionalising and appropriating adaptation strategies. For example, the Support Fund for Local Adaptation Strategies (FSSA) has enabled local people to build improved wood stoves, get training on composting techniques and rationalise their firewood consumption.

"*With the FSSA project, we found a way for women to be less dependent on cutting wood by introducing improved stoves. This has led to a marked reduction in woodcutting and thus helped improve environmental management"* (P., member of the Jaambar association management committee in Nguèye Nguèye, and an official on the livestock fattening committee).

"*The FSSA has supported adaptation strategies. We recently had training on composting to help improve our soils, and it has done a lot to help reduce household expenditure on gas and firewood through the use of improved stoves (…) I got funding to go into livestock fattening. Our incomes have increased because the training we've had has enabled us to improve our agricultural yields. We're better able to deal with climatic risks because our production system is stronger and we've diversified our activities"* (P., vice-president of the Diourbel Union Régionale des Associations Paysannes, member of the Jambaar association in Nguèye Nguèye, and rural councillor for the rural community of Ngoye).

In order to sustain these actions, local people have formed associations or economic interest groups (EIGs) like *Jambaar* EIG. These are trained by structures such as the Diourbel regional union of farmer associations (URAPD), which communicates and disseminates actions defined by projects such as the FSSA at the local level. The involvement of civil society organisations has helped communities implement strategies for adaptation to climate change, by promoting reforestation and encouraging collective reflection and action on

adaptation to climate change. URAPD supports local adaptation initiatives through micro-credit, income-generating activities (livestock fattening) and literacy programmes, and training on techniques for managing micro-projects and funding village saving and credit schemes.

These initiatives play an important role in local adaptation to climate change, but are not an alternative to income diversification based on more intensive mobility. The two are in fact complementary and mutually beneficial (Tacoli, 2009).

Photo 1 : FSSA improved woodstove project in Nguèye Nguèye

Source: Report authors

3.2. Perceptions of climate change and adaptation strategies in Gandiole

Although people in Gandiole had been aware of various environmental and economic changes for several decades, these have been amplified by the development of the Diama dam and the opening of the breach south of Saint-Louis. The Diama dam was developed to prevent the influx of salt water when water levels were low and to regulate the flow of the Senegal River, which had become very unpredictable as a result of irregular rainfall; the breach was opened to halt cyclical flooding that was threatening to submerge the city of Saint-Louis. These State interventions were intended to shield people from the vagaries of the climate and were part of broader efforts to adapt to climate change, but they have actually had several unintended impacts on local livelihoods.

The opening of the breach allowed waves to come in head-on from the ocean, eroding the Barbary Spit and changing the mangrove thickets.[6]

[6] Cheikh Tidiane Wade, Impacts des changements climatiques et des contraintes environnementales sur les migrations au niveau des zones côtières du Sénégal: cas des localités de la Langue de Barbarie, Malika, Camberène, Yoff et Rufisque, Groupe d'Etudes et de Recherches sur les Migrations, Université Gaston Berger de Saint-Louis, Concept Paper, 2009, 22 p.

"*This site has a lot of potential, but the ecosystem in Gandiole has changed radically. This is due to two major events: the creation of the Diama dam and then the opening of the breach. We used to have plentiful freshwater resources and could use rainwater on our market gardens for seven months of the year. Now that the breach is there all this water goes into the ocean and saltwater flows into the area south of the breach, reaching farms within a 5km radius of the Barbary Spit. The currents have swept away the replanting that was done along the riverbank in 1976, accelerating erosion and threatening to destabilise the dunes. Wind erosion has worsened, some species of fish like mullet have become rare, and certain species of water bird are leaving the area because the island where they used to lay their eggs is shrinking*" (P.C., President of Gandiole Rural Council).

In fact, the effects of climate change were evident long before the breach was opened. Environmental changes that are attributed to climate change include soil salinisation, increases in the incidence and violence of winds, the disappearance of certain species of vegetation and fauna, fewer migratory birds, rising temperatures and changes in the timing of the seasons:

"*The river has got wider in certain places and is silted up with sand in others due to wind erosion. The Barbary Spit has also become much narrower and the floodplain has shrunk: this is due to climate change*" (M., President of the Association des Ecoguides).

These changes have had a significant impact on living conditions in Gandiole, and are compromising the traditional activities on which local livelihoods depend. As a result, some people have had to switch to other occupations and sectors:

"*I used to grow onions, but then the land started to become degraded, and now you have to go further and further away to find cultivable land. People who can't afford to rent land are having to stop farming and fall back on activities like trading, weaving or dyeing*" (S., farmer).

"*When you've spent more than 30 years in one occupation it's hard to learn a new one. Incomes have fallen drastically and some people have had to abandon their traditional activities. Everyone in the supply chain is affected. Women used to buy seafood from the fishermen and then prepare and sell it (…) Dwindling fishing resources and declining agricultural production have sent prices sky-high. This puts a strain on household incomes and people are getting poorer (…) which means that they can't save*" (A., resident of Gandiole).

The opening of the breach is often identified as the catalyst that accelerated the disruption of the local economy. By affecting activities based on fishing and market gardening, it has amplified impacts that were already being felt and attributed to climate change:

"*The changes have been noticeable for some time. It's getting hotter and the seasons have become irregular. But the main problem in Gandiole at the moment is the breach"* (M. A., resident of Gandiole).

"*The new opening has caused a lot of problems. The breach destroyed many houses and the mixture of seawater and river water ruined the ecosystem. Many species of fish have disappeared. Salinisation has reduced agricultural production, and loads of people have moved to fishing areas like Kayar, Joal, the Casamance, Lompoul and Mboro because of the situation here*" (El H. A., fisherman).

Some migrants earn enough during the season to buy fishing equipment, while others fund family members' commercial activities or invest in transport. The desire to continue to pursue agricultural activities seems to be due to the farmers' determination to hang on to their land – even if it means hiring farm labourers.

> "*Migrants are a very important part of local life. They enable families to pay farm labourers, and they've helped urbanise the area (…) They send money to their families and help them at times like Tabaski*" (F., relative of migrants).

> "*Young people lost heart when the land became saline. They didn't want to stay in the village, so their only option was migration (…). It's a good thing, because migrants send money to their families and participate in community development by building places of worship and equipping health centres (…). They build houses and support their families. And migration encourages the development of sectors of activity like stonework and woodwork, etc. Some of the people who left here in canoes (pirogues) play an important role in the locality now*" (N., President of Diappo Liguey EIG).

One aspiring migrant told us:

> "*I've set off for Spain twice in a pirogue. I never got to Europe, but I'll try again if I get the chance. We want to go because we think there are more opportunities in Europe*.
>
> *Things are organised a bit differently with the pirogues. Some people go to Mauritania first, then to Algeria or Morocco and on to Spain or Italy. Loads of young people go to Spain. These migrants help support their families; lots of families in Gandiole use their remittances to cover their needs. And migrants build houses too. It takes much longer to succeed if you stay in the village. So many young people set off for Spain in pirogues in 2006 that almost every household in the village has someone who left like that (…).*"

Migration offers a way out of the crisis, making this form of mobility a central element of adaptation to climate change. As in Nguèye Nguèye, transfers from migrants help support families and improve their level of consumption and quality of housing; they also help develop income-generating activities like transport, crafts, building services, etc. So there is a positive link between mobility as an initial strategy for adapting to the effects of climate change and other strategies that use the resources it generates. Transfers are also used to create community infrastructures that improve well-being in the locality, such as health centres.

Mobility has an impact on local social dynamics too. The men's departure has drawn women out of the private sphere in which they used to be confined, and prompted them to invest in production chains. The money transferred by migrants gives certain women access to financial capital and enables some to hire farm labourers to compensate for offspring who have gone abroad. Other women have started harvesting salt in Gandiole since the opening of the breach caused salination.

> "*Women used to spend most of their time doing housework. Now they're involved in lots of activities like men, such as trading, market gardening and processing seafood. They can get micro-credit through their groups, which helps them increase their household income*" (A., member of the Association des Ecoguides).

"*It used to be men who employed farm labourers in their fields; now women are doing it too. They can also earn money collecting salt, which is not something men do. This is a longstanding activity in Gandiole, but it has developed a lot recently*" (M., President of the Association des Ecoguides).

Farm labourers make up for the shortfall in local labour caused by young men leaving for places like Kafountine, Elinkine, Diogué, Goundioure, Karabane, Kayar and Joal. Many young Africans who want to emigrate clandestinely pass through Gandiole, where they are hired to water the crops in market gardens while waiting to try their luck in Europe.[7]

People in Gandiole are developing different adaptation strategies to deal with the situation. Some see migration as the only solution to their problems, while others maintain that the answer is to rehabilitate agriculture and fishing. Most of the proposed new activities are related to tourism, which offers various opportunities and would benefit from links with other activities:

"*We need to try to rehabilitate sectors of activity like agriculture and fishing. We should also encourage women to attend training on dyeing and sewing, and develop micro-finance. That would enable people to stay in the area and create opportunities to facilitate access to land and develop a market for local produce. We need to invest in tourism-related activities, by setting up restaurants and getting pirogues for guided tours. These activities could be facilitated through local community structures like EIGs*" (F., member of Dekh-Gui EIG).

A number of national and international structures are working in partnership with local people and supporting them through development programmes. These partners include the Communauté Engagement Service Volontariat (CESV), the Global Environment Facility, the rural communities support programme, the African network for integrated development, the Agence Nationale de Conseil Agricole et Rural, the National Society of Planning and Land Use in the Senegal River Delta (SAED), Plan International, the Poverty Reduction Support Programme and the regional development agency, Solidarité internationale et Coopération décentralisées Sud-est toulousain (SICOVAL) and others. They support local organisations like the EIG Dekh-Gui (the river), which grants loans to women for market gardening, and are using different strategies and activities to help residents stay on their land:

"Savings and credit associations allocate funds to women. They use the money to process fish products or set up small businesses, and the rural council plans to allocate land to women who want to invest in market gardening" (A.M., member of Dekh-Gui EIG).

[7] Serigne Mansour Tall and Aly Tandian, 2010, 'Regards sur la migration irrégulière des Sénégalais: Vouloir faire fortune en Europe avec des pirogues de fortune', Consortium for Applied Research on International Migration (CARIM), Florence, 22 p.
Aly Tandian, 2007, 'Barça ou Barsaax (*Aller à Barcelone ou mourir*): le désenchantement des familles et des candidats à la migration', *DIASPORAS. Histoire et Sociétés*, n°9, pp. 124-137.

Photo 2 : Produce from a salt marsh between Tassinère and Ndiébène Gandiole.

Source: Report authors

3.3. Perceptions and adaptation strategies in the Senegal River delta

Given Gandiole's proximity to the Senegal River delta, it was entirely foreseeable that some of the environmental changes observed in the first site would be seen in the latter. And like the residents of Gandiole, people in the delta are also feeling the effects of climate change:

> "*The first signs of climate change in Ross Béthio were differences in the flow of the seasons. The main change is the shift in temperature ranges, which has altered the cropping calendar. This puts dry season crops at risk, and the lower temperatures are bad for rice.*" (M. D.).

These climatic disturbances are affecting production and people's ability to make savings:

> "*Yields have really gone down this year. We used to be able to get up to 10 tonnes per hectare in the dry season, now it's about 3.5 tonnes per hectare. And it's not just rice growing that's affected by climatic variability; we're feeling the consequences in market gardening too. The cold dry season in this sector lasts from December to March, and if the hot weather starts too early we get loads of insects that damage crops and reduce yields*" (M.D).

Unlike other regions of Senegal, rice growing is combined with market gardening in the delta thanks to irrigation, which has played a key role in shaping farming practices in this area. However, these activities require a strict agricultural calendar, and this is being disrupted by climatic changes that local people cannot anticipate due to a lack of relevant scientific information.

> **"***Climate change is disrupting the cycle of the seasons, and we no longer know when the best time to sow is. In principle, March should be in the cold season. Last year, the dry season was very short and the rainy season started early. The rice fields*

were flooded with rainwater and farmers had to harvest in the middle of the rains, which caused a lot of arguments" (B.A.).

These agro-ecological disturbances have caused yields to fall from the levels of the 1990s, and poor harvests mean that farmers who obtained loans from savings and credit schemes at very high rates of interest (12 to 15 per cent) are running into debt. While some people are opting to move elsewhere in order to deal with the situation, there is also an inflow of migrants seeking work as farm labourers in the delta.

"*Many young people from the town have emigrated to Europe, but we've also got people from remote areas in the Walo or other regions of Senegal and neighbouring countries (Guinea, Mali) coming in to work in the agricultural sector (…) Villages like Thiéniène are deserted in the growing season as their residents come to winnow rice after the harvest*" (M.D.).

The National Society of Planning and Land Use in the Senegal River Delta (SAED) provides institutional support in developing strategies to revitalise irrigated farming in the Senegal River delta. Its first mission was to develop the irrigated areas and train farmers, but collaborative difficulties prompted small producers to seek alternative solutions and this led to the formation of the Amicale Socioéconomique Sportive et Culturelle des Agriculteurs du Waalo (ASESCAW), a powerful farmer NGO whose presence is felt everywhere in the delta. Farmer associations now play a key role in marketing and varietal diversification, and act as an interface between producers and partners (intermediation).

3.4. Perceptions and adaptation strategies in Ourossogui

Migration has always been a key component of livelihoods in the valley, especially seasonal migration. It began when a colonial policy abolished the payment of taxes in kind and instituted cash payments, which meant that people in the Fouta had to move to urban areas or the groundnut basin to earn money as waged farm labourers. This probably explains why migration naturally emerged as a primary strategy for adapting to the severe impacts of climate change in this area.

3.4.1. Economic and social change in Ourossogui

Until the early 1970s, agricultural activities in Ourossogui followed a calendar that had not changed for centuries. After the first major rainfall (*ngatamaré*) farmers would sow fields on poor quality, dry sandy land (*diéri*), usually with millet (a variety of known as *féla*), groundnut and cowpea (short-cycle beans). Women had gardens (known as *ndambédji*) where they grew groundnut, cowpea and condiments to improve the quality of their meals. Other growing practices, such as turning the earth and setting seeds that would grow after the first rains (*ouldé*), reflected the regularity of the rainfall and absence of climatic hazards.

In October, when the floodwaters that fertilised the land had receded, farmers would turn to their fields on the floodplains. This was the most sought-after land for agricultural activities, and was mostly located in settlement depressions and alluvial plains (*koladé*). For centuries it belonged to members of the Yirlaabé clan in Ourossogui and Ogo, whose landholdings (*djey*) extended as far as the gates of the neighbouring town of Matam. Some of their land was incorporated into Matam's territory when the administrative authorities ordered the official demarcation of its municipal boundaries, but it seems that they never claimed their customary rights to this land.

The village would empty as everyone went off to cultivate flood recession crops in the depressions and alluvial plains. This temporary migration was known as *kournal,* when villagers went to tend their fields and try to limit the damage done by granivorous birds and wandering livestock. They combined these agricultural activities with rearing cattle and goats, and women from Ourossogui would sell or trade milk products in Matam. This association with pastoralism explains why the first thing that emigrants from Ourossogui invested in was livestock, especially cattle. Climate change began to have long-term impacts on this agrarian economy when a cycle of droughts hit the Sahel in the 1970s, and a particularly severe drought in 1973 prompted the first waves of mass migration.

Yet we should not forget that migration from this area started in the colonial period, when the colonial authorities demanded tax payments in cash rather than kind and youth and adults started heading for the groundnut zones of central Senegal or for Dakar and other urban centres. Most of these migrants ended up as waiters in hotels and restaurants, where successive generations of Ourossoguis have since found work. Before various African nations gained their independence in the 1960s, some migrants went on to Abidjan or moved into more lucrative sectors like the diamond trade. A whole generation of migrants from Ourossogui and the surrounding villages have tried their luck in this field, with varying degrees of success. The locality's recent history and economic and social development are inextricably linked with the careers that some former residents have forged trading diamonds and precious stones, particularly emeralds. Their travels have taken them to the diamond mines of Séguéla in Côte d'Ivoire, Kafanchan in Sierra Leone, Mbuji Mayi and Léopoldville in the Congo, and to Angola. Some traded Zambian emeralds and Madagascan tourmaline, and several married Zambian women, who they brought home along with their offspring. The precious stones were resold in various cities around the world, such as Tel Aviv, Geneva, Toronto, Anvers and Bangkok, and much of the urban, economic, political and social change in the locality has been driven by such dealings in diamonds and gemstones. It could be said that this migration to African countries was the first strategy in adapting to drought and the destabilisation of local economies based on foodcrop production and extensive livestock rearing.

3.4.2 From vulnerability to adaptation to climate change in Ourossogui: a historical perspective

It is important to have a historical perspective on the levels of climatic and environmental vulnerability in and around Ourossogui, and on the way people have gradually adapted to it. The agrarian economy in Ourossogui, which depended on rainfall for crops on the *diéri* and floodwaters for those on the floodplain, was very vulnerable. Poor (insufficient and irregular) rainfall compromises production in the *diéri* as lack of water after the first rains (*ngatamaré*) and sowing causes the young shoots to wither (*hokéré*); while crops on the floodplain suffer if flooding is insufficient or very short-lived (lasting for just a few days). Farmers believe that the land needs to be submerged for at least a month to absorb sufficient water and nutrients to sustain crops.

A cycle of droughts in the early 1970s that peaked in 1973 made it impossible to grow crops, drained local household economies and prompted a mass exodus to Dakar and other African destinations: Côte d'Ivoire to the west, Gabon, the Central African Republic and the two Congos in Central Africa, Burundi in East Africa and Zambia in South Africa. These destinations were certainly chosen with a view to the trade in diamonds and other precious stones. The better-off headed for France, where no visas were needed and demand for labour in national industries like the famous Flins Renault factory in Yvelines was high; hence the large number of migrants from the middle Senegal River valley in places like

Mantes-la-Jolie and les Mureaux. The last village chief before Ourossogui became a Commune is a former civil servant, for whom migration from the locality in the last 50 years can be divided into four periods:

> "*Initially, in the 1970s, the main destination was West Africa, especially Côte d'Ivoire; then in the 1990s it was Central Africa (Gabon, Congo, Zambia etc.); by 1994 most people were heading for Europe, and since 2000 it's been the United States. Most emigrants go through Central Africa, whether they're going to Europe or the United States.*"

These migrants help reduce the vulnerability of households in Ourossogui, as some of the money earned from international migration is invested in herds of livestock, especially sheep. However, the realisation that such '*wealth on the hoof*' (*diawdi ndarindi*) is also vulnerable to climate change and drought prompted a shift to investments in "*resources that don't decay*", such as houses.[8] This investment in property was the catalyst for urban development, which in turn drew numerous incomers into the area, especially from Baol. Thus, while the drought drove large numbers out of Ourossogui on international migration, the consequences of their departure attracted other people who had also chosen mobility as a response to changes in their environment and living conditions. As one trader from central Senegal remarked, "*... Baol used to be a highly developed area, but the drastic fall in agricultural production has prompted people to migrate in search of a better life*."

3.4.3. Perceptions of climate change in Ourossogui

Most of the people we spoke to cited rising temperatures, shorter rainy seasons, lower rainfall, dwindling vegetative cover and declining soil fertility as evidence of climate change. The municipal secretary, M.N.L., explained:

> "*The rains are more irregular and rainfall is lower. This reduces agricultural production and grazing for livestock, and has made living conditions difficult. Agricultural production activities are gradually disappearing, and people have to find alternatives in order to survive, such as emigration or activities in the commercial and services sectors. In the past it was older people who emigrated, but as living conditions have become more difficult lots of young people are leaving to try their luck elsewhere*."

This was confirmed by a trader, I.K.: "*Our living conditions have changed radically. People used to grow crops and raise livestock, but they've had to abandon these activities because they can't survive on them any more*."

Some people see a direct link between these observed phenomena and climate change. The head of the local development support centre in Ourossogui, M.M.B., told us:

> "*The impacts of climate change include lower rainfall, higher temperatures, degraded vegetative cover, erosion, etc. And agricultural production has fallen too.*"

[8] Sall M., 2004, Acteurs et pratiques de la production foncière et immobilière à Ourossogui (Sénégal), UCL, Presses universitaires de Louvain, June, p. 137.

A trader who settled in Ourossogui in the 1980s also sees this causality:

> "*(…) We could say that the current levels of migration are caused by climate change, as it has had such enormous consequences for local living conditions. (….) Rainfall is lower and scarcer, vegetative cover is degraded and soils are impoverished. Temperatures are rising, and the seasons have virtually disappeared - there's no longer a proper cold season.*"

These changes seem to have accelerated over the last two decades, in that they have even been noticed by people who do not originate from Ourossogui. According to this same trader, "*temperatures are very high in Fouta, there are sandstorms and the vegetative cover is constantly declining. The rainy season used to last at least three or four months but it's become very short now, with irregular rains. And the trees are disappearing too*"*.*

Awareness of climate change is growing in Ourossogui as the local environment becomes less productive and increasingly inhospitable due to major changes such as rising temperatures, lower rainfall, impoverished soils and dwindling pastures.

3.4.4. Views on adaptation to climate change in Ourossogui

Almost everyone we spoke to maintained that the sole response thus far to changes in their environment and living conditions has been migration. This is probably largely due to their local history: since migration was already common practice, it seems like a natural solution to the problems caused by deteriorating living conditions. Some see it as an easy option for those who can afford to migrate, highlighting the selective nature of this adaptation strategy.

> "*People's strategies for adaptation aren't sustainable, because they go for the easiest options. There's lot of emigration from Fouta because people help younger relatives who have chosen migration as a means of adaptation. To a lesser extent, they also support activities in the commercial or services sectors. But this has a negative knock-on effect on agricultural activities. Young people in the area don't feel that they're getting proper support from the State in developing sustainable agriculture, so they're convinced that emigration is the only way to succeed*" (M.M.D., local development officer in Ourossogui)

Some of the most dynamic emigrants from Ourossogui have helped establish solid development links between their new place of residence and their hometown. A good example of this energy is the creation of the Association de Développement de Ourossogui (ADO), which has been at the heart of decentralised cooperation in the area. It led the cooperation between Ourossogui and the Ardèche-Drôme, which has had a significant influence on local development plans (formulation of the local development plan) and the establishment of local amenities such as the new market in Ourossogui. Analysis of institutional relations in the area also indicates that the municipal authorities are showing greater interest in political planning and the ADO, and through it, migrants' associations. Local emigrants are certainly behind initiatives like the one that led the town of Montigny to support a group of young people who wanted to set up a dairy:

> "W*e got together to deal with these difficulties, and set up monthly subscriptions that would enable us to start an activity. An emigrant from the town who is a local elected official in Montigny acted as an intermediary and found partners who have agreed to fund a milk processing unit*" (S.B. milk processing unit).

Although the sustainability of the adaptation strategies in Ourossogui is open to question, since migration is still the main strategy for adapting to climate change, it should be noted that migration not only offers a financial lifeline but also provides social support in areas like health and education:

> "*Migrants' associations play an active role in improving services in sectors like health, education and culture, trade, ICT-related occupations and construction. Most traders and stonemasons come from Baol. Every adaptation strategy is born out of the need to deal with socio-economic change and changing modes of production. But migration does little to support other activities like agriculture, trade or livestock rearing. Migrants invest more in building because of the social prestige it brings."* (E.B.D, last elected village chief of Ourossogui, and retired civil servant)

It is clear that international migration has been a strategy to compensate for the lost revenues previously generated by agriculture, through the remittances that migrants send home. The manager of the Ourossogui branch of the micro-finance mutual association PAMECAS claims that migrants transfer huge sums of money

> "*Migrants send back an enormous amount of money. Every month PAMECAS (the partnership for the mobilisation of savings and credit in Senegal) transfers 12,000,000 francs CFA through Money Express and 4,000,000 francs CFA through Money Gram"* (O.S.).

And this doesn't include the money sent by post and other informal circuits, which is believed to amount to much more. Nevertheless, this financial bounty has still failed to produce sustainable solutions to the challenges posed by climate change and environmental problems. The flow of remittances that keep domestic economies afloat can only be maintained through constant international migration, and it is becoming increasingly difficult to meet the conditions for its renewal. We know of households whose survival depends on these 'transfusions', but such transfers are tying households to an economy of consumption that is not connected to local production. According to one head of household, E.B.D.:

> "*Agricultural produce accounts for a very small proportion of household consumption. We're increasingly part of a monetary space that revolves around the power of money, moving from a productive society to a consumer society. Families tend to get their supplies from the market rather than subsistence agriculture.*"

S.B., who manages a milk-producing EIG, agrees:

> "*Most food was locally produced in the past, but now people have to get their ingredients from the market. This makes life very difficult, because money has become the only means of living decently. The only way people can manage is by getting together to survive, which is why we created an EIG to develop income-generating activities.*"

On another level, the use of migration as an adaptation strategy has increased land insecurity and made local people more vulnerable, because international migrants are feeding land speculation. Much of the land that has been parcelled up and sold off for development is former agricultural land. For example, the new neighbourhoods Moderne 1, Moderne 2 and Moderne 3 were all built on rural land that has been transformed into urban land. According to E.B.D.:

"*Traditional landowners have seen their land expropriated in order to extend the town. Land that used to be used for agriculture and rearing livestock has been parcelled up and sold off for development. And this land is usually acquired by incoming migrants rather than local people.*"

3.4.5. Supporting local efforts to adapt to climate change

Partner organisations are backing local actions to adapt to climate change. The ZARESE project, which is supported by the Italian cooperation, is involved in reforestation activities, protecting village woodlands and building basic social infrastructures to protect the environment and improve local living conditions. Decentralised structures are also working on capacity building for women, especially in the field of environmental protection:

"*We have been able to deliver capacity-building training for women, help set up committees to prevent bushfires, and provide assistance in preparing and submitting funding applications. At the moment we're considering a multi-actor partnership that will be responsible for local development*" (M.M.B, head of Ourossogui local development support centre).

This training enables women to harness the positive synergy between policies on adaptation to climate change and the social changes needed for development. As men leave the area in response to the increasingly arid conditions, it is up to the women who are left behind to grasp any socio-economic opportunities that arise. They have taken up various production activities, such as modern livestock rearing (artificial insemination) and milk production and processing, with support from several agricultural development projects and NGOs. The micro-finance institution PAMECAS works on a broader range of initiatives, and even has some projects that encourage migrants to return to their home towns:

"*Our overall strategy is to offer various forms of support. We have developed different types of credit for emigrants – for livestock fattening, trade, agriculture and transfers – so that they can prepare for their return or manage their investments. In addition to individuals, we work with the local consultative framework for producer organisations (CLCOP), which brings together producers and emigrants, and we've also got what we call 'insertion products' that we're developing with young people and artisans*" (O.S. PAMECAS official).

To ensure that their strategies are sustainable, people need to make a link between migration, which is the main adaptation strategy in Ourossogui, and other strategies that will enable them to adapt to changes in their climate and living conditions. This raises questions about the logic behind emigrants' investment strategies:

"*Emigrants are also big savers; they deposit huge sums with traders for household emergencies. Migration does help with development efforts, but it's a shame that emigrants don't create employment as they have the financial capacity to create small and medium-sized enterprises*" (E.B.D.).

There is a clear need to sustain what has been achieved as a result of strategies developed at the local level, and for policies to support them. Local strategies need to be framed and regulated by the local municipal authorities. Migrants who have left in response to the drought-induced decline in rain-fed and floodplain agriculture have invested hugely in property in areas set aside for rain-fed crops, and successive municipal teams have supported this process of urbanisation to the detriment of foodcrop production. This process

needs to be regulated and viewed in the long term in order to avoid the risk of irrevocably disconnecting agriculture from the local economy, increasing the vulnerability of poor social groups and generating new forms of mobility for those with no other option but to head for large urban centres like Dakar.

IV. Review of policies on adaptation to climate change in Senegal

Local economies in Sahelian countries have always been largely agrarian, and therefore susceptible to climatic hazards. History shows that the demographic disruptions and economic crises they have undergone are invariably associated with climatic phenomena like drought. Local people have also always had the capacity to adapt to these adverse situations and mitigate the effects that climatic hazards have on their daily lives. Mobility has emerged as a key element of local strategies for adapting to changing living conditions. In his work *Une histoire des famines au Sahel: Etude des grandes crises alimentaires (XIXe-XXe siècles)*, Gado (1993) notes that leaving the area on what he calls 'exodus from hunger' has been a common response to famine in the Sahel since 1870 (Gado, 1993: 74). He writes about one of these famines:

> "*An incalculable number of Sahelian farmers and herders left their home territories during the 1900-1903 famine. When food resources are exhausted and there is no hope of survival in the area there is only one solution: to leave*" (Gado, 1993: 74).

Mobility also played a central role in local responses to the droughts endured by Sahelian countries in the 1970s. These droughts marked an important landmark in the history of migration in Senegal, and the Senegal River valley in particular. At a higher level, national governments across the region attempted to put in place policies and programmes that would help shield their populations and domestic economies from the crisis.

How did the adaptation strategies developed at the local level, which often entailed various forms of mobility (internal and international migration by youth, women, etc.), fit into these policies and programmes? In order to be effective and sustainable, such government initiatives clearly need popular support from communities for whom migration remains the best adaptation strategy. To what extent can policies support this mobility as an essential component of adaptation strategies?

4.1. National policies of adaptation to climate change

The agro-ecological crisis in 1973 prompted the formulation of a sub-regional policy on measures to combat drought. Although little was known about the effects of climate change at the time, and the term 'climate change' had yet to become common in political and scientific discourse, the national policy responses formulated by Sahelian countries could be seen as the very first policies on adaptation to climate change, prepared ahead of their time. When the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) was created in September 1973, member countries, which included Senegal, decided to engage directly in the battle against desertification by reducing food insecurity and promoting viable domestic energy strategies. Education and training are also important levers in CILSS policy, and CILSS plans to develop a dedicated Masters programme on 'Agricultural adaptation to climate change' as part of its training arm, AGRYHMET.

An organisation focusing on coordinated management of the Senegal River basin had been created a year before CILSS was established: the Organisation pour la Mise en Valeur du fleuve Sénégal (the OMVS, or Senegal River valley development organisation). This took

over from several bodies, the oldest of which was the Mission d'Etudes et d'Aménagement du fleuve Sénégal (MEAF) dating from 1934, and the youngest the Organisation des Etats Riverains du fleuve Sénégal (OERS), which was created in March 1968 in Labé in the Republic of Guinea. In the absence of any mechanisms to predict the adverse effects of climate change on agricultural economies, the creation of these organisations could be seen as part of efforts to adapt to climate change and its effects.

Referring to the specific case of national government initiatives to combat desertification, Ndiaye (2002:101) notes that:

> "*One of the State's permanent strategies is to slow the adverse processes that will occur at territorial levels across the continent over very long periods. Although the discourse mainly concerns actions and results, over the last three or four decades efforts to combat desertification have emerged as the emblematic strategy whose most eloquent expression is Senegal's participation in sub-regional organisations like the Interstate Committee for Drought Control in the Sahel* (*CILSS)*."

In addition to participating in CILSS, the Senegalese government has also ratified various conventions and signed international protocols aimed at reducing climatic adversity. These include:

- the Abidjan Convention on cooperation in protecting and developing coastal areas, and its protocol on cooperation in combating pollution in critical situations, which came into force in 1984;
- the Vienna Convention and Montreal Protocol on substances that deplete the ozone layer, which were ratified in 1993;
- the Convention on Biological Diversity, ratified in June 1994;
- the International Convention to Combat Desertification in countries experiencing severe drought and/or desertification (CCD);
- the United Nations Framework Convention on Climate Change (UNFCCC), ratified in 1994;
- the Kyoto Protocol in 2001.

Despite these commitments, adaptation to climate change is a relatively recent addition to the political agenda in Senegal. The National Environmental Action Plan of September 1997 makes no mention of adaptation to climate change in the section on 'Structural approaches to sustainable development', even though Senegal had ratified the UNFCCC in June 1994. However, a National Implementation Strategy (SNMO) was formulated in 1999 with support from the international community in general, and the Global Environment Facility (GEF) in particular, which assisted the Senegalese government in anticipating and resolving problems associated with climate change. The SNMO is a tool that should respond to the country's development needs while taking climate change into consideration. It objectives are to:

- incorporate concerns associated with climate change in development policies;
- strengthen national capacities through institutional support and human resources training;
- identify mitigation and adaptation strategies for vulnerable sectors of society;
- design projects to mobilize available financial resources;
- establish databases on climate change;

- inform, educate and involve all actors.

In order to achieve these objectives, the SNMO examines:

- the institutional framework of the UNFCCC and the Kyoto Protocol;
- different national policies and priorities in key sectors, in order to determine the extent to which they take account of or can incorporate climate change;
- the key findings of studies on climate change undertaken in Senegal;
- the measures and policies that need to be implemented in order to better integrate climate change into development policies;
- mitigation and adaptation projects that could support State initiatives.

The SNMO can be seen as an innovative instrument in terms of policies on adaptation to climate change. This strategy, which was developed with financial support from the GEF and assistance from UNITAR, is innovative in that it deals with several aspects of climate change that need to be understood and managed in order to frame and support efforts to adapt to climate change.

It starts by drawing up a list of the impacts of climate change at the national level, and then attempts to assess vulnerability to these changes in certain sectors, namely, water resources, agriculture, tourism and fisheries. It then outlines the country's opportunities to attenuate climate change emissions, before setting out the implementation plan. This constitutes significant progress towards an action plan and the formulation of adaptation projects.

A National Adaptation Programme of Action (NAPA) was prepared in 2006, with critical multi-lateral support from cooperation agencies such as the GEF, the UNFCCC, the United Nations Environment Programme (UNEP) and the World Bank.

4.2. Critical review of policies and programmes

The policies and programmes relating to climate change developed and implemented by the Senegalese government have several shortcomings, namely:

- lack of political engagement on adaptation to climate change;
- lack of coordinated action on adaptation to climate change;
- lack of resources to implement programmes effectively;
- problems associated with the formulation and implementation of policies on adaptation to climate change in Senegal.

4.2.1. Lack of political engagement on adaptation to climate change

While it is true that Senegal has ratified several conventions and signed various protocols, the fact that the two Poverty Reduction Strategy Papers (PRSP 1 for 2003-2005, PRSP 2 for 2006-2010 and the DPES for 2011-2015) make no explicit mention of the issue of adaptation to climate change raises questions about the government's political commitment to action in this domain. At most, Theme 3 of PRSP 2, 'Social protection, risk management and disaster prevention', focuses on vulnerable groups and considers their vulnerability to natural

disasters. The PRSP is an excellent political and social policy instrument, but the only hope that government policy will take real account of adaptation to climate change rests on the 11th Plan (diagnostic phase) prepared by the 'Environment' Commission. This defines a number of strategic themes, which include 'Adapting to the adverse impacts of climate change and promoting sustainable modes of production and consumption'.

4.2.2. Lack of coordinated action on adaptation to climate change

Another criticism is the lack of overall coherence between policies and programmes regarding adaptation to climate change. The deficiencies observed in areas like health and education are also evident in this domain, despite the fact that the key mission of the National Adaptation Programme of Action (NAPA), which was implemented in 2006, was to ensure that projects developed in Senegal are coherent and that adaptation to climate change is built into their design and implementation. Several programmes have been developed at the level of state structures (ministries, the university and research institutes like the Institut Sénégalais de Recherche Agricole) and semi-public institutions such as the Centre de Suivi Ecologique, while others are more or less directly designed by development partners like IDRC, UNDD and UNEP. Strategies for adaptation to climate change are now one of the central funding themes for projects in Senegal.

4.2.3. Lack of resources to implement and disseminate programmes

The State faces various constraints in mobilizing the financial resources needed to fund policies and programmes to mitigate the risks associated with climate change. The resources made available to complete NAPA's missions fall well short of what is actually needed: "*Senegal had estimated that it needed at least $US30 million for its NAPA, but international donors only gave us $US 3 million*."[9]

The second constraint – low visibility – is indicative of a failure to communicate and properly publicise the programme in order to ensure that it is appropriated by the actors concerned. In the field of adaptation, this is known as the principle of equity, defined as "*the desire for equity, which requires the involvement of all local governments and socio-professional categories likely to suffer from the consequences of climate change*."[10] Even if the State does instigate initiatives, their success is still determined by support from other actors such as local governments, civil society and non-governmental organisations involved in implementing strategies for adaptation to climate change.

> "*Government's actions by themselves will not be sufficient to achieve significant results to mitigate - or adapt to - climate change. The acceptance of government policies and regulations by citizens, businesses and non- governmental organisations, as well as their own initiatives to improve the effectiveness of the judiciary, are needed*" *(Willems, Baumert, 2003:14).*

Analysis of these constraints shows that there are two major weaknesses in this National Adaptation Programme of Action. First, its execution seems to depend on mobilising resources given by donors; second, it is not the result of a participatory process involving interventions by the actors directly concerned with adaptation to climate change. Even if it is

[9]Mohamed Gueye, 2008, 'Au Sénégal, le climat scrute encore le temps', *Défis Sud*, n°84.
[10] French National Office on the impacts of global warming, 2007.

not endogenous, the programme would have benefited from being appropriated by these actors, which does not seem to have happened.

Senegal has also set up a National Committee on Climate Change (COMNAC), which is based at the Department of the Environment and Classified Buildings (DEEC). This committee provides a platform for experts and decision-makers, bringing together actors in this domain in order to engage the State and partners in a tacit mechanism for dialogue on climate change. COMNAC is usually invited to intervene on all programmes and initiatives concerned with the theme. It advised the government of Senegal on the procedures for obtaining funding from the Adaptation Fund for signatories to the Kyoto Protocol, which was put in place in the framework of the United Nations Convention on Climate Change. Funding was granted, and in April 2010 the Centre de Suivi Ecologique (CSE) was appointed as the national body responsible for assessing the admissibility and pertinence of projects, and monitoring and evaluating their implementation. Yet local implementation of this convention is under-funded. Known as the 'convention of the poor', it raises the question of drought and decentralisation, which has been shelved since Praia+9 despite the fact that this is a key issue in the development of Sahelian countries like Senegal.

4.2.4. Difficulties in formulating and implementing policies on adaptation to climate change in Senegal

There is a discrepancy between the solid scientific consensus within the IPCC and the fragmentary and unconsolidated nature of local perceptions of climate change. A case in point is the ongoing debate between politicians, geographers, environmentalists and urban and population specialists regarding the ecological, economic and environmental effects of the opening of the breach in Saint-Louis. This situation underlines the need for more action and studies at the local level, and highlights a number of weaknesses and deficiencies, such as:

- the limited number of climate change experts at the national and local levels and subsequent need to accelerate training and capacity building; and the fact that most experts come from other disciplines, which creates problems in harmonising methods and sharing data;
- the lack of resources to fund projects and programmes to combat climate change;
- the lack of local frameworks for consultation and action on climate change, and the timidity of civil society initiatives;
- failure to establish a rigorous link between the scientific consensus on climate change and perceptions of changing environmental factors at the local level, even though local people are clearly aware that elements of the climate are changing or that routine changes are occurring much more quickly and erratically than in the past;
- the lack of attention paid to climate change in urban areas, except insofar as they relate to sectoral issues relating to coastal erosion or flooding;
- lack of local government engagement and champions to spread the message about climate change;
- the scant account taken of climatic risk in planning and implementing development strategies, especially those formulated at the regional and local levels; a mechanism needs to be found for local planning instruments to take account of these changes and, just as importantly, to monitor their application.

These last two points highlight the fact that policies on adaptation to climate change take insufficient account of local realities, and particularly of local responses to climate change and alterations in the local environment and livelihoods. These shortcomings can be partly explained by the difficulty of reconciling the objectives and strategies developed by the population on the one hand and the State on the other. Local people believe that the public authorities should help them become mobile because they see this as the only way of dealing with the effects of climate change and their deteriorating living conditions; while the State is busy promoting projects and programmes designed to reduce mobility.

Conclusion

This analysis shows that climate change is exacerbating vulnerabilities that have certainly existed for a long time, but which have become more complex and extensive, and consequently require adaptation strategies that are largely developed at the global level but implemented at the local level.

Putting these strategies into practice entails taking account of local inter-relationships, specificities and perceptions. Climate change is usually seen as a calamity, rather than an opportunity that can be seized. In this respect, we also need to evaluate the social, economic and environmental impacts that it has had on people's lives, the sustainability of their adaptation strategies and their varying capacity to implement them.

Climate change raises questions about the permanency of particular aspects of the social order, and can accentuate social and economic vulnerability. In Ourossogui, for example, the pyramidal social structure is projected onto agricultural spaces, as land held by those at the lower end the social hierarchy is less fertile and less likely to be irrigated than that held by those higher up the social scale. In other words, in a context of insufficient rainfall, the social categories at the bottom of the social ladder are most affected, and thus the most inclined to leave.

Paradoxically, this selective migration by the groups most affected by climate change may reduce economic and social inequalities, as the financial resources and experience gained on migration can offer economic freedom to those concerned, even if it does not radically change their social status.

The mobility triggered by climate change is also causing fundamental shifts in gender relations. As the men depart, women are coming out of the home and engaging in activities like milk production and processing and assuming more responsibilities, thereby not only improving their social and economic status, but also gaining greater access to financial resources and thus to spheres of decision-making.

The fact that climate change is affecting the availability of land raises the issue of land redistribution. Supporting changes in behaviour will allow people to build on what they have, and to pursue sustainable adaptation strategies in local contexts. National and local policies play a crucial role in this respect, and we need to involve local councils to ensure that international negotiations relate to local realities and local specificities. Climate change could provide public policies with a federative framework for action that would help us manage decentralised competences for the environment and natural resource more effectively. The current situation shows that the future of our planet is linked with that of our land, even if the link is not yet perceptible with our current observational tools. Even more importantly, this future requires decision-makers and scientists to devise innovative approaches to development, with coherent and sustainable actions to respond to changes in living

conditions that are causing floods, desertification and heatwaves, and altering seasonal cycles.

While it is true that there is global consensus on the reality of climate change and its effects on local ecosystems and livelihoods, it is not clear how this scientific agreement fits with local perceptions. We need to build a local body politic to link the two perspectives, and focus on actions that aim to manage climate change through local development policies. Doing this will not only require greater knowledge about climate change, but also entail considering it from different angles and re-evaluating the possibilities and opportunities it offers for beneficial change. The overall guidelines are in place; what is needed now is for local elected officials and local governments to take action and, as with gender and human rights issues, for climate change to be incorporated into development policies from the global to the local level.

References

ANTOINE Philippe, 1995, *La ville à guichets fermés? Itinéraires, réseaux et insertion urbaine*, Dakar, IFAN-ORSTOM, 1995.

DAFFE G, 'Les transferts d'argent des migrants sénégalais. Entre espoirs et risques de dépendance' in DIOP Momar-Coumba (ed.), *Le Sénégal des Migrations*, Paris, Karthala, Collection 'Hommes & Sociétés', 2008, pp. 105-131.

DAI A., PETER J. Lamb, KEVIN E. Trenberth, MIKE Hulme, PHILIP D. Jones & PINPING Xie, 'Comment: The Recent Sahel Drought Is Real', *International Journal of Climatology*, 24, 2004, pp. 1323‑1331.

DESANKER P.V., *The Impact of Climate Change on Life in Africa: Climate Change and Vulnerability in Africa*, WorldWide Fund for Nature, Washington DC, 2002.

ENSOR J. & BERGER R., Understanding Climate Change Adaptation. Lessons from community based approaches, Practical Action Publishing, Warwickshire, 2009, 192 p.

GADO B.A., *Une histoire des famines au Sahel. Etude des grandes crises alimentaires (XIX^{è}-XX^{e} siècles)*, Paris, L'Harmattan, 1993, 200 p.

GIEC, *Climate change 2007: The physical science basis*, Cambridge University Press, Cambridge, 2007a, 996 p.

GUEYE M., 'Au Sénégal, le climat scrute encore le temps' in *Défis sud*, n°84- Bimestriel - August, September 2008, pp. 20-22.

IDRC-CCAA, Workshop Report on Towards a Regional Strategy in Climate Change Adaptation: Sharing Knowledge on Climate Risks and Adaptation Options. UNECA/CCAA, Addis Ababa, April 16-20, 2007.

KERGOMARD C., 'Changement climatique: des causes physiques à la géographie des risques', *Regards croisés sur l'économie* 2009/2, n°6, pp. 33-44.

KITUYI E., *Institutional Mapping for Climate Change Adaptation in Eastern Africa*, Industrial Ecology Institute, October 2008, 68 p.

LAVIGNE Delville P., *La rizière et la valise. Irrigation, migration et stratégies paysannes dans la vallée du fleuve Sénégal*, Paris, Syros Alternatives, 1991, 231 p.

United Nations Framework Convention on Climate Change, 1992, 31 p.

NDIAYE P., 'L'environnement au Sénégal. La gestion en perspective' in DIOP M.-C. (ed.), *La société sénégalaise entre le local et le global*, Paris, Karthala, 2002, pp. 87-107.

Office National sur les Effets du Réchauffement Climatique, *Stratégie nationale d'adaptation au changement climatique*, Paris, French documentation, 2007, 95 p.

UNDP, Human Development Report 2009. Overcoming barriers: mobility and human development, 104 pages.

UNDP, Climate change, food security and human development, NHDR, 2010, Senegal, 108 pages + annexes.

RABOURDIN S., *Changement climatique. Comprendre et agir*, Paris, Delachaux et Niestlé, 2005, 268 p.

Ramade F., *Eléments d'écologie. Ecologie fondamentale*, Paris, Dunod, 3rd edition, 2003, 690 p.

RAYNAUT C., LAVIGNE Delville P. & KOECHLIN J., 'Les relations sociétés/nature au Sahel. Quelques grands types de situation' in RAYNAUT C. (ed.), *Sahels. Diversité et dynamiques des relations sociétés-nature*, Paris, Karthala, 1997, pp. 227-260.

Republic of Senegal, Ministry of the Environment and Nature Protection, Department for the Environment and Classified Buildings, *Stratégie Nationale de Mise en Œuvre (SNMO) de la Convention Cadre des Nations Unies sur les Changements Climatiques (CCNUCC)*, October 1999, 54 p.

SECK M., MOUSSA Na Abou M., WADE S. & THOMAS J.-P., Adaptation aux Changements climatiques. L'étude de cas des systèmes de production agricoles de Sébikotane (Sénégal), Enda T.M., February 2005, 33 p.

STARK O. & BLOOM D.E., 'The New Economics of Labour Migration', The American Economic Review, 75 (2), 1985, pp. 173-178.

TANNER T. & MITCHELL T., 'Entrenchment or Enhancement: Could Climate Change Adaptation Help to Reduce Chronic Poverty?' in *IDS Bulletin*, Volume 39, Number 4, September 2008, pp. 6-15.

TACOLI C., 'Crisis or adaptation? Migration and climate change in a context of high mobility, *Environment and Urbanization*, Vol. 21(2): 513-525, 2009, pp. 513-524.

TERDIMAN M., Sécurité environnementale, changements climatiques et conflits: le cas du Darfour, *Outre – Terre,* 2007/3, n° 20, pp. 141-150.

WILLEMS S., BAUMERT K., *Institutional Capacity and Climate Actions*, OCDE, 2003.

WOODFINE A., 'Using sustainable land management practices to adapt to and mitigate climate change in sub-Saharan Africa', *TerrAfrica*, Regional and Sustainable Land Management, August 2009, 89 p.

Recent Publications by IIED's Human Settlements Group

WORKING PAPER SERIES

All working papers can be downloaded at no charge. For a complete list, see http://www.iied.org/human-settlements/group-publications/publications

URBAN POVERTY

Capital, capacities and collaboration: the multiple roles of community savings in addressing urban poverty – Diana Mitlin, David Satterthwaite and Sheridan Bartlett (2011)

Understanding pro-poor housing finance in Malawi - Mtafu A.Z. Manda, Siku Nkhoma and Diana Mitlin (2011)

Interrogating Urban Poverty Lines – the Case of Zambia - Miniva Chibuye (2011)

Assessing the Scale and Nature of Urban Poverty in Buenos Aires – Jorgelina Hardoy with Florencia Almansi (2011)

Broadening Poverty Definitions in India: Basic Needs in Urban Housing - S. Chandrasekhar and Mark R. Montgomery (2010)

Poverty lines in Greater Cairo: Underestimating and Misrepresenting Poverty –Sarah Sabry (2009)

Poverty Lines and Lives of the Poor: Underestimation of Urban Poverty, the case of India – Meera Bapat (2009)

Community Finance: the News from Asia and Africa. Report of a workshop held in November 2007 – Asian Coalition for Housing Rights (2008)

Urban Poor Funds; Development by the People for the People – Diana Mitlin (2008)

Building Homes, Changing Official Approaches: the Work of Urban Poor Federations and their Contributions to Meeting the Millennium Development Goals in Urban Areas – Celine D'Cruz and David Satterthwaite (2005)

Catalysing Pro-Poor Development; the Role of Savings and Savings Organizations: Key Issues arising from an International Workshop on Housing Finance and Poverty – Diana Mitlin (2005)

The Under-estimation of Urban Poverty in Low- and Middle-income Nations – David Satterthwaite (2004)

RURAL–URBAN

Climate change, adaptation strategies and mobility: evidence from four settlements in Senegal / *Changements climatiques, stratégies d'adaptation et mobilités. Evidence à partir de quatre sites au Sénégal*- Mohamadou Sall, Serigne Mansour Tall and Aly Tandian (2011)

Rural migration in Bolivia: the impact of climate change, economic crisis and state policy - Carlos Balderrama Mariscal, Nico Tassi, Ana Rubena Miranda, Lucía Aramayo Canedo, Iván Cazorla (2011)

Not only climate change: mobility, vulnerability and socio-economic transformations in environmentally fragile areas in Bolivia, Senegal and Tanzania – Cecilia Tacoli (2011)

International Migration, Social Change and Local Governance in Ourossogui and Louga, Two Small Urban Centres in Senegal – Mohamadou Sall, Serigne Mansour Tall, Aly Tandian, Al Assane Samb, Abdou Khadre Sano and Souleymane Sylla (2010)

Migration, Local Development and Governance in Small Towns: Two Examples from the Philippines – Charito Basa and Lorna Villamil with Violeta de Guzman (2009)

Migration and Small Towns in China: Power Hierarchy and Resource Allocation – Bingqin Li and Xiangsheng An (2009)

Migration and Small Towns in Pakistan – Arif Hasan and Mansoor Raza (2009)

Urbanization and Rural Development in Viet Nam's Mekong Delta: Livelihood Transformations in Three Fruit Growing Settlements - Hoang Xuan Thanh, Thi Thu Phuong Dinh, Thu Huong Nguyen and Cecilia Tacoli (2008)

Toward Synergistic Rural–Urban Development: the Experience of the Rural–Urban Partnership Programme (RUPP) in Nepal – S.F. Momen (2006)

Rural-Urban Migration in China: Policy Options for Economic Growth, Environmental Sustainability and Equity – Gordon McGranahan and Cecilia Tacoli (2006)

Livelihood Diversification and Rural–Urban Linkages in Vietnam's Red River Delta – Anh, Dang Nguyen, Hoang Xuan Thanh and Cecilia Tacoli (2005)

Rural–Urban Change, Boundary Problems and Environmental Burdens – Gordon McGranahan,
David Satterthwaite and Cecilia Tacoli (2004)

WATER AND SANITATION

Groundwater, Self-supply and Poor Urban Dwellers: A Review with Case studies of Bangalore and Lusaka – Jenny T. Gronwall, Martin Mulenga and Gordon McGranahan (2010)

Urban Water and Sanitation in Ghana: How Local Action is Making a Difference - Kanton I. Osumanu, Lukman Abdul-Rahim, Jacob Songsore and Farouk R. Braimah with Martin Mulenga (2010)

Improving Water and Sanitation Provision in Buenos Aires: What can a Research-oriented NGO do? – Florencia Almansi, Ana Hardoy and Jorgelina Hardoy (2010)

Water Service Provision for the Peri-urban Poor in Post-conflict Angola – Allan Cain and Martin Mulenga (2009)

Water and Sanitation in Urban Malawi: can the Millennium Development Goals be Met? A Study of Informal Settlements in Three Cities – Mtafu A. Zeleza Manda (2009)

Lessons from Karachi: The role of Demonstration, Documentation, Mapping and Relationship Building in Advocacy for Improved Urban Sanitation and Water Services – Arif Pervaiz, Perween Rahman and Arif Hasan (2008)

Local Water and Sanitation Companies and the Urban Poor – Gordon McGranahan and David Lloyd Owen (2006)

Informal Water Vendors and the Urban Poor – Marianne Kjellén and Gordon McGranahan (2006)

Governance and Getting the Private Sector to Provide Better Water and Sanitation Services to the Urban Poor – Gordon McGranahan and David Satterthwaite (2006)

URBAN CHANGE

Africa's Urban Transition and the Role of Regional Collaboration – Gordon McGranahan, Diana Mitlin, David Satterthwaite, Cecilia Tacoli and Ivan Turok (2009)

The Transition to a Predominantly Urban World and its Underpinnings – David Satterthwaite (2007)

Urban Environments, Wealth and Health: Shifting Burdens and Possible Responses in Low and Middle-income Nations – Gordon McGranahan (2007)

Outside the Large Cities: the Demographic Importance of Small Urban Centres and Large Villages in Africa, Asia and Latin America – David Satterthwaite (2006)

A Pro-poor Urban Agenda for Africa; Clarifying Ecological and Development Issues for Poor and Vulnerable Populations. A Report for the Ford Foundation - Joel Bolnick, Happy M Kayuni , Richard Mabala, Gordon McGranahan, Diana Mitlin, Sikhulile Nkhoma, John Oucho, Amal Sabri, Sarah Sabry, David Satterthwaite, Mark Swilling, Cecilia Tacoli, Richard I C Tambulasi and Mirjam van Donk (2006)

CLIMATE CHANGE AND CITIES

Community-driven Disaster Intervention: Experiences of the Homeless People's Federation Philippines, Incorporated (HPFPI) – Jason Christopher Rayos Co (2010)

Towards Pro-poor Adaptation to Climate Change in the Urban Centres of Low and Middle-income Countries – Caroline Moser and David Satterthwaite (2008)

Climate Change and Urban Children: Impacts and Implications for Adaptation in Low and Middle-Income Nations – Sheridan Bartlett (2008)

Adapting to Climate Change in Urban Areas: the Possibilities and Constraints in Low- and Middle-income Nations – David Satterthwaite, Saleemul Huq, Hannah Reid, Mark Pelling and Patricia Romero Lankao (2007)

URBANIZATION & EMERGING POPULATION (Joint series with the United Nations Population Fund)

Trends and Processes of Urbanisation in India - Amitabh Kundu (2011)

China's Post-Reform Urbanization: Retrospect, Policies and Trends - Anthony G.O. Yeh, Jiang Xu and Kaizhi Liu (2011)

Brazil's Early Urban Transition: What can it Teach Urbanizing Countries? – George Martine and Gordon McGranahan (2010)

Planning for High Density in Low-income Settlements: Four Case Studies from Karachi – Arif Hasan, Asiya Sadiq and Suneela Ahmed (2010)

The Food Price Crisis and Urban Food (in)security – Marc J. Cohen and James L. Garrett (2009)

Is Urbanization Contributing to Higher Food Prices? – Jesper Stage, Jørn Stage and Gordon McGranahan (2009)

OTHER HUMAN SETTLEMENTS PUBLICATIONS

Assessing the Costs of Adaptation to Climate Change. A Review of the UNFCCC and Other Estimates - Martin Parry, Nigel Arnell, Pam Berry, David Dodman, Samuel Fankhauser, Chris Hope, Sari Kovats, Robert Nicholls, David Satterthwaite, Richard Tiffin and Tim Wheeler (2009)

Population Dynamics and Climate Change edited by José Miguel Guzmán, George Martine, Gordon McGranahan, Daniel Schensul and Cecilia Tacoli (2009) (A joint UNFPA-IIED publication)

EARTHSCAN BOOKS

Adapting Cities to Climate Change: Understanding and Addressing the Development Challenges, edited by Jane Bicknell, David Dodman and David Satterthwaite (2009)

The New Global Frontier: Urbanization, Poverty and Environment in the 21st Century, edited by George Martine, Gordon McGranahan, Mark Montgomery and Rogelio Fernández-Castilla (2008)

Scaling Urban Environmental Challenges; From Local to Global and Back, edited by Peter J Marcotullio and Gordon McGranahan (2007)

The Earthscan Reader on Rural–Urban Linkages, edited by Cecilia Tacoli (2006)

Water and Sanitation in the World's Cities 2006; Meeting Development Goals in Small Urban Centres, prepared for UN–Habitat by IIED (2006)

Empowering Squatter Citizen: Local Government, Civil Society and Urban Poverty Reduction, edited by Diana Mitlin and David Satterthwaite (2004)

Water and Sanitation in the World's Cities: Local Action for Global Goals, UN–Habitat Report prepared by Gordon McGranahan and David Satterthwaite (2003)

Air Pollution and Health in Rapidly Developing Countries, edited by Gordon McGranahan and Frank Murray (2003)

The Citizens at Risk: From Urban Sanitation to Sustainable Cities – Gordon McGranahan, Pedro Jacobi, Jacob Songsore, Charles Surjadi and Marianne Kjellén (2001)

Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia and Latin America – Jorge E Hardoy, Diana Mitlin and David Satterthwaite (2001)

Cities for Children: Children's Rights, Poverty and Urban Management – Sheridan Bartlett, Roger Hart, David Satterthwaite, Ximena de la Barra and Alfredo Missair (1999)

The Earthscan Reader in Sustainable Cities, edited by David Satterthwaite (1999)

The Environment for Children – David Satterthwaite, Roger Hart, Caren Levy, Diana Mitlin, David Ross, Jac Smit and Carolyn Stephens (1996)

Squatter Citizen: Life in the Urban Third World – Jorge E Hardoy and David Satterthwaite (1989)

ENVIRONMENT AND URBANIZATION

A twice-yearly journal published since 1989, this is one of the most cited and widely distributed international journals on urban issues. Each issue has a special theme and includes 9–14 papers and some include a guide to the literature on that theme. It also has a special section of papers on climate change and cities (since 2007), profiles of innovative NGOs (in some issues) and Book Notes – which includes summaries of new books, research reports and newsletters and how these can be obtained (including those in Spanish, French and Portuguese).

For more details, see http://www.environmentandurbanization.org/

The on-line edition is at http://eandu.sagepub.com/ The full text of all papers in all issues (from the first issue in 1989) are available on-line at this site and all but the issues from the last two years are available at no charge. From this site, subscriptions and back issues can be purchased and searches made. There is also a list with the theme of each issue.

Environment and Urbanization Briefs: A five page summary of each issue of Environment and Urbanization is available in print and electronically; to receive this, e-mail Candice.sly@iied.org. All Briefs can be downloaded from http://pubs.iied.org/search.php?s=EUB

HOW TO OBTAIN WORKING PAPERS: Printed versions can be obtained from Earthprint Ltd, PO Box 119, Stevenage, Hertfordshire SG1 4TP, UK; T: +44 1438 748 111; F: +44 1438 748 844; E-mail: customerservices@earthprint.com; Web: www.earthprint.com for US$ 20 each plus postage and packing. All working papers are free to download at www.iied.org.

HOW TO OBTAIN BOOKS: These are available from Earthscan Publications, 8–12 Camden High Street, London NW1 0JH, UK; E-mail: earthinfo@earthscan.co.uk; Web: www.earthscan.co.uk; also available in bookstores. In the USA, available from Earthscan, 22883 Quicksilver Drive, Sterling, VA 20166-2012, USA. The Earthscan website also has details of Earthscan representatives and agents in all other countries.

HOW TO OBTAIN ENVIRONMENT AND URBANIZATION: Since 2006, *Environment and Urbanization* has been published by Sage Publications, and subscriptions and back issues can be ordered from them at: http://eau.sagepub.com/

Order on-line for:
The Americas: http://www.sagepub.com/journalsSubscribe.nav?prodId=Journal201733
Rest of the world: http://www.sagepub.co.uk/journalsSubscribe.nav?prodId=Journal201733

Free subscriptions are available to NGOs and teaching/training institutions in Africa and in low- and middle-income countries in Asia and Latin America that have difficulty obtaining foreign exchange; contact IIED (eandu@iied.org).