



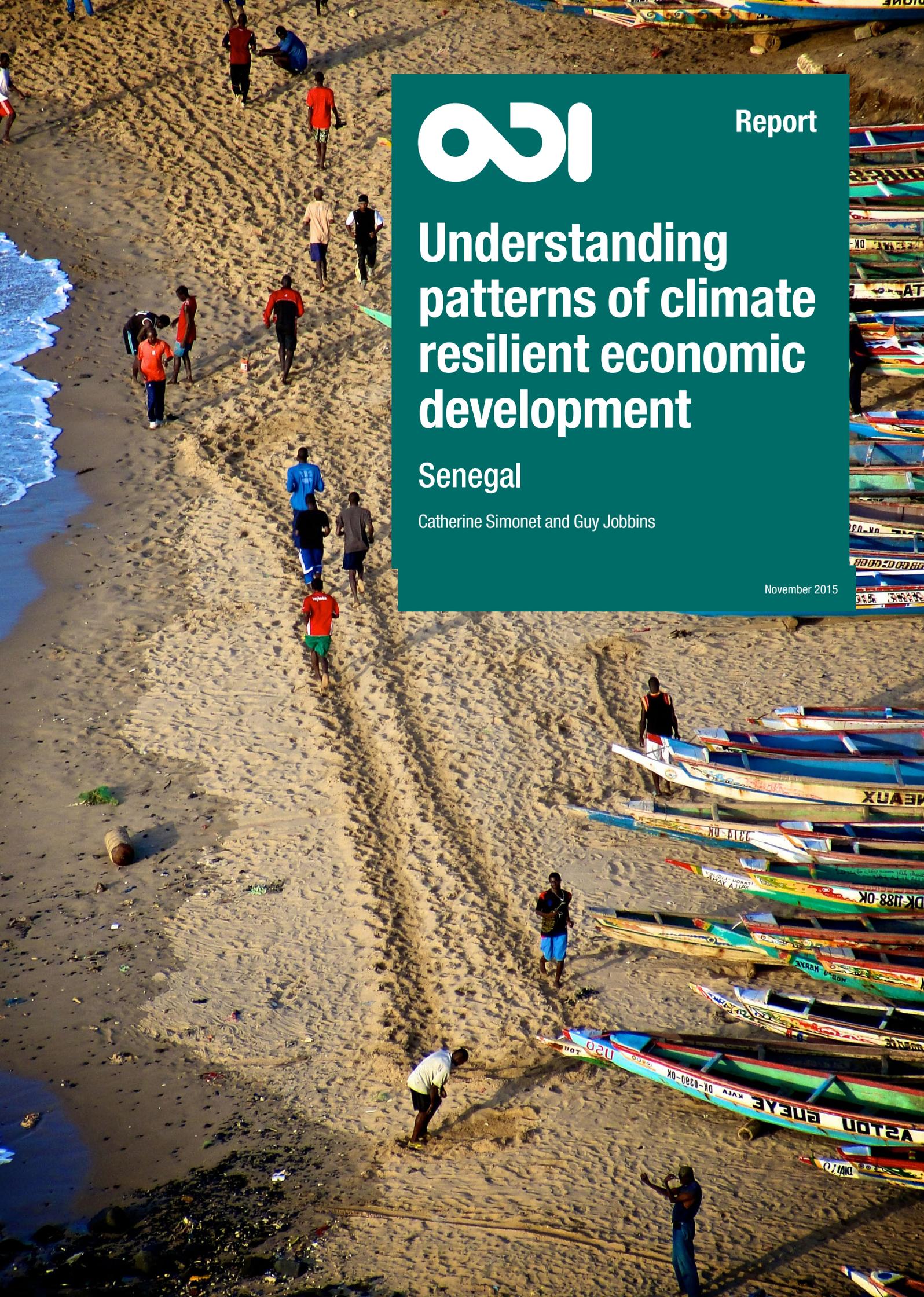
Report

Understanding patterns of climate resilient economic development

Senegal

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November 2015



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ISSN: 2052-7209

Cover photo: Jeff Attaway, Dakar, Senegal.

Acknowledgements

We gratefully acknowledge the financial support of the UK Department for International Development for the project, 'Understanding patterns of climate-resilient economic development'. The project was led by Vivid Economics, and the contributions of John Ward (Vivid), Charlie Dixon (Vivid), and Annika Olsson (DFID) to this report are gratefully acknowledged. We also thank Sam Fankhauser (Vivid), Nicola Ranger (DFID) and Paul Watkiss for their constructive comments during the review process.

The authors are grateful to interviewees from the private and public sectors in Dakar and Saly during March 2015. We especially thank colleagues from Innovation Environment Developpement (IED-Afrique) for their availability and their assistance in Dakar. We would like also to thank Mamadou Lamine from APIX for his help.

We are also grateful to Dr. Marie-Christine Cormier and Dr. Luc Descroix from the Institut de Recherche pour le Developpement (IRD), M. Jean-Michel Marchat from World Bank in Dakar, Souadou Sakho-Jimbira from IED and M.El Hadj Malick from the Tourism Ministry for sharing their valuable knowledge on the tourism sector and the Senegalese economy.

Key messages

- In Senegal, socio-economic development is characterized by a diversified growth but unevenly distributed geographically
- The concentration of activities in urban centres and along the coast has reduced the country's vulnerability to droughts but has also contributed to increased exposure to new climate risks
- Economic diversification in Senegal reduces vulnerability to climate change, especially by reducing sensitivity of agriculture to drought and to a general reinforcement of adaptive capacity
- The tourism sector, historically presented as an opportunity to reduce exposure to drought of the economy, has in fact contributed to new forms of vulnerability due to the geographical and economic concentration of the sector
- Diversified economic growth combined with geographical decentralisation of socio-economic activities can provide the conditions for resilient economic development in Senegal.

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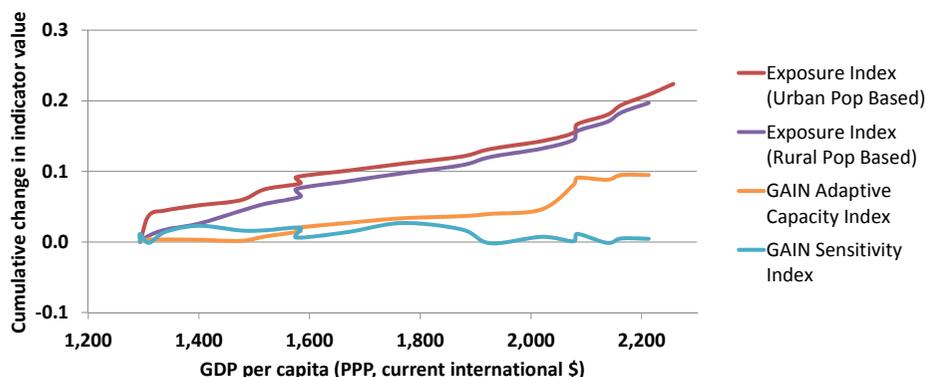
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Executive Summary

Urbanisation and economic diversification are transforming the climatic risks that Senegal faces and widening the rural-urban resilience gap. Internal migration from rural inlands to urban coastal areas in combination with strong growth of the tertiary sector, particularly tourism, reduced vulnerability to droughts but increased exposure and sensitivity to floods and coastal erosion. Economic diversification also decreased sensitivity to climate variability and led to broad-based improvements in living standards, social infrastructure and adaptive capacity. However, such benefits have been concentrated among urban centres and widened inequalities in resilience across Senegal.



Both **rural exposure** and **urban exposure**, based on approximations of the population living in areas at high risk of droughts and floods respectively, have increased steadily with GDP per capita. **Sensitivity**, as measured by the ND-GAIN vulnerability index component, has shown some variation across the dataset, with Senegal becoming slightly more sensitive as GDP per capita surpassed \$1,300 but then decreasing to initial levels from around \$1,900. **Adaptive capacity**, from the same source, grew moderately with development. until a sharp rise around \$2,000 per capita, after which it levelled off.

The case study addresses the question: 'How has coastal and tourism development affected exposure and sensitivity to droughts and floods as well as adaptive capacity in Senegal?' over the 1990-2015 period. It drew from desk-based research and fieldwork including the review of technical reports, policy and legal documents, national and international databases and interviews.

The direction and relative scale of the impacts presented in the scorecard below are subjective judgements based on quantitative data wherever possible. Due to the availability of credible and accurate data, approximations are used for each indicator which may vary by geographical focus or time period and others may draw from qualitative research. A full discussion of analytical constraints is given in the synthesis presentation.

Change in resilience
due to change in indicator

← (Red arrow pointing left) (Green arrow pointing right) →

EXPOSURE

The presence of people and assets in places that could be adversely affected by climate change.

Category	Indicator	Change Direction
People	Population at high risk of drought	Decreasing (Red)
	Risk of drought	Decreasing (Red)
Assets	Urbanisation of coastline	Increasing (Red)
	Rates of coastal erosion	Increasing (Red)
	Risk of flood	Increasing (Red)

While urban centres are also at risk of drought, the population living in rural areas highly exposed to drought remained relatively stable as rural-urban migration was masked by strong rural population growth. Decreasing average rainfall increased the likelihood of droughts though this was not attributable to economic development. Construction along the coastline rose, indicated by a higher share of urban land, exposing new assets such as hotels and shops to floods and coastal erosion. Rising sea levels intensified the risk of floods and erosion rates were accelerated due to uncoordinated protection measures such as dikes and breakwaters which concentrated erosion in vulnerable areas.

SENSITIVITY

The degree to which a system is affected by or responsive to a climate stimuli.

Category	Indicator	Change Direction
Societal resilience	DRRM activities	Increasing (Green)
	Pressure on water resources	Decreasing (Red)
Economic resilience	Economic diversification	Increasing (Green)
	Dependence on agriculture	Decreasing (Green)
	Development of flood-sensitive activities	Decreasing (Red)

The tertiary sector continued to be the main driver of GDP growth, accounting for 73 per cent of growth between 2006 and 2014, indicating economic diversification away from climate-sensitive agriculture, which declined as a % of GDP. In particular, the tourism sector grew substantially though this also increased sensitivity to floods and coastal erosion and placed additional pressure on already scarce water resources. However, initial disaster risk reduction and management (DRRM) activities such as flood defences and early warning systems helped to mitigate these risks.

ADAPTIVE CAPACITY

The potential or capability of a system to adapt to, or alter to better suit, climatic stimuli or their effects or impacts.

Indicator	Change Direction
Poverty incidence	Decreasing (Green)
Depth of poverty	Decreasing (Green)
Education and training	Increasing (Green)
Inequality	Decreasing (Green)

Urbanisation and the growth of the tertiary sector drove increases in income and economic development which, combined with small declines in inequality as indicated by a lower GINI index, helped build adaptive capacity. Both national rates of poverty and the average income gap to the poverty line also declined. Migration to urban areas raised national educational attainment, as reflected in literacy rates, and the quality of health care but widened the gap in adaptive capacity between the rural and urban population.



Are impacts different for the poorest?

Migration is often unaffordable for the poorest and their resilience has remained low as a result. The rural poverty rate and gap are approximately double that in urban centres and access to electricity, water and sanitation facilities are significantly lower. **Even when rural households can afford to migrate, it is typical for men to migrate leaving women and children vulnerable** and draining remote areas of young, skilled labour and income.

Even within urban centres, exposure and sensitivity to floods varies across income groups. **The poorest tend to settle in low-lying informal settlements with little social infrastructure or service provision amplifying the damage caused by climatic events.** Formal and planned areas, such as the historic centre of Dakar which is only accessible to the rich, often benefit from higher locations and effective flood defences.

The poorest also tend to find seasonal or casual work in agriculture or tourism, both sectors which are highly sensitive to climate variability and consequently, offer little job security. If harvests are low, farmers will hire fewer seasonal workers **leaving the poor with no income and severely limited adaptive capacity.**



Are impacts locked in?

The absence of a legal land use framework and inadequate urban planning in Senegal has underpinned much of the urban construction exposed to climate risks. Such a framework is complex, costly and requires multi-stakeholder approval, and thus **its absence may cause political lock-in of low adaptive capacity.** Without it, informal settlements and construction could further expand into high-risk areas and coastal zones could be further degraded.

The densely developed port of Dakar has caused physical lock-in of high exposure and sensitivity. As an international trade hub, the port is central to Senegal's economy. Little available land in the city (due to geographical characteristics) has caused development in areas prone to floods and coastal erosion. This has made relocation or coastal defence programmes highly expensive, if at all possible.

The growing tourism sector may also lead to economic lock-in of high sensitivity due to its high water consumption. Water supply in Senegal is often threatened by droughts. While current supply appears to be sufficient, a water management plan is required to manage increased competition among sectors, particularly if climate variability is set to increase.



What are the policy implications?

Economic diversification is a powerful climate risk mitigation tool. In Senegal, diversification away from agriculture and towards the tertiary sector has substantially reduced sensitivity to droughts but also introduced new risks associated with growing sectors. For example, the rapid expansion of tourism among the Senegalese coastline has created an increase in sensitivity to floods and coastal erosion. However, as the agricultural sector is a larger share of GDP, the impact of a drought is likely to be more severe than that of a flood. Therefore, Senegal is judged to have become less sensitive overall. From a risk perspective, standard economic policy may also encourage judicious diversification, but this is given greater emphasis by a climate resilience lens.

A legal framework for land use which accounts for climate risks may help focus development in low risk locations increasing the resilience of assets. As much development in Senegal has been concentrated along the coastline, the value of assets exposed to floods and erosion has significantly increased. Due to a lack of information regarding climate risks, development decisions are often made without concern for resilience. A land use framework may have ensured that people and businesses accounted for climate risk and limited the development of informal settlements and tourism infrastructure in high risk areas. Such factors are unlikely to factor into standard economic development policy.

1 Introduction

1.1 Background to and context of the study

The physical effects of climate change will have direct and indirect impacts on economic and social structures and natural systems, and these impacts will have high costs (IPCC, 2001; IPCC, 2014; Stern, 2006). Although the manifestation of climate change will vary across regions, at the global level the Intergovernmental Panel on Climate Change (IPCC) projects an increase in temperatures, melting ice sheets and rising sea levels, and changing climatic variability potentially leading to more extreme events such as flooding and drought (IPCC, 2014; Field et al., 2012). Many of these trends are already occurring, with attributed impacts on the fundamental components of human development, including livelihoods, health and food production (ibid; Sachs, 2014; Fischer et al., 2005).

Within this context, it is important to consider how to build resilience, at both the macro, national level and the micro, household and individual level, to reduce or avoid the economic and societal costs of climate change. This will allow decision makers within government and bi- and multi-lateral donor agencies to identify what development trajectories can support climate resilient growth and poverty reduction. As such, this research, focused on a case study of the Senegal, aims to understand better how patterns and trends of economic development affect vulnerability and exposure to climate impacts across sectors and populations, including distributional effects. This project is embedded within a broader agenda exploring the nature of climate resilient growth in lower-income countries, in order to mitigate risks and avoid 'locking-in' vulnerability to hazards.

This report presents a case study from Senegal that explores the relationships between economic development and climate change. Commissioned by the Climate and Environment Department of the UK Department for International Development (DFID), it is one component of the project "Understanding Patterns of Climate Resilient Economic Development", a research project to improve understanding of how climate change will affect economic development, and in turn, how economic development shapes resilience to climate extremes and changes. It will make practical recommendations as to how policymakers in developing countries can influence patterns of economic development in order to avoid or reduce the costs of climate impacts. This phase of the research is undertaking four in-depth case studies to understand better how economic development has influenced vulnerability and exposure to climate impacts and the distribution of this vulnerability across different groups.

1.2 Conceptual framework

This case study was developed around a conceptual framework which aims to capture how patterns of geographic and sectoral development affect resilience, while also considering distributional effects, in particular the impact on the poor and marginal groups. Resilience is conceived within the IPCC-defined framework of exposure and vulnerability to climate-related hazards, i.e. the presence of people or assets at risk to climate variation, and the degree to which a system is susceptible to or unable to cope with adverse climate impacts (IPCC, 2001; IPCC, 2014). Vulnerability – the propensity or predisposition to be adversely affected (IPCC, 2014) – can encompass a variety of concepts. In this report we use a commonly cited framework in which vulnerability can be disaggregated as a function of sensitivity, the degree to which a system is affected by positive or negative climate variability or change (IPCC, 2014), and adaptive capacity, the ability of systems, institutions, humans, and other organisms

to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.). These different aspects are integrated into the framework in Figure 1.

Figure 1: Conceptual framework for climate-resilient patterns of economic development

	Vulnerability		
	Exposure	Sensitivity	Adaptive capacity
Geographic			
Sectoral			
Distributional			

Source: *Vivid Economics and ODI (2014)*, developed from *Tarazona et al. (2014)*

1.3 Methodology

The methodology of the case study included desk-based and field-based research, spanning from January to April 2015. We collected and reviewed a variety of socio-economic reports and data about Senegal and generated a list of research questions and data needs based on our conceptual framework. We visited Senegal (Dakar) for 10 days in March 2015, including the M’Bour region and Sally, to undertake interviews and site visits with stakeholders and to collect data. In all, we consulted 15 organisations and government agencies, often meeting with several staff from each.

1.4 Rationale for selection of case study

Senegal was selected as a case study because of its socio-economic profile. Senegal is a lower-middle income country in the World Bank’s classification. The average annual economic growth rate has been around 3% in recent years, with 14.79 billion dollars gross domestic product in 2013 for a population of about 13.5 million.

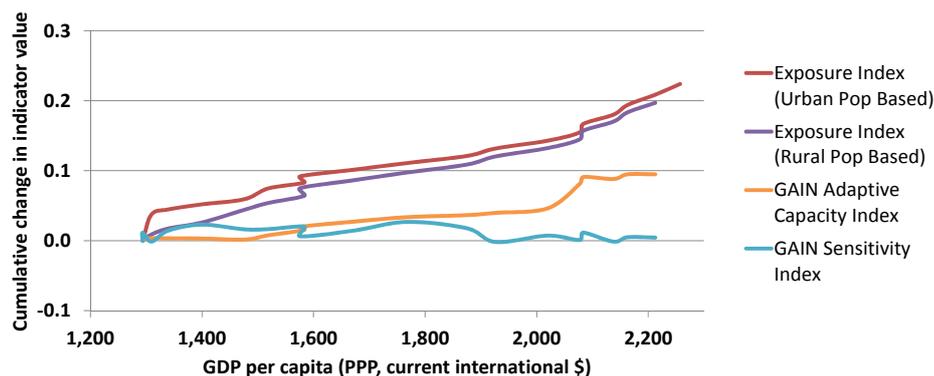
As in all West-African countries, seasonal internal migration (accompanying seasonal agricultural production) characterizes traditional population movements in Senegal. In the last decade, these movements have been coupled with permanent internal migration from rural to urban areas, accelerating urbanisation. Urban centres - mainly located along the coast - concentrate increasing numbers of people and economic activities, and are generating new benefits and also new climate vulnerabilities.

Senegal has traditionally relied on rainfed agriculture, and in many ways is representative of other West African Sub-Saharan economies. However, macro-economic trends over the last decade highlight an economy in the process of diversifying, with growth in tertiary sector activities such as tourism and finance. Economic diversification of products and exports has contributed to economic resilience by diversifying sources of income. Although climate change has not been a particular driver of this diversification, it provides a window to understand how economic transformations can increase or reduce resilience to climate change.

Dakar is a regionally important capital, and so the economic and political changes in this city often influence the whole sub-region. For this reason, Senegal offers insights on how urbanisation, and economic tertiarisation and diversification, might affect climate resilience across West Africa.

Indicators from ND-GAIN index¹ suggest how economic trends in Senegal might affect resilience. Figure 2 shows the ND-GAIN indicators for exposure, adaptive capacity and sensitivity against national economic growth (assessed by GDP per capita). The graph shows an increase in exposure (in both rural and urban areas) and adaptive capacity dimensions, while sensitivity remains constant. However, aggregation and definition of indicators, the ND-GAIN data provides little insight into *how* economic growth has changed resilience. The current study therefore focuses on how economic and geographical patterns (i.e. urbanisation and tertiarisation) have shaped these general patterns of resilience.

Figure 2: GDP per capita and ND-GAIN Index on climate change vulnerability.



Source: ND-GAIN Index, World Development indicators and Authors calculations.

1.5 Structure of the report

Our report is structured into three main chapters. Chapter 2 presents the historic economic patterns in Senegal. Chapter 3 assesses the impact of these patterns on resilience in Senegal. Chapter 4 discusses issues of policy, distributional impact and lock-in with respect to this analysis.

¹ The ND-GAIN Index is calculated at the national level as a composite index of climate change vulnerability using three dimensions: exposure, adaptive capacity and sensitivity. Available on <http://index.gain.org/>

2 Historic patterns

This chapter analyses three main socio-economic patterns experienced by Senegal over the last decade. The first section explains why these patterns were selected, showing that they are representative of regional changes and relevant to issues of climate resilient development. The section also outlines the broad national contexts within which these changes occurred. The second section provides figures and indicators to characterize and analyse these patterns over the last ten years.

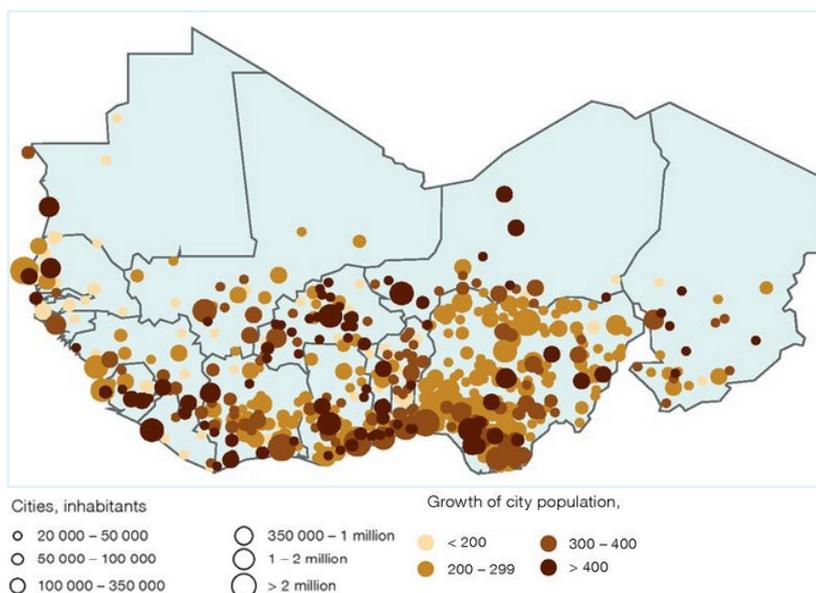
2.1 Context

National and regional socio-economic dynamics

Senegal is similar to other West African countries in terms of agricultural production systems and climate risk. Agriculture is largely based on traditional rainfed and pastoralist systems and so is highly dependent on climate conditions. Correlations between agricultural performance, agricultural prices and rainfall variability are both important in West Africa, although these relationships can be complex (Aker, 2010; Araujo and Simonet, 2012; Ndamani and Watanabe 2014; Yengoh, 2013).

As in other West African countries, Senegal is experiencing large internal migration and urbanisation (Figure 3). The population of Senegal is estimated at 13.5 million, of which about 50% live in urban areas.

Figure 3: West African city growth (in % over 1980-2010)



Source: OECD (2013)

In Senegal, this internal migration is coupled with an unbalanced population distribution between the interiors and the coastal areas. Urban centers, economic activities, and half the

population are concentrated along the coast². In a context of political decentralisation, being implemented in Senegal and across the West African region at various level (Caldeira and Rota-Graziosi, 2014), the question of uneven population distributions and their consequences for equitable economic development is important to examine. Especially for Senegal, this economic disequilibrium combines with specific geographic and climate vulnerabilities.

Finally, Senegal is experiencing significant economic tertiarisation and diversification. Most Sub-Saharan African economies are still dominated by a primary sector and agricultural production that is highly vulnerable to drought events. In this context, Senegal's experience of economic diversification (the country is one of the most diversified economies in West Africa) provides an important lesson for neighbouring countries. In Sub-Saharan African economies in 2013, the average share of GDP from the agriculture sector was 25 % (IMF, 2014): in Senegal it was 17.5%. In the same year, real GDP economic growth in Senegal was estimated at 3% (World Bank, ANSD 3.5%), mainly due to the growth of the services sector (6.4%). Economic diversification in general, and tertiary sector development in particular, which have accelerated over recent years, are regarded as key to increasing economic growth and strengthening economic resilience to shocks.

National context specificities

There are a few key contextual factors that are useful background to understand how Senegal's economy has grown, why, and the implications for climate resilience.

- A sustainable political stability. Considered by the World Bank as one of the most stable African countries, Senegal has a strong and stable democratic and political administration. The last election was recognised by the international community as transparent. Compared to recent events in Cote d'Ivoire, Mali and North Africa, Senegal has political stability in an agitated sub-region. As a result, Dakar is effectively the regional hub in West Africa.
- A vulnerable and indebted economy. Political stability has not been matched by an acceleration of economic growth. Senegal's recent economic growth rate has been around 3% per year on average. The country is still included in the list of the Least Developed Countries. The human development index remains low, and the country faces significant economic vulnerability. A frequent attendee of the Club of Paris, Senegal is heavily indebted in spite of debt relief under the Multilateral Debt Relief Initiative in 2006. Senegal's public and external debts ratios have been substantially augmented in the last years, from 25% of GDP in 2007 (just after the 2006 debt relief) to 49% planned in 2014 by the IMF. The current ratio of the debt service is again close to levels of the initiative for developing countries (3.8% of GDP) and represents a warning threshold for various stakeholders. This level is one of the highest of West African Economic and Monetary Union's countries (UEMOA). Senegal has to implement long-term and important reforms without financial flexibility.
- A dominant informal sector. In 2010, the informal sector accounted for more than 90% of employment in Senegal, 39.8% of the total national production, and 57.7% of the non-agricultural added-value (ANSD, 2013) Income in the informal sector is generally volatile: risks are high and often uninsured, and salaries are lower than in the formal sector. The informality of the economy erodes the country's budget and fiscal base. The formalisation of the private sector remains a political major challenge for the country (IMF, 2014). Data included in this report need to be considered,

² The World Bank report (2014) defines the Senegalese coastal area as the territory of 10 km to the shore along the coastal line (531km). We refer to this area when we cite the World Bank Report. Unfortunately specific socio-economic data have not been produced on this areas. For socio-economic dimension we considering coastal regions of all Senegalese regions with an access to the sea.

keeping in mind that a large part of the Senegal economy is informal and, therefore, not fully reported here.

- **Decentralization reform and the Plan Senegal Emergent (PSE).** Two key national policies support diversification and strengthening of the Senegalese economy. In principle, decentralization reforms should empower municipalities, stimulating growth in urban centers and consequently diversifying destinations for migrants and reducing migration towards Dakar. The PSE aims to redistribute investment around the country and to support economic diversification, particularly in the tertiary sector. These two reforms are key policy drivers of the socio-economic patterns in Senegal.

Selection of the socio-economic historic pattern for the analysis

Against this background, our study examines three key geographic and socio-economic patterns:

- **Migration from inland to coastal areas.** This pattern is also related to rural-urban migration, as the largest and fastest growing towns and cities are in coastal areas. It leads to unequal sub-national development, with concentrations of investment, poverty, sectors and economic activity, and socio-demographic characteristics. We consider how this migration has contributed to changes in climate risk exposure.
- **Urbanisation.** Urbanisation is a global phenomenon, but particularly high in Africa. Africa is urbanizing faster than the other regions of the world and is projected to become 56 per cent urban, by 2050 (UN, 2014). This case study considers how national patterns of urbanisation are shaping vulnerability to climate change.
- **The tertiarisation of the economy with a focus on tourism sector development.** The role of economic diversification as a way to reduce the impact of shocks is well known in the macro- and microeconomic literature (Rugman 1976, Barrett 2001). We consider how recent economic diversification has affected climate vulnerability at the national scale. In particular we focus on the tourism sector, and ask how tourism development has changed the risk profile of the national economy to internal shocks (e.g. drought) and external shocks (e.g. regional health crises).

The following section details these three socio-economic patterns and the next chapter studies vulnerabilities and opportunities for climate resilient development led by these transformations.

2.2 Historical trends

2.2.1 Internal migration, migration from interiors to the coast

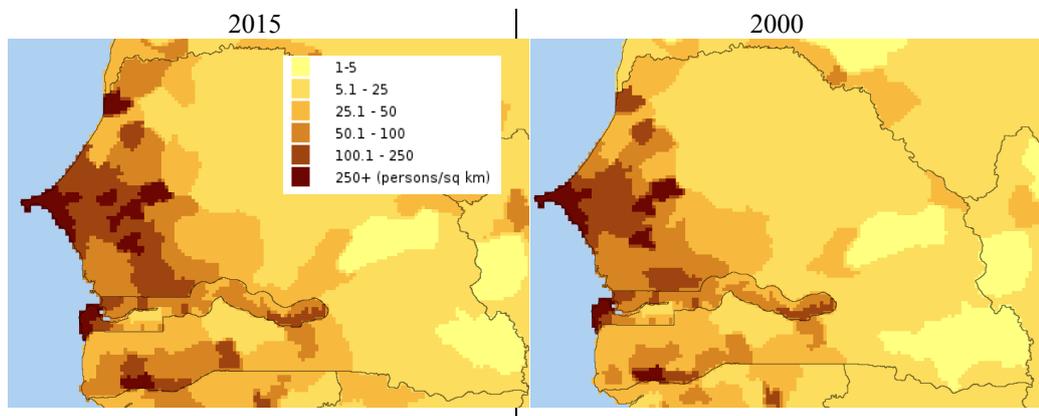
Migration in Senegal is a traditional and seasonal phenomenon, documented at least since the 19th century. This migration is very particular. Early authors studying peanut production, named “navétanes”, found migration followed each peanut growing season. This seasonal labour migration was a coping strategy for rural households to diversify their income (de Haan and Zoomers 2005). Since 1960, migration studies identified a change in the characteristics and an acceleration of the permanent rural to urban areas. Evidence suggests that the decision factors driving this migration include the impacts of drought, lack of water resources and decreasing yields during this period. As climate extremes appear to have been driving mobility historically, experts identify that climate change could have a role in accelerating patterns of migration (UNESCO, 2014). The role of climate change as a push factor of migration in Senegal is still debated but Sall et al. (2011) argue that even if climate change is not a trigger for migration, mobility is still clearly an adaptive strategy. Droughts

and bad harvest are driving factors, while searching for socio-economic opportunity (e.g. jobs) are the main pull factors. The difficulties of the work and the uncertainties of rainfed production are often presented as reasons for migration decisions (ANSD, 2013).

Population distribution over the country is highly imbalanced between interior and coastal areas. Coastal areas have high concentrations of population and economic activities. Population densities are five times higher along the coast than in the center of the country, and around 60% of the population is located in the coastal zones, generating 68% of GDP. This high concentration of economic growth is reinforced by current national migration and leads to environmental vulnerabilities. The Senegalese coastline is densely urbanized, at 25.7% of the shoreline (over the period 2005-2010). The strong and rapid expansion of human activities near the fragile coastline raises local sustainability issues.

The economic patterns over the last ten years have been characterized by the development of coastal regions in the urbanized western part of the country. Increasing population density and activity along the coast is visible over the last 15 years (Figure 4). Current projections indicate growth of the Senegalese urban population at 16% over the period 2005–2030, with maximum growth along the “Petite Cote” of about 49% (World Bank, 2014).

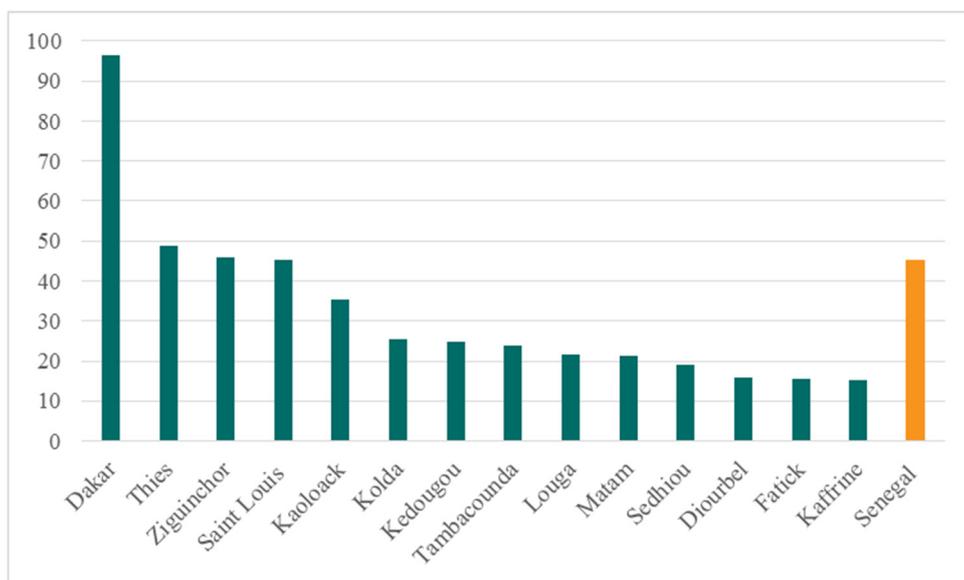
Figure 4: Population distribution patterns



Source: CEISIN Population Density web site.

Coastal areas hold concentrations of urban centres and economic activities. The national Census of 2013, confirms the unequal geographical dynamics of Senegalese regions (Figure 5). The coastal regions of Thiès, Ziguinchor and Saint Louis have an urbanization rate greater than the national average. Conversely, inland regions have a negative migratory budget, especially Louga and Kaolack (ANSD, 2013).

Figure 5: Urbanization rate by region in 2013 (in percentage)

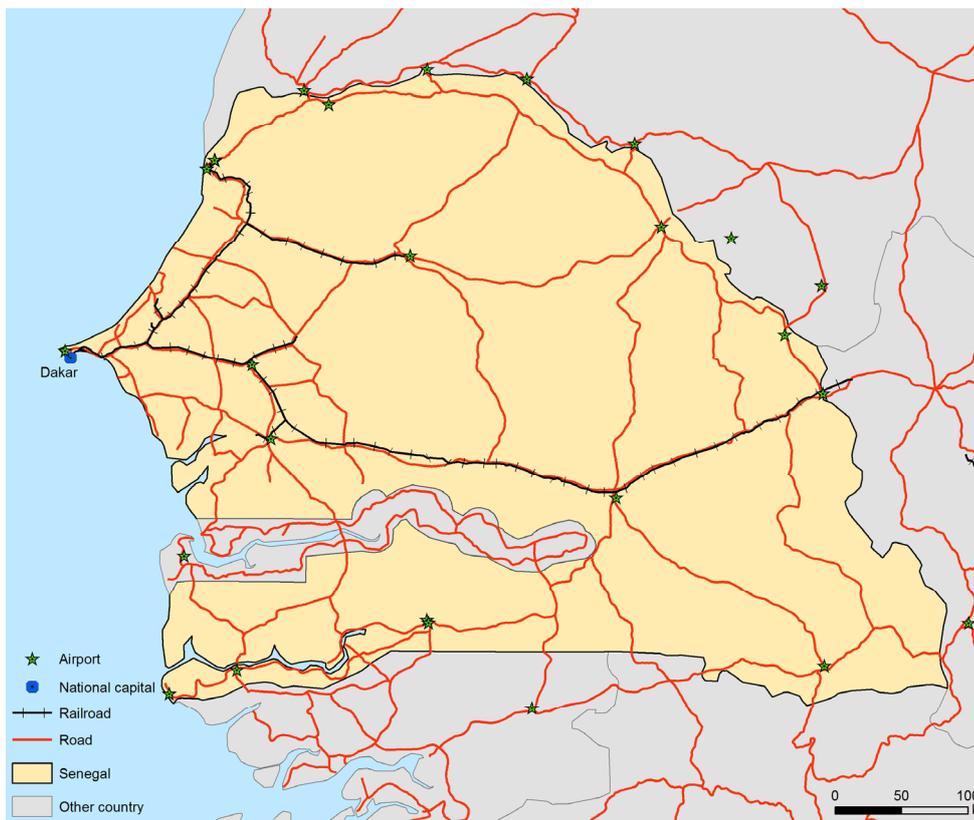


Source: Author's calculation based on National Census data (2013).

The distribution of transport assets over the territory also contribute to the unbalanced population distribution. Major infrastructures are located in or close to the major urban centres and along the coast. For example, Dakar has a strategic port and international airport, and is connected to the historic capital of Saint Louis by a major highway and a railroad. There are fewer major assets elsewhere in the country. As shown in Figure 6, airport and rail stations mainly follow the same unbalanced location and the road network is denser in coastal areas.

Recent decentralisation reform is intended to promote the construction of dynamic urban centres to slow massive population movement to Dakar and create attractive alternative towns and cities for migrants. The growth of the urban centre of Touba is one example of this development, supported by the construction of a highway linking the town to Dakar. .

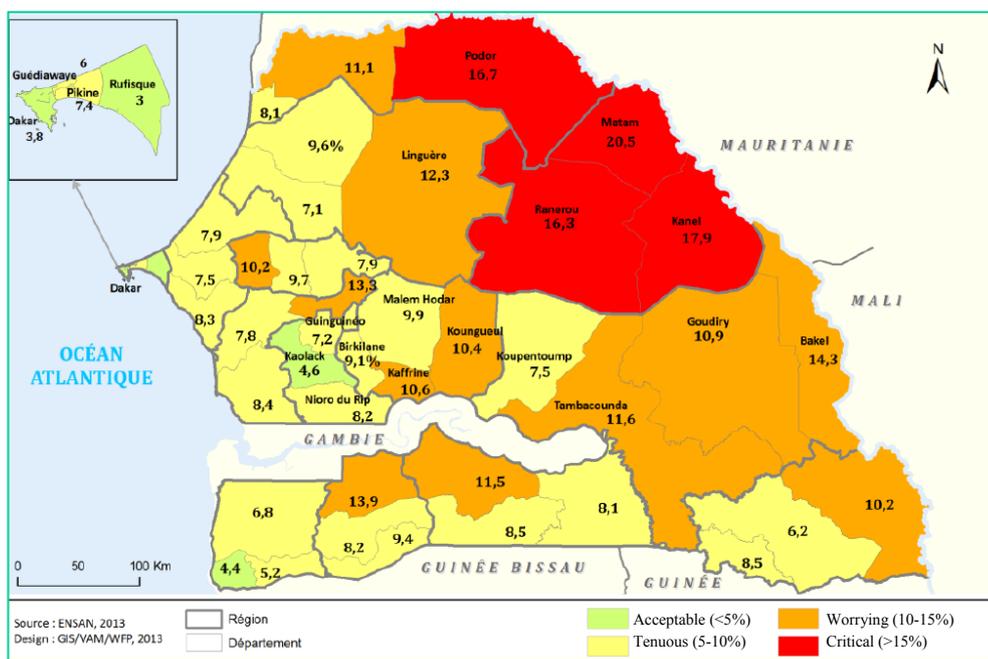
Figure 6: Location of assets



Source: Author's calculation using <http://www.basegeo.gouv.sn/Senegal-vectoriel.html> database and FAO roads map

These geographical disparities in assets and populations contribute to socio-economic disparities. Coastal regions are more developed, with better access to health centres, hospitals and education. In Senegal, the urban population is mainly located along the coast, and is, on average, better educated and healthier. Mapping multidimensional poverty index at the subnational scales confirm these territorial inequalities (OPHI, 2013; UNICEF 2010; Pokhriyal et al. 2015). The coastal zone is also less vulnerable to food insecurity, as shown in Figure 7.

Figure 7: Prevalence of acute malnutrition



Source: World Food Program (2014b)

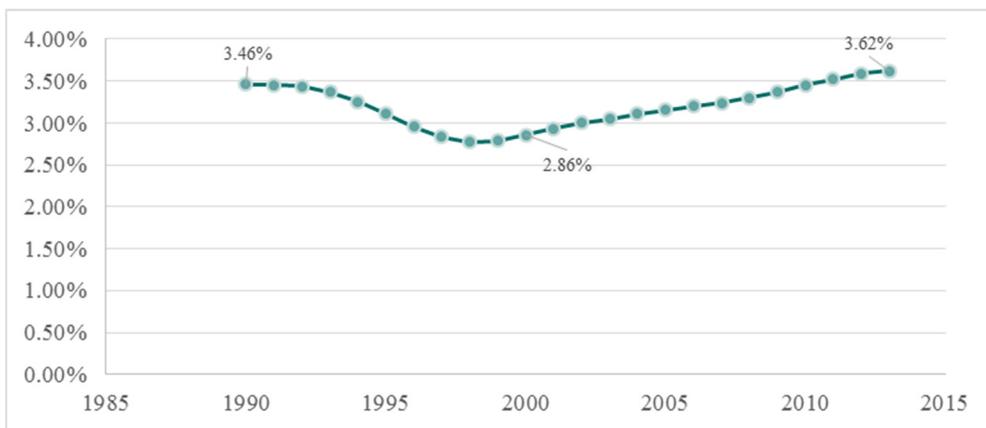
Internal migration from rural to urban areas has been partly driven by the search for new economic opportunities after drought events. The coastal area contains fragile ecosystems, and high concentrations of assets, populations and activities exacerbates environmental issues in some areas. Coastal erosion, for example, is a serious issue along the Senegalese coast, threatening infrastructure, urban areas, and the tourism sector in particular.

2.2.2 Urbanization

The Senegalese population is still mainly rural. Half of Senegalese households are still involved in agriculture, their income relying mainly on rainfed agricultural production. Some regions of Senegal have a particularly rural profile: Diourbel, Fatick and Kaffrine report 80% people working in rainfed agriculture. Despite the “traditional” agricultural profile of the Senegalese population, the main economic pattern of the last decade is growing urbanisation.

The population of Senegal is estimated at 13.5 million, of which approximately 45% now live in urban areas (National Statistics estimations for 2015). Urban population growth rose from 2.86% in 2000 to 3.62% in 2013 (World Development Indicators database consulted in March 2015), with a noticeable increase in the five years to 2013.

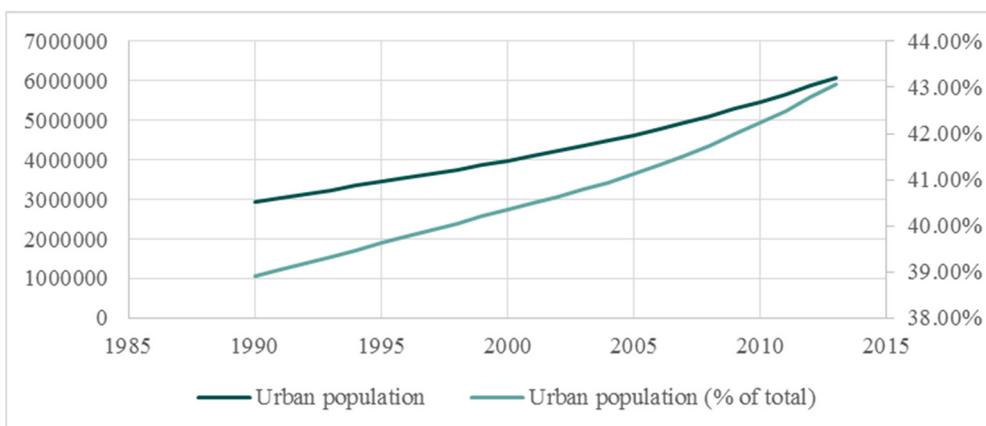
Figure 8: Urban population growth (% annual)



Source: Author's calculation from 2014 World Development Indicators

The last Senegal census report published in 2013 confirms a “rapid and uncontrolled” urbanization (Figure 8 and 9). The urban population doubled from 2.9 million to 6 million between 1990 and 2013, and the urban population as a percentage of the total population also increased from 39% to 43%.

Figure 9: Urban population changes



Source: Author's calculation from 2014 World Development Indicators

Urbanisation is concentrated in two important urban centres: Saint Louis and Dakar. Dakar is densely populated and characterized by a strong urbanization rate. Dakar covers just 0.3% of the overall national surface area, but holds one quarter (23%) of the population (ANSD, 2013). However, the urbanisation phenomenon is national-wide and has led a growth of all city centres over all the country. It also corresponds to an increase of the coastal population.

The urban population is younger than the rural one (more than 50% of the urban people are less than 25 years old). Inequalities in urban centres are also larger and have more significant consequences for living standards and vulnerability than in rural areas (ANSD 2014).

Urban centers are subject to specific climate risk. In Senegal, most losses due to floods events are concentrated in urban centres (World Development, 2014). Over recent years extreme rainfall episodes have caused high levels of runoff, contributing to soil degradation, erosion, and floods of low-lying areas.

2.2.3 Diversification of the economy: focus on tertiarisation through tourism

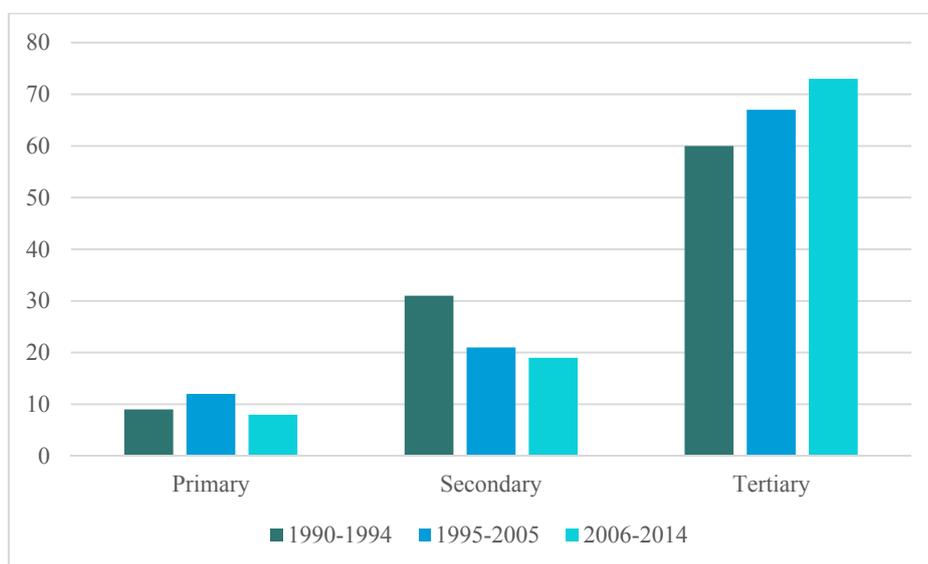
Senegal is one of the most economically diversified sub-Saharan countries. This diversification is the result of a sectorial shift from agriculture to services, including telecommunications and financial services.

Tertiarisation of the economy

In 2013, real GDP economic growth was estimated at 3% (World Bank). This value is mainly due to the services sector (6.4%). The weakness of the secondary sector (-1.5%) and the poor primary sector (-8.3%) explain the weak economic growth in 2013, which reflects a decrease in cereal production in a poor crop year.

While the industrial sector is almost nonexistent in Senegal, the primary and tertiary sectors shore up the economy by their production and the employment they generate. The primary sector is mainly driven by agricultural performance (and fisheries). The tertiary sector is characterized by a diversification of the activities from trade, information and communication technologies (ICT), and tourism.

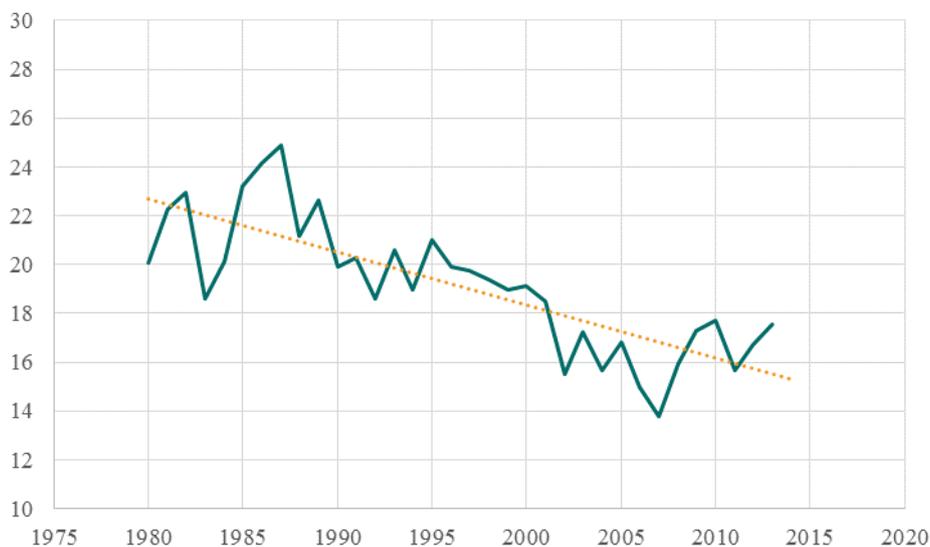
Figure 10: Sectoral contribution to GDP growth (in %)



Source: Authors based on ANSD data and World Bank report (2014)

The Senegalese economy has diversified over the last decade, with a reduced proportion of GDP being generated by agriculture and a large increase in the tertiary sector. Over the period 2006 – 2014, the primary sector contributed just 8% to GDP growth, down from 12% a decade earlier. By contrast, the contribution of the tertiary sector to growth rose from 67% to 73% (Figure 10). Primary sector employment experienced a drop from 63% to 55% of employment between 1980 and 2012. Over the same period, tertiary sector generated 62% of GDP and employment grew from 22% to 33%. Since currency devaluation in 1994, economic growth has been mainly due to construction, telecommunications, chemical industries, tourism and trade business, with declining relative contributions from agriculture (PSE, 2014).

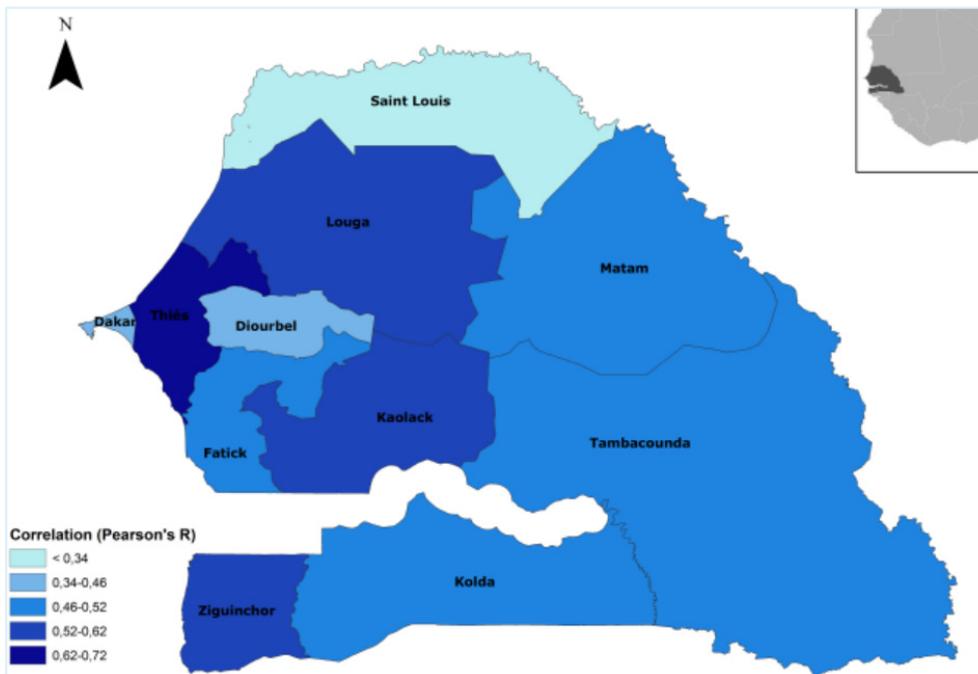
Figure 11: Trend of agriculture contribution in GDP over 1980-2012 (in percentage of GDP)



Source: World Development Indicators (2014), Author's calculations.

Although the economic weight of the agricultural sector is declining, it remains the largest single source of employment and has an important role in food production and food security. Poor harvests lead to critical periods of food insecurity and greater reliance on food imports, and agricultural performance is highly weather dependent. Variable rainfall and climate extremes, particularly drought, are common causes of poor harvests. The contribution of the primary sector to economic growth is irregular and vulnerable to rainfall volatility (Figure 11). This high sensitivity of the primary sector, and erratic year-on-year performance, is mainly due to agriculture that is largely non-irrigated, rainfed and unindustrialized, and which is highly dependent on the rainy season (Figure 12). However, industrialized agriculture, especially peanut production, is also dependent on rainfall (Fall et al., 2013). Over the last decade, all years of low agricultural performance are correlated with low rainfall levels (ANSD, 2014). This high correlation is not uniform over the territory, with areas of irrigated agriculture showing a lower correlation.

Figure 12: Correlations between cereal production and seasonal rainfall at region level, 2000-2012



Source: WFP (2014a)

The tertiary sector represented the biggest percentage of Senegal GDP in 2013, estimated at 59.3%, a performance in line with the historical trend in this sector which is growing every year.

Senegal's profile as a developing country vulnerable to climate extremes and change, with a diversifying economy based in the primary and tertiary sectors, is a useful case to explore issues of climate resilient economic development. Based on a robust macro- and micro-economic theory, this case study will consider whether economic diversification improves national economic resilience to climate change and extremes. More specifically, we set out to test assumptions about the role of the tourism sector in strengthening economic resilience.

Tourism sector

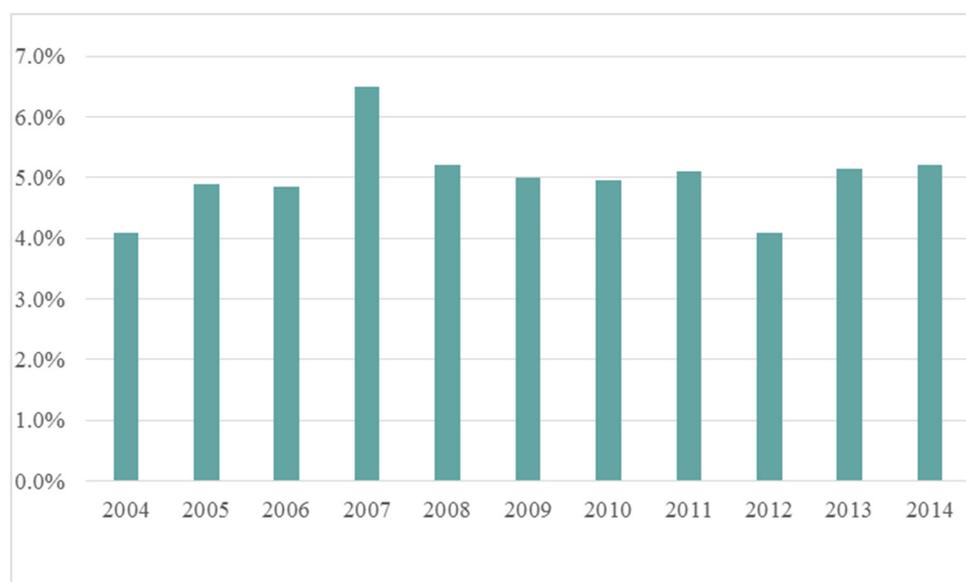
Since the end of 1970's, Senegal's tourism sector has been supported with the help of the World Bank to diversify the economy, reduce economic dependence on agriculture, and mitigate the impact of droughts. Tourism was first developed in coastal areas, especially on the "Petite Côte" between Dakar and Mbodiene, areas previously dominated by agriculture and fisheries. The *Société d'Aménagement et de Promotion de la Petite Côte (SAPCO)* was created in 1975 to support development tourism, and by 1990, the Petite Côte was one of the main tourism destinations in Sub-Saharan Africa.

Today, tourism is a key sector for the economy. Senegal's tourism product has some diversity (see Appendix), but seaside (beach) tourism dominates the sector. In 2000, Saly village, the main touristic village of the Petite Côte, hosted 22% of the overall tourists in Senegal, and the Petite Côte as whole hosted around one third. Most tourists are from European countries, particularly France and Spain, and the sector has a marked seasonality with peaks in January-March, during European winter.

Tourism development is supported by national infrastructure and international investments, notably the highway from Dakar to M'bour (World Bank, 2014). Construction of the new Blaise Diagne International Airport is deliberately located between Dakar and Saly in order to increase access of international tourists to the Petite Côte.

One of the characteristics of the tourism sector is the socio-economic spillovers that have accompanied the development of the sector. The Tourism Satellite Account (CST) is now developed by the Minister of Tourism in order to analyze in detail all the aspects of goods and services linked to visitor activities.³ Economic activities generated by industries such as hotels, travel agents, airlines, passenger transportation services, restaurants and leisure industries are directly supported by tourists, and other activities also benefit from tourism. The total contribution to GDP of tourism was estimated at 11.9 % in 2014, representing FCFA 937.2 billion (WTTC, 2014). It is forecast to rise by 4.2% to FCFA 1,419.9 billion by 2024 (11.2% of GDP). As presented in Figure 12, the direct contribution to GDP of tourism constitutes 5.3%. Moreover the sector is source of formal employment, representing 10.2 % of the overall employment (WTTC). The sector also constitutes the main source of foreign currency for Senegal, a key parameter for a country with a large external debt. Direct, indirect and induced contributions of the sector are summarized in Figure 14.

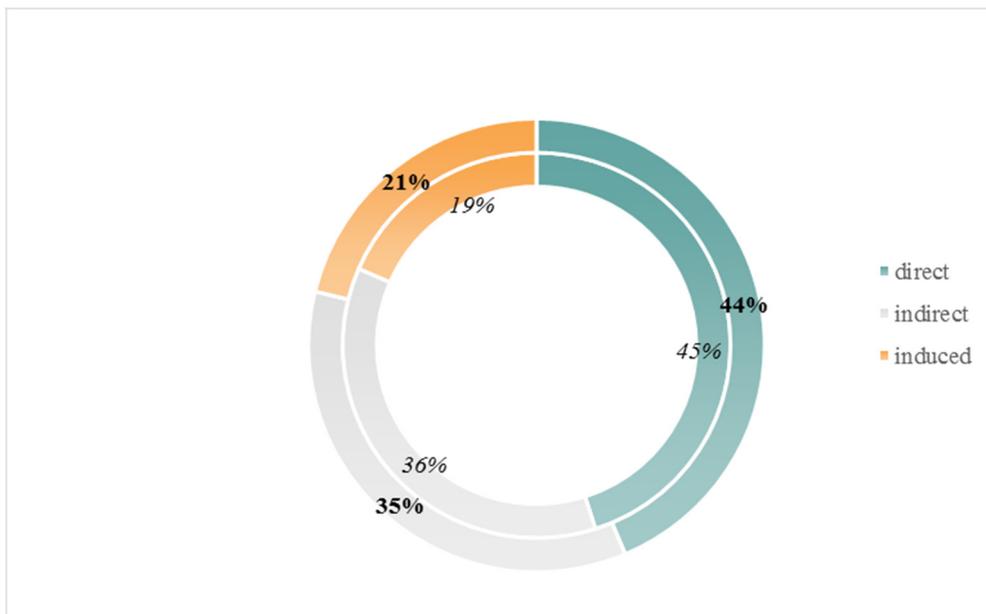
Figure 13: Direct contribution of travel and tourism to GDP (in %)



Source: Author's calculation using WTTC (2014)

³ Methodology established by the World Travel and Tourism Council (WTTC) in collaboration with Eurostat, OECD and UN.

Figure 14: Direct, indirect and induced contributions of transport and tourism to GDP and employment in 2014



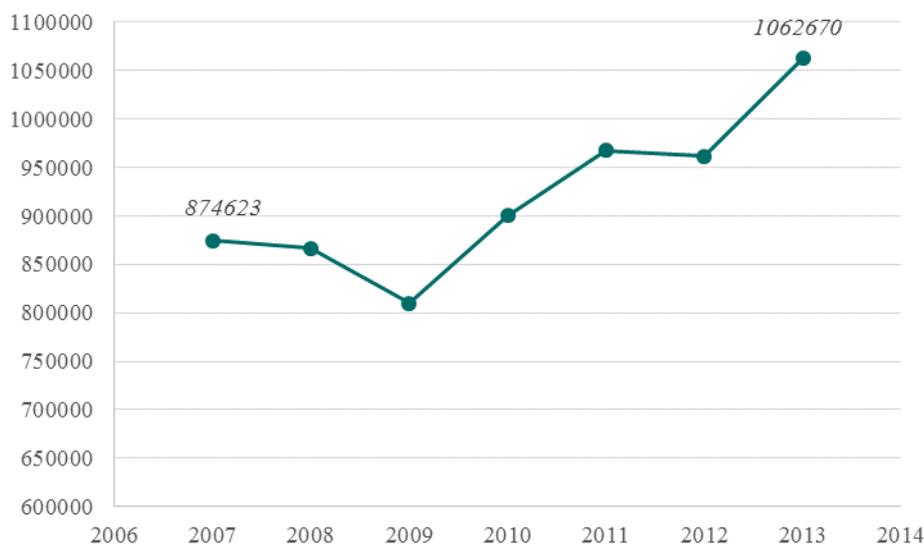
Note: Direct, Indirect and Induced contributions of Transport and tourism to GDP are in italic and Indirect and Induced contributions of Transport and tourism to Employment are in bold

Source: Author calculation based on WTTC statistics (2014)

Senegal has natural assets such as a subtropical climate along the coastline, sand beaches and proximity to European markets. The sector has always seen an important number of entrances. However, the tourism sector in Senegal faces several challenges, and tourist arrivals are sensitive to a range of factors, including some beyond the control of domestic policymakers. Domestic issues and challenges include the need for policy reforms (high taxes, lack of public investment, mismanagement), and the loss of beaches (beach erosion) which undermines the quality of the tourism product. There is undeniable evidence that the erosion of beaches, the most attractive Senegalese tourism asset, has caused severe decline in the tourism industry in recent years.

Recent impacts of the Ebola crisis in West Africa and the Malian conflict on tourism arrivals has highlighted the importance of external shocks and stressors on tourism. The proximity of countries affected by the epidemic or in conflict discourages tourists, who tend to avoid or to postpone their journey to Senegal. At the time of field work, no clear data on the effects of the Ebola crisis were available, but all interviewees agree on a massive impact of these two event on the sector during 2014 and 2015.

Figure 15: Number of tourists entrances since 2007



Source: Author's calculation based on Aviation, transport and tourism Ministry statistics (2014)

2.3 Summary

- Internal migration and urbanisation are important socio-economic development patterns in Senegal. These changes indicate people responding to economic incentives, migrating from drought prone areas where incomes are highly dependent on variable agriculture performances towards urban coastal regions. Migration provides more diversified activities, and income is less correlated with rainfall (drought). At the same time, urbanization and higher population densities in coastal areas have led to unequal subnational development.
- The economic diversification of the country has spread risks. More specifically, the development of the tourism sector development over the last 30 years has diversified national sources of income source. The national and international authorities supported this sector, which has constituted a key component of recent economic growth. This strategy led the development of highly concentrated beach areas now exposed to coastal erosion. However, as this diversification strategy itself was highly concentrated in one area – tourism – this has not removed the vulnerability to shocks, as evidenced by the impact of the Ebola crisis or Malian conflict (although this shock is not climate induced).
- The next section analysis the resilience “budget” of these changes, looking how these have led to a shift in the climate vulnerability profiles of the country. It analyzes how the current economic transformation has respectively affected exposure, sensitivity and adaptive capacity to climate.

3 Analysis: impacts on resilience

3.1 Geographic patterns: migration and tension between rural/urban and inland/coastal areas

Rural-urban migration has accelerated in Senegal over the last decade. Dakar is both the centre of national economic activity and the main destination for migrants. As discussed in Chapter 2, internal migration in Senegal is characterised by a desertion of the interior and unplanned and uncontrolled urbanisation in coastal zones. As a consequence, assets, infrastructure, population and economic activities are unequally distributed over Senegal, with concentrations in coastal zones. This uneven development has led to specific geographic characteristics and climate risks. Coastal urban centres experience floods and storms, while the rest of the country is more exposed to drought. This section investigates how these population dynamics have altered the climate vulnerability of the population.

3.1.1 Geographic patterns & exposure

Senegal has historically experienced large inter-annual and inter-decadal variations in rainfall. The high levels of climate variability are seen in particularly periods of high rainfall years as well as drought years. Future projections of climate change for the region indicate that this variability is likely to continue, and could potentially increase, though there is high uncertainty with the future projections (Niang et al. 2014)

In addition, urban centres located along the coastline are periodically exposed to floods due to heavy rainfall or storm surges today, highlighting issues of land use in the city. These events arise from the heavy precipitation associated with rainfall variability (above), but also coastal wind storms and storm-surges. The latter exacerbate underlying natural processes of coastal erosion, i.e. from wind and wave action. There are, however, some additional anthropic factors (coastal artificialization, dams that decrease sediment supply, sand mining and extraction from beaches) aggravating the issue.

These coastal areas are at potential risk from future sea-level rise, and the associated changes in erosion, inundation, storm-surges, and so on. Climate change, and the associated rise in global mean temperature, is projected to accelerate sea-level rise over the 21st century. Projecting sea-level rise is, however, complex, and a range of uncertainty is usually given in projections (Church et al. 2013).

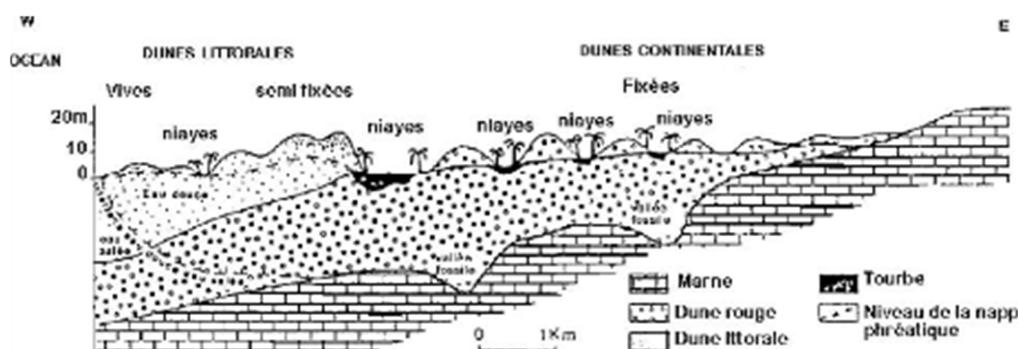
Global mean sea level rise for 2081–2100 relative to 1986–2005 will likely be in the range 0.26 to 0.98 metres (IPCC, 2014), reflecting different future emission scenarios, climate model warming and sea level-response. This can be compared to historic rates: global mean sea-levels rose by 0.17 ± 0.02 metres (Church et al. 2013) over the past century, with higher rates over the last few decades (from 1993 to 2010 global mean sea-level rise increased by 3.2mm/year).

Senegal's rural to urban migration implies a desertion of rural areas, which are most significantly affected by droughts. Although drought can affect almost the whole country, as people leave inland areas (sometimes due to drought events), internal migration reduces population exposure to major events of low rainfall.

Urbanisation is aggravating flood risks. Hardening of roads and surfaces concentrate water runoff in urban areas, especially in formal built-up areas. In Senegalese cities several actors and publications have confirmed the problem of drainage channel sizes and insufficient infrastructure capacity for coping with intense rainfall (interview with INRA researchers). Dakar and Saint Louis are both already affected by run-off flooding (World Bank, 2013). On the 26th August 2012, the area of Fann received 146 mm in less than one hour. This was the second largest rainfall experienced in Dakar on record (IRD databases). Following the event, the area of Fann was completely flooded and inaccessible for several hours. Interviewees identified both recent increases in heavy rainfall events and urbanisation as responsible for the increasing frequency of flood events. However, there is little evidence that heavy rainfall is increasing, as historic records document these events and high variability in the observations makes detecting any recent trends difficult.

Urbanization has, however, driven construction in areas more frequently affected by and exposed to natural hazards. In Saint-Louis and Dakar, urbanisation has resulted in the occupation of flood-prone areas. In Dakar, the historical centre, called "Plateau", is 10 meters above sea level and experiences few flooding events. Recent construction has concentrated in areas more exposed to floods, called the *Niayes*. The Niayes are a geological formations located at the North of Dakar along the coastal areas, and are low-lying areas between dunes that function as flood channels (Figure 16).

Figure 16: Niayes description



Source: Pezeril et al. (1986)

Usually unoccupied, and officially areas in which construction is prohibited, Niayes are now fully integrated in the urban zone of Dakar due to the city's expansion of informal settlements. The informal settlements are prohibited by the municipalities, but very few initiatives exist for enforcing regulations and enacting development controls. During heavy rainfall, the water table rapidly rises due to infiltration, and this reduces drainage and exacerbates flooding from runoff. Several deaths in these areas have occurred in recent heavy rainfall events, with six people dying during floods in 2012.

Coastal flooding is also a risk along Grande Côte. In Saint-Louis, exposure to flood risk is significantly affected by the risk of coastal flooding, and will be further affected by future sea level rise, especially in Saint-Louis where elevation of the buildings are close to zero meter above sea level. Recent flooding events illustrate the important and growing population exposure to flood, mainly due to the recent occupation of flood prone areas (World Bank, 2013). More than 50% of the coastline is already considered at high risk from storm surges, particularly along the Grande-Côte.

The World Bank's report (2013) analysed the coastal land use occupation and, assessed the exposure dynamics of the coastline. The report projected that urbanisation (share of building occupation) in the Petite-Côte Region will grow by 49% (coverage of building areas) between 1990 and 2030, representing the most significant change in the exposure to climate hazards

over the coastline. Over the 2005-2030 period, the study estimated that change in coastal land use will accelerate. Superficies of urbanized areas are projected to increase by 16% over the coastline (following coastal definition of the World Bank report from 143.3km of urban land use in 2005 to 166.5km in 2030), to the detriment of agricultural and natural areas (Figure 17). This urbanisation implies a greater exposure of assets and population to coastal climate events.

Figure 17: Evolution of coastal occupation with respect to the baseline situation

	1990 (km)	2005 (km)	Diff.	1990-2005 (%)	2030 (km)	diff	1990-2030 (%)
Urban	127.0	143.3	16.3	13%	166.5	39.5	31%
Agricultural	260.8	249.0	-11.9	-5%	236.4	-24.5	-9%
Natural	126.7	122.3	-4.4	-3%	111.7	-15.0	-12%

From World Bank 2012

Internal migration has led to the construction of assets and infrastructure directly affected by flood and coastal erosion. The Senegalese coastline is facing the consequences of an unplanned land-use and development regime. In turn, accelerating coastal erosion deteriorates and destroys private and public infrastructure, and dwellings located in this area (World Bank, 2013). For instance, traditional fishing communities in Rufisque and Bargny underlined that sea encroachment has been present for many years but that it has greatly intensified over the past decade. It is characterized by coastal flooding and storm surges, and rough seas with waves of more than 2 meters damage seafront buildings (World Bank consultation, 2012).

Nonetheless, these areas remain economically valuable compared to inland zones, with land prices and markets remaining high and strong in both urban and rural coastal areas. The values of stationary assets such as houses and land do not yet appear to be affected by exposure to floods, erosion and sea level rise. Despite the risks, individual investors still regard coastal property as desirable, and assets in urban and coastal areas remain more valued than in rural areas. For the labour market, the urban and coastal areas are still considered as an important place for employment: indeed, the desertion of inland rural areas is making it difficult for farmers to find workers (INRA researcher interview).

Policy decisions at local and national level are increasingly taking growing exposure to flood risk into account, and trying to identify measures for improving prevention. An independent ministerial secretariat is developing an early warning and emergency response system to reduce flood risk. Nonetheless, policy decisions and actions often lack coordination and coherence. The Coastal Act is another illustration of the interest of the government in the problem, although it has been waiting to be passed into law since 2009. The draft law is creating many expectations, as it is supposed to regulate the real estate market, and establish rules for construction and creating protected areas in coastal zones. The recent Plan Senegal Emergent aims to balance population distribution and economic activities locations by future investments. For example by favouring local and regional airports. To date, the planned national infrastructure investments are mainly located in focus areas of economic development: (as illustrated by the future airport aiming at reinforcing the link between Dakar and the south coastal area). If national public investments are not directly constructed in exposed areas, their location can reinforce asymmetries and drive population movements. Governments and ministries are sensible to the issue of increasing exposure to floods and coastal erosion, and regulations for urban planning and coastal development, although not yet adopted, are intended to reduce this exposure

Rural to urban migration is an important demographic phenomenon over the last ten years in Senegal. Driven by economic factors, migration has led to two population distributional aspects: the growth in the existing urban centres and a strengthening of coastal urbanization. Migration has changed the population exposure to natural disasters: reducing populations in drought-prone inland, while increasing the number in coastal and flood exposed zones. Economic assets and activities are also mainly located in the coastal and urban areas. National

investment have always been important and asymmetric between rural to urban areas, but recent rapid urbanization has reinforced this asymmetry. Nonetheless, recent policy decisions (PSE, Coastal Act) confirms a real political desire to reduce this exposure and vulnerability by: (i) better managing coastal and urban occupation and (ii) improving decentralised investments in order to slowdown the migration pattern.

3.1.2 Geographic patterns & sensitivity

Internal migration and seasonal population movements can be understood as a behaviour that reduces the exposure (if the migration is permanent) or the sensitivity (especially for seasonal migration) to drought. Seasonal migration helps households to diversify their income sources. Then, working in tertiary sectors during the dry season, the household's income is less dependent on the rainy season and agricultural harvest.

Reducing drought sensitivity is complex. Water infrastructure, such as for irrigation, is a costly investment. Especially in inland areas (semi-arid and Saharan regions), irrigation is not necessarily an appropriate option given the crops cultivated or the behaviours of households. Diversifying source of income to non-agricultural activities is one of the best options for households to reduce their drought sensitivity. Permanent and seasonal migration respond to this reduction of sensitivity, and work condition and income variability are often cited as departure drivers by young people (ANSD survey on migration, census report). Migration reduces overall sensitivity of the population to drought by reducing the dependency of the population to climate sensitive activities (agriculture and livestock). But migration and urbanisation raise potential new sources of sensitivity to climate risk.

Urban and coastal areas are places of economic activities less sensitive to certain climate extremes than agriculture (trade, TIC, transport, buildings, and public services). However, urbanisation increases other kinds of sensitivity because of hardening and non-adapted building. Flooding during storms and heavy rain sensitivity is increased by urbanisation. Floods that affects urban areas have important economic consequences. In particular, the city of Saint Louis and Dakar are sensitive to the phenomenon. This situation is critical in Saint Louis, a city that is highly sensitive to flooding from the Senegal River. The study of the World Bank assessed the main damage from future climate change on flooding at 1 550 billions /year (FCFA) in coastal areas (sea-level rise and inundation, coastal erosion, and river floods) by the 2080s. This was about 25% of GDP in 2010 and 35% of GDP in coastal areas. Saint-Louis was projected to experience half of the estimated damages.

Moreover migration patterns exacerbate inequalities of sensitivities. Poor people do not have the means to migrate (which is costly) and so usually stay in rural areas, employed in climate sensitive activity. The poor urban population is often locked into informal settlements areas that are particularly exposed and sensitive to natural hazards. Saint river side and Dakar have large areas of low-lying informal settlements. These zones are more at risk and land planning of these areas is a recent concern of the authority. Flood sensitivity is important for informal settlements and informal commercial activities based on these areas. All informal economic activities are completely stopped during severe floods in Saint Louis (University researchers' interviews). These findings are confirmed by loss assessment of the 2009's flooding event in Dakar. In 2009, flooding mostly affected formal and informal trade sectors (World Bank, 2010). Losses in the sector were estimated to be 1 305 million FCFA for formal and informal trade activity. 75% of the losses were experienced by the informal trade. The discharge capacity of the urban canals was judged to be insufficient in most of the city centres (World Bank, 2014).

Finally, urbanisation raises another potential problem in areas such as Dakar: the population's sensitivity to water shortages, especially during dry periods. Data from SONES shows that half of Dakar's supply comes from surface waters channelled from Lake Guiers, and that the other half is supplied from boreholes. Increasing aridity – due to a combination of factors - is increasing the risk of water deficit in the short term for all the other urban areas along the coastline. While Senegal experiences periods of higher and lower rainfall, there does seem to be a recent trend of reducing global annual rainfall contribution, with a reduction from 176

billion m³ to 132 billion m³ since 1970, a loss of almost 25% of annual rainfall (Ndiaye, 2009). Along the coastline, sea level rise will add additional pressures. Although this is not yet a limiting economic performance, it is likely to be a growing problem in the future (World Bank 2014). Potential decreasing rainfall in the upper Senegal River catchment, increases in evaporation due to higher temperatures, and increasing competition for water and demand from urban areas could lead to much more demanding conditions for the management of Lake Guiers. Moreover the hydrological balance of all the water tables is currently in deficit, and has been so since the 1960s in Dakar. This situation, combined to a deterioration in surface water quality due to overexploitation, means there are no obvious options for mobilising alternative water sources.

Moreover previous large national investment supported by World Bank to reduce flood impacts in informal settlements in Dakar illustrate policy makers' awareness of the issue. The development of Early Warning Systems (EWS), national disaster planning, and a secretariat ministry specially dedicated to flood risk illustrates capacity development at the national level to manage this growing risk. Urban drain to reduce sensitivity to flood are recognised as being important, and this is reinforced by plans for further investment. For example, 50 billion FCFA between 2006 and 2012 has been requested by the Plan Jaxaay in Dakar to construct flood defences. State and municipality authorities are more and more concerned by the sensitivity to flood in urban area and informal settlements. In Dakar, recent initiatives undertaken by the government aims at reducing the flooding risk during rainy season (drainage channels).

Nonetheless we find it important to highlight that this political awareness must be aligned with rigorous disaster risk management planning. Historic attempts to manage flood risk have not always been successful despite the political willingness. In Saint-Louis, the breaching of the Langu de Barbarie to manage river floods has had serious negative consequences (cf. Appendix) which are important not to repeat. Disaster risk management decisions, to be effective, need a combination of political will, good early warning system but also long term planning that takes account of environmental consequences.

3.1.3 Geographic patterns & adaptive capacity

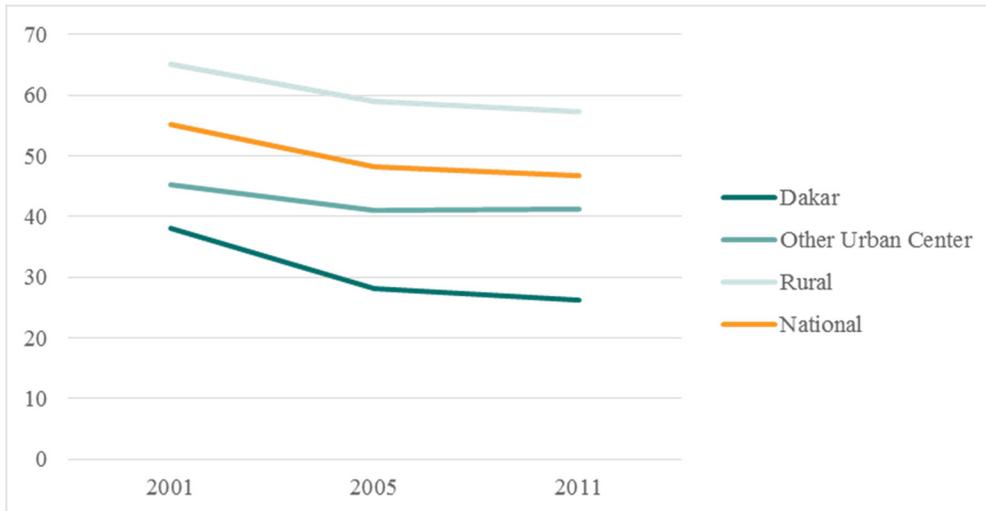
Senegal's geographic pattern of growth is mainly one of infrastructure development along the coastal areas and a population movement from inland to urban coastal cities. This development has influenced adaptive capacity in various ways.

As shown in the previous section the coastal development has led an asymmetric development in term of infrastructure between rural and urban areas, with roads, investments, and airports mainly concentrated in the coastal areas. This development has consequences for human and institutional capacity in the coastal zone. Dakar and Saint Louis are now just three hours' drive apart, and infrastructure along the whole coastal zone facilitates migration as adaptive strategy. Seasonal migration or permanent migration with intra-household's funds transfer are two ways of coping with shock by diversifying the sources of risks. For instance, several hostels managers underlined that their seasonal workers are coming from rural areas, and typically migrate during the dry season. In Dakar, a significant number of workers are single men transferring their incomes to their family in the rural areas to supplement agricultural activities. At the same time, these infrastructures have helped the connection between agricultural areas and producers (especially horticulture) in the coastal areas with urban centres, guarantying demand and more stable prices. However this asymmetric development of infrastructure has left behind remote and interior rural areas. The adaptive capacity of these areas benefit from the development of urbanization only through funds transfer and remittances. The incidence of poverty had the most important decrease in Dakar (from 38.1 to 26.2) whereas in rural areas it is still really high (57.2 in 2011). Malnutrition prevalence follow the same pattern (WFP interview). In the last Census, alphabetisation rate presents also a clear unequal performances from 28.4% in Matam to 68.6% in Dakar.

Interviews at the Ministry of Decentralisation also revealed high heterogeneity across municipalities in term of local receipt from taxes. Important urban centres (Dakar, Saint

Louis) seem more capable to rely on stable fiscal basis and so fully benefit of decentralisation reform whereas this capabilities are still really poor in rural municipalities (Figure 18).

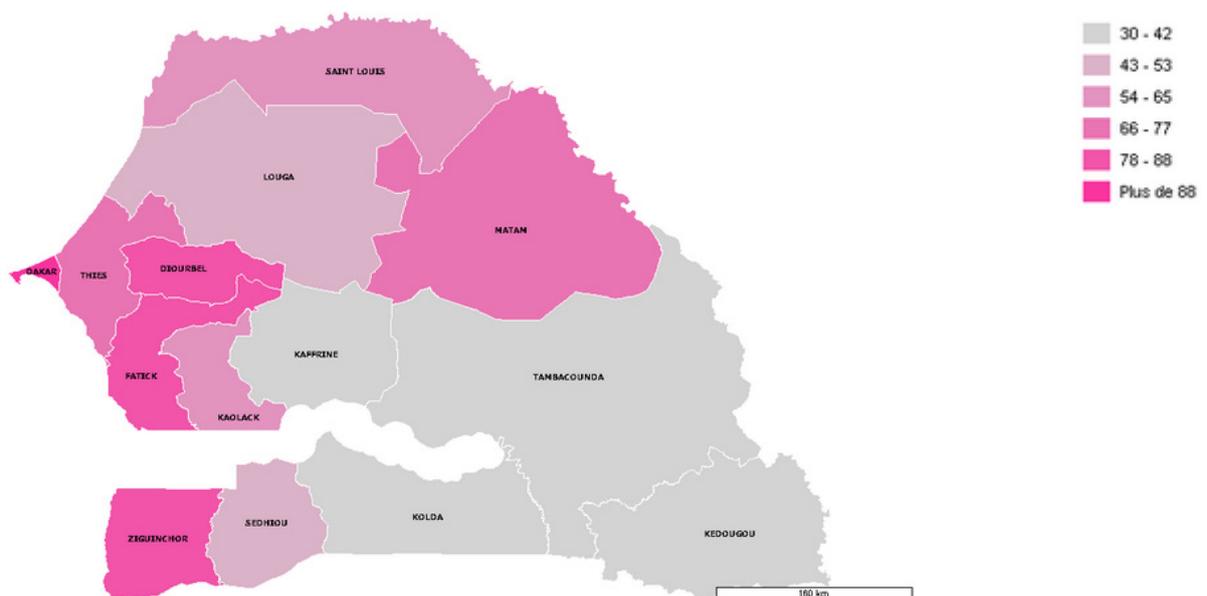
Figure 18: Poverty incidence changes



Source : Enquête de Suivi de la Pauvreté au Sénégal (ESPS-II), ANSD

School and health coverage represent also this imbalance. Rural population is more spread across the territory. *The Programme d'Eau Potable et d'Assainissement du Millénaire* (PEPAM) helps the government to reach the MDGs in term of provisioning water. The share of the population having access to water in urban areas is almost complete (from 97% in 2009 to 98.7%) whereas in rural areas improvements have been more important (from 73.6% to 80.1%). But results for sanitation are still low, with average coverage of 34% in 2011 in rural areas 63.3% in urban zones (IMF, 2013).

Figure 19: Share of population living at less than 5km to health centres



Source: ANSD website based on data from 2009's survey

Urban centres create new risks in the form of floods, and the government appears well aware of these problems, even if urban use planning and disaster risk management need to be improved (especially post-disaster management). Individuals are still attracted by migration because of socio-economic opportunities, and because the new risks they are exposed and sensitive to are less than the drought risks they are leaving or diversifying away from. For instance we can imagine the trade-off calculated by a person now leaving in the Niayes in Dakar for whom the high vulnerability to flood is still positive compared to the risk and consequences of drought and consequences at home. Overall they perceive the gain in term of health centre access, education and economic opportunities as more important.

It is not clear whether migration to urban areas necessarily improves access to basic services. For instance the last census 2012-2013 in Senegal, summarised in the Figure 19, highlights a good availability of basic health service in all Senegalese regions (an average availability of 75% for all basic health centres characteristics). However, access to public services is below average both in remote interior areas and in highly dense cities such as Dakar, Kaolack, Kolda and Tambacounda (ANSD, 2014). This implies that as rapidly growing urban areas struggle to provide high levels of service, and may not be strengthen the adaptive capacity of migrants as much as might be expected.

Summary – impacts of geographic patterns on resilience

Over the last ten years rural-urban migration has coincided with a rise of new exposure. Drought exposure is still high for all the population in the country because this is phenomenon determining food availability. Drought also affects all the population through water and food availability. Urbanization and coastal land occupation have led to do new exposure of assets and people to coastal erosion and floods, primarily driven by socio-economic drivers. Private and public infrastructures loss are already noted along the coast and the exposure of people and infrastructures to floods and coastal erosion is expecting to be more important in future decades

Urbanization and rural-urban migration are reducing existing drought sensitivity by diversifying income sources and risk likelihood. Cities are place of income diversification, they are also providing economic activity and compensating drought sensitivity. Migrants' behaviors imply fund transfer to the origin regions, helping to mitigate drought consequences, although the new economic activity in coastal and urban areas exposes people to flood risks. The net change in risks from these changes is unquantified, but indicatively, it is likely to lead to a net reduction risk, at least in the short-term (or future risks of climate change). Moreover government's infrastructure to face to floods and sea level rise aims at reducing the overall sensitivity of the economy.

The high levels of urbanization coincides with important economic growth in the country. Urbanized areas are centres of various economic opportunities. Services provided in urban centers (school, health centers, and public transport) help to reinforce the adaptive capacity of the population. Urban centers are drivers of Senegalese economic growth, they host a population that is healthy and more educated than those in rural remote areas where the prevalence of malnutrition is still high. Moreover rural-urban migration provides an opportunity to compensate and cope with drought events by providing diversified sources of income (through seasonal migration or fund transfer between households' members). However it is still important to note that although this helps cope with drought shocks it is also leading to rural desertion which leaves the agricultural sector with less workers. Moreover the migration has also led to a disequilibrium in term of public and private investments and political attention: it is important to underline this to prevent a socio-economic abandonment of rural areas.

3.2 Sectoral pattern: tourism as example of economic diversification and tertiarisation

This section focuses on the development of the tourism sector. Tourism has been a key part of economic diversification away from agriculture at the national level, and we will consider how the tourism development pattern is an adaptive strategy to climate. Tourism has numerous economic advantages in the Senegalese economy: it is an important share of the formal employment, foreign currency provider, and has spillovers into other economic sectors that include trade, transport, and handicrafts and retail.

In Senegal, tourism development has been a way to diversify the economy and to develop sectors less vulnerable to drought. However the high concentration of the sector has led some new forms of vulnerability.

Senegal's economy is mainly exposed to drought and floods events, but the tourism sector is particularly vulnerable to coastal flooding and sea level rise, and the consequences of coastal erosion. Tourism sector development is supported by important public infrastructures including road networks and airports, and most of the main public and private touristic infrastructures are concentrated in the Petite Cote where they are highly vulnerable to coastal erosion. Some hotels have already closed in Saly, a main tourism destination. This high exposure and sensitivity of the sector has already had physical and economic consequences. At the same time, the importance of the sector and its exposure and sensitivity to coastal erosion have helped raise the political awareness for the issue.

There is little data on how current climate variability or future climate change will affect the tourism sector. Data related to tourism in Senegal is mainly confidential and not available for sharing and evaluation. There is also apparently no regular public survey about levels of touristic satisfaction. There is no clear correlation between tourism decline and beach erosion due to the lack of data, although sector specialists have noted that this is a contributing factor.

3.2.1 Sectoral pattern & exposure

International tourism in Senegal relies largely on beach tourism. Tourism arrivals in the future could be affected by changes in seasonality due to temperature increases, or by changes in environmental conditions and risks resulting from climate change (Bigano et al., 2008).

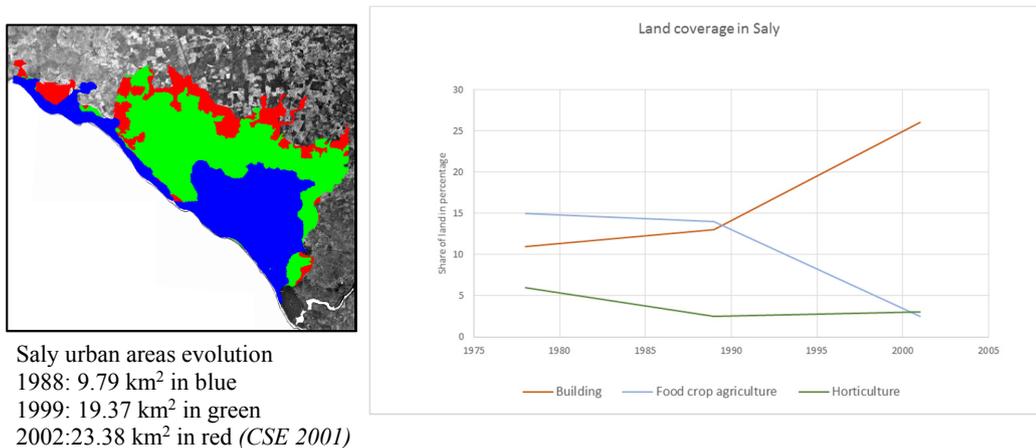
The changes in climate could affect the attractiveness of the climate for beach tourism. This change is usually captured through a metric called the Tourism Climate Index (TCI). The TCI is a composite measure aiming to assess the climatic elements influencing to the quality of the tourism experience. The index has been first defined by Mieczkowski (1985), since then the definition and the composition of the index have changed but the purpose is to assess physical climate dimensions that could influence tourism activity. A change in this index regarding climate change projections could impact the future touristic attendance in Senegal, although changes in this index need to be seen in the context of other changes globally given the international dimensions of the sector.

Senegal's tourism sector is also potentially vulnerable to environmental changes in the coastal area. As described in the previous section, coastal beach tourism is the main contributor to the tourism sector. Beach zones are particularly exposed to coastal flooding, erosion, and in the future, sea level rise. The Petite Cote and also Dakar is already suffering from coastal erosion, and projections made by the World Bank (2014), expect an increasing vulnerability of all coastal areas in the future.

Touristic infrastructure is concentrated in La Petite Côte, an area south of Dakar that runs for 110 kilometres from Bargny to Pointe de Sangomar. Beach tourism is mainly concentrated in 90km of coastal zone from Bargny to Joal Fadiouth, with around 20 villages and urban areas. Saly, which hosts the majority of beach tourism near Dakar, was a fishermen's village in the 1970's. All the available land is now covered by hotels or residential buildings, and land occupation by buildings rose from 10% to 25% between 1978 and 2011 (Figure 20). Saly has 15 different hostels and 23 holiday homes intended for rental, many of which were supported

by the Senegalese government between 1980 and 1990 through SAPCO⁴ with the support of World Bank funds. Many touristic buildings are located close to the shoreline, and the unplanned and uncontrolled nature of construction has both exacerbated coastal erosion and led to high exposure to coastal flooding.

Figure 20: Change in the land occupation in the area of Saly



Source: Author's calculation based on CSE report (2001)

Most hotels managers interviewed in Saly have already seen their beaches reduced, disappeared or hard infrastructure destroyed (Figure 21). Some hotels experiencing high levels of coastal erosion cite that as a main reason for their poor performance in recent years

Figure 21: Example of coastal erosion impact on the touristic areas in Senegal (south of Dakar)



Source: Intac (2011)

Urbanisation and touristic buildings have accelerated the erosion process and probably exacerbated their own vulnerabilities to coastal risks. Moreover, poorly planned actions by the private sector has also had negative consequences. For instance, in Saly each hotel has built its own breakwater to reduce beach losses (see pictures). However, the lack of planned coordination and reliance on *ad hoc* construction has led to an overall acceleration of erosion.

In the areas of Saint Louis, some hotel camping areas were also exposed to flooding and erosion during the Langu de Barbarie opening (see Annex 2). No clear assessment has been made of the costs to the tourism sector due to the losses of the camping settlements in this

⁴ La Société d'Aménagement et de Promotion des Côte et Zone Touristiques du Sénégal (Society for the Planning and Promotion of Coastal and Tourist Areas of Senegal)

area, but private actors recognise that, similar to the beach in Saly, this erosion has damaged a particularly attractive part of their tourism offer.

Over-urbanisation and the concentration of tourism activities in a sensitive and fragile environment has exacerbated erosion. Today, more than one third of the tourism sector is directly affected by coastal erosion, and infrastructure is already being undermined and damaged (author's assessment). In turn, high levels of erosion are increasing exposure to storm surges, coastal floods, and in the future, sea level rise. The PSE and the Tourism Development Plan for the period 2014-2018, recognised the high exposure of the tourism sector to coastal erosion and support integrated approach with a systemic assessment of environmental cost benefits analysis in new touristic areas development in the future.

3.2.2 Sectoral pattern & sensitivity

Senegal has always experienced high levels of rainfall variability. However, there are some observed changes in rainfall pattern and anecdotal reports of increasingly erratic rainfall, heavy rainfall, and shortening of the rainy season. These reports must be treated with caution given the region's characteristic inter-decadal variability, but these changes are linked to poor agricultural performance in various crops by local experts (e.g. CSE, 2010). In particular, erratic rainfall and shortening of the rainy season is blamed for poor crop development and low agricultural yields.

In some areas, soil salinisation has led to dramatic impacts on rice cultivation, and cultivated areas in Kaolack, Ziguinchor and Kolda have been abandoned due to soil salinisation. Salinisation is also affecting horticulture in Gandiol in the Niayes. It has been estimated that by 2025 cereal production in Senegal could be reduced by 30% due to the reduction of agricultural lands (Funk et al, 2012). The inland salinization is due to both to saltwater intrusion (especially in Saint Louis region with the breach in the Barbary langue) and poor water and bad crop management (all along the coast).

Against this background, the tourism sector is an opportunity to reduce the exposure and sensitivity of the household and national economy to drought. Drought periods have a direct impact on the economic performance of the country through reducing yields from agriculture and livestock production. Drought is costly for the Senegalese economy and has numerous consequences in Senegal, as most agriculture is rainfed. The economy is directly impacted by a bad rainy season, which is highly correlated with low production (but all poor production years are not all due only to the rainfall). These events happen frequently, and some areas suffer food insecurity as a consequence.

These shocks often force households to temporarily reduce their consumption. This situation - even when transitory - can force poor households to sell their assets to compensate for the loss of revenue. Droughts can also affect negatively the production capacity of the household over several seasons and over the long term. This has a chronic or persistent impact on the future households' situation (Rosenzweig and Binswanger 1993, Rosenzweig and Wolpin 1993a, b, Jalan and Ravallion 1998 Morduch 1999, Jalan and Ravallion 2001, Dercon and Christiaenen 2011). Even if most of these studies are not specially focused on Senegal, they report general findings that are applicable, especially given insurance coverage is very low in Senegal especially for poor rural households. Drought is therefore responsible for a vicious poverty circle (Lokshin and Ravallion 2000, Sarris and Karfakis 2006). These lock the household into a low equilibrium. Long term consequences are especially visible in low human investment with for instance a low education investment or a stop in child scholarship (Duryea et al., 2007) or a diminution of the health care expenses (Jacoby and Skoufias 1997). Beegle et al. (2006) show how in Tanzania economic shocks are directly related to child schooling and Hoddinott and Kinsey (2001) confirm the important impact of drought on child health and malnutrition in Brazil (through economic channel). Furthermore, a poor state of health and a low education have important consequences on the future productivity and wealth in adulthood (Barker 1998). Long term consequences of fragile health in childhood can't be underestimated regarding the various repercussions (Dercon and Hoddinott 2003, Strauss and Thomas 2008, Ferreira and Schady 2009, Alderman 2011). Drought is also a

factor in exacerbating poverty and insecurity of households (Morduch 1995). The overall consequence for Senegal are high, although there is a low base of empirical evidence. The shift to tourism therefore will change risks.

The tourism sector has several spillovers on the economy. Tourism generates taxation revenue for the government through airport taxes, residential taxes, sales taxes and other sources. Second, the sector creates jobs directly in activities such as hotel employment, and guiding. Third, it creates demand for goods and services from others sectors such as handcrafts, transport, and food. Peak tourism corresponds to the period of January to March which is the low agricultural activity period. With this timing, tourism activity raises the demand for horticultural products during the dry period, creating incentives for irrigated agriculture. So the tourism sector is a source of diversified income during slack agricultural period, and contributes to reducing the sensitivity of the overall Senegalese economy to drought.

During field work, several tourism stakeholders confirmed the importance of activity during dry season for income diversification at the household level. In touristic areas, it is common for families to develop a tourism-related activity to complement the agricultural main source of income. Typically, young people are employed as touristic guide and the women develop a handcraft activity. Some households also have changed their crop in order to respond to demand from hotels and restaurants. For instance, a hotel manager in Saly mentioned a significant improvement in the regional/local supply over the last decade to meet the higher standards expected by tourists. Farmers interviewed talked about the choice they have made to reorient their production in line with hotel demand. For instance some of them have abandoned chicken production for rabbit or quail farm.

In Saly, partly due to the increased demand from urbanisation and tourism, there is increased competition over land and water resources, and this is translating into increased sensitivity to climate change. At the local level actors mentioned some tension regarding the water use by the hotel and leisure activities in Saly. For instance, irrigation of golf courses with recycled water is a source of tension between local people and farmers and the tourism sector.

Tourism is highly sensitive to the water management in the area. Swimming pools, golf courses, fountains and irrigated garden/parks are all seen as key parts of the hotel package. During the last ten years the tourism sector has benefited from a discount in their water utility bill. Water supplies in the area are mobilised from groundwater, and the abstractions current exceed recharge levels. This has not yet translated into water shortages in Saly and touristic areas. However, a prospective report on future climate change (World Bank, 2014) notes that erratic rainfall and raise of temperature in the next years combined with the current bad water management of the sector could provoke important consequences for Saly and more specifically on the tourism sector.

In term of reducing the sensitivity to natural hazards, various private or national infrastructures have been constructed, although their impacts on disaster risk reduction are variable. Numerous breakwaters along the coast, especially south of Dakar, have accelerated coastal erosion. In order to protect their property, some hotel owners have built protection dikes in front of their establishment. However, this has intensified erosion in other areas. The lack of cooperation between public and private initiatives is also a problem. Recently, in collaboration with the World Bank and Global Environment Fund finance, the government has planned to construct several breakwaters after cost-benefits analysis and environmental assessment.

It is finally important to mention that tourism is sensitive and vulnerable to non-climate risks. Political stability of the region and Ebola are both factors that explain the recent slowdown of tourism arrivals. More generally Senegal's image in source markets is the main driver for demand in tourism. This perception and reputation is sensitive to multiple and diverse dimensions, both positively and negatively. For instance the country's long period of political stability is regarded as one reason for tourist consumer confidence in Senegal.

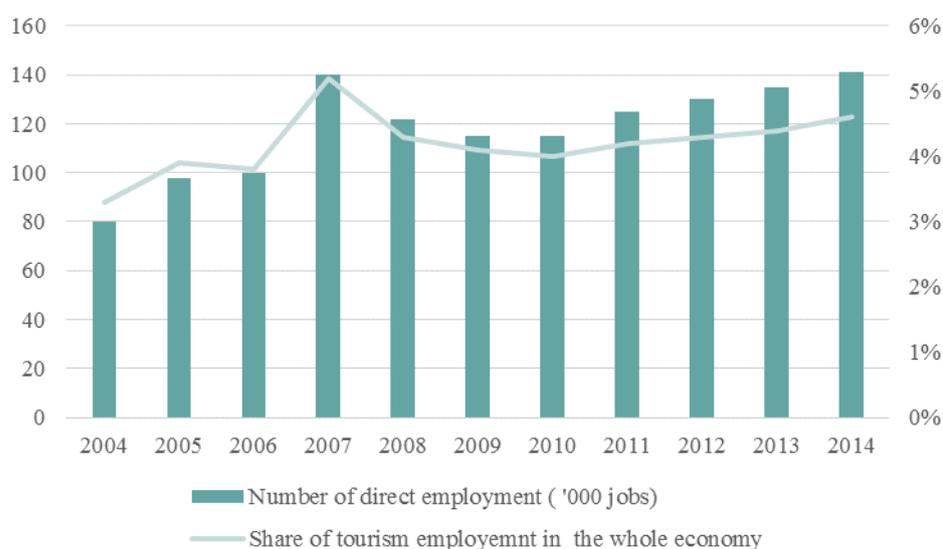
3.2.3 Sectoral pattern & adaptive capacity

The tourism sector has contributed to the diversification of Senegal’s economy at all scales. Spill over from tourism has supported socio-economic services such as financing services, health care and schools in the touristic centres. Senegal’s adaptive capacity has clearly benefited from development of the tourism sector in various ways.

First, by its contribution to the national economy, the tourism sector constitutes a new source of income, and this income helps strengthen resilience. The total contribution of travel and tourism to GDP in Senegal is twice as large as its direct contribution (WTTC, 2014). The resulting taxation and revenue is an important part of the wider economy. The shift towards tourism in the Senegalese economy has definitely been a diversification strategy diversifying national and household’s revenues and contributing to the national income. The international devises entrance constitutes also a way for the country to reimburse its debt and to insure an international sources of income.

The sector is an important source for employment in the country and especially in touristic areas, with tourism sector providing important direct and indirect employment. As presented in Figure 22, tourism generated 134,000 jobs directly in Senegal, representing 4.5% of total employment in 2013 (WTTC, 2014).

Figure 22: Direct contribution of tourism to employment in Senegal



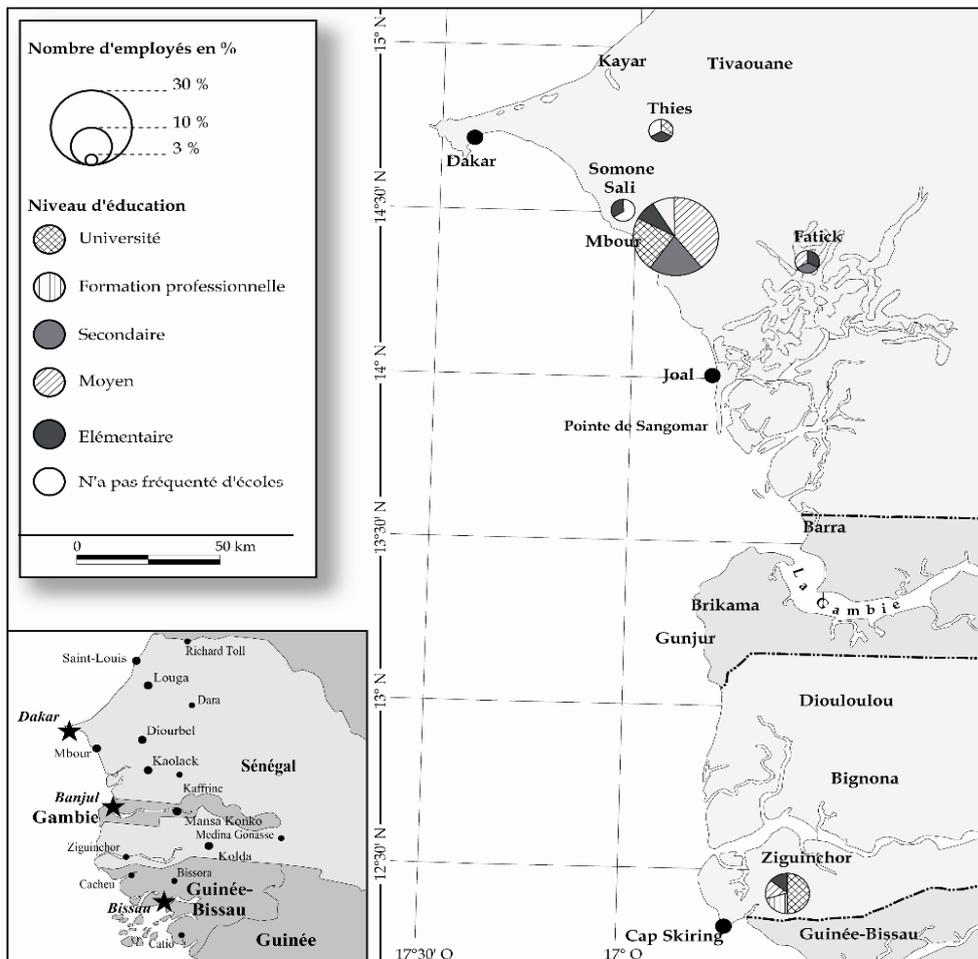
Source: Author calculation based on WTTC (2014).

Tourism activities have also helped accelerate the formalisation of the economy. In Saly, 65% of the population has an activity directly related to tourism and 54% of employment in hotels is formal. WTTC’s estimations are higher than the national statistics (only 10% of the employment is formal in Senegal). As most of the tourism infrastructure is both international and formal, the sector’s development has supported the formalisation of the wider economy. This has allowed the government to tax the private sector and enlarge its tax base.

Since 1980, the productivity and quality of services has improved in the areas where tourism has been developed. The interviews with majors, hotel managers of Saly confirms the appearance of new services induced by tourism. Before 1980s, no bank or health care systems were in Saly, for instance. Development of the sector has encouraged hospitality, schools, and training development in the capital (Dakar) and also at a decentralised level in M’bour. During interviews, managers confirmed that qualified national workers for hospitality services are now easy to find at national and local level, which is a marked change from the

case in Saly during the 1980's. Some interviewees mentioned the tourism sector as a key factor for higher levels of education. Interviewees in Saly also mentioned the role of sanitation infrastructure – triggered by the growth of tourism - as a factor that has improved school attendance. The provision of basic services is also accepted as key to reducing the prevalence of malaria and malnutrition in the region (CSE, 2011) In general, touristic areas have higher levels of public health services and school coverage compared to the national level, and higher rates of employment and educational qualification

Figure 23: Employment and qualification in touristic areas



Source: Dehoorne and Diagne (2008).

The tourism sector has also encouraged a form of informal international development cooperation. In her thesis on tourism in Saly, Hayat (2006) notes that repeat tourists (guests who visit Senegal each year) are often involved in cooperation organisations and non-governmental organisation in touristic destinations such as Saly. These NGOs support initiatives that provide opportunities for development, often supporting health centres, school, and social infrastructure. They also provide a source of long-term, independent financial investment which could have dramatic consequences on the economic development of an area. Saly is one of the municipality benefiting the most from tourism (Tourism ministry Interviews). A small majority of households (51% of Saly's population) identified tourist friends in their social and financial networks (Intac, 2011).

The tourism sector has also played a direct role in the financing of infrastructure for managing environmental risk. In Saly this experience has been quite negative, with private initiatives by hotels constructing an ad hoc and non-harmonised series of breakwaters that have

exacerbated coastal erosion. Nonetheless, the tourism sector has also supported private public partnerships for climate change adaptation. The Hotel Sindone in Saint Louis in partnership with the Regional Inspectorate of Forestry has constructed windbreaks and planted casuarina trees to fix coastal dunes, reducing erosion (REPAO, 2010). Here the tourism sector has supported the public sector and strengthened adaptive capacity.

Although tourism actors are not well organised in Senegal, their voices are often listened to at the national level due to the sector's importance in the national economy. For instance, the strong reaction of tourism operators to a changing national visa policy led to its cancellation after several months (Rodriguez, 2014). As the sector is highly preoccupied by the coastal erosion issue, their advocacy has raised policy interest on issues of coastal erosion and vulnerability to coastal flooding and longer term sea level rise.

The concentration of tourism in areas such as Saly also has potential perverse effects. Several interviewees mentioned changes in the fishery and agricultural production in response to demand from hotels and tourism. In Saly, the fishery has become more selective in response to the demand from hotels. Agricultural production has shifted from subsistence to a niche production, making smallholders highly dependent on the touristic season. During interviews in Saly, hotel managers mentioned cancelling contracts with regular local food suppliers due to the recent slowdown in tourism arrivals. Tourism in Saly is also associated with sexual tourism, which can have serious negative implications for the human capital.

The development of tourism has strengthened adaptive capacity both directly and indirectly. By generating and diversifying income, tourism has contributed to creating opportunities and resilience for people and businesses. The sector has induced the development of supporting services, and contributed to a better coverage of basic services in the touristic areas. As it is highly vulnerable to environmental risks, the sector has also initiated both policy awareness and investment in defensive infrastructure. Nonetheless, some negative externalities should be highlighted, including rising inequalities and perverse behaviour aiming at rent capture, which underlines the importance of appropriate supporting policies. A stronger legal framework and economic support for tourism development would help constrain potential negative externalities of such kind of development and maximise the adaptive opportunities.

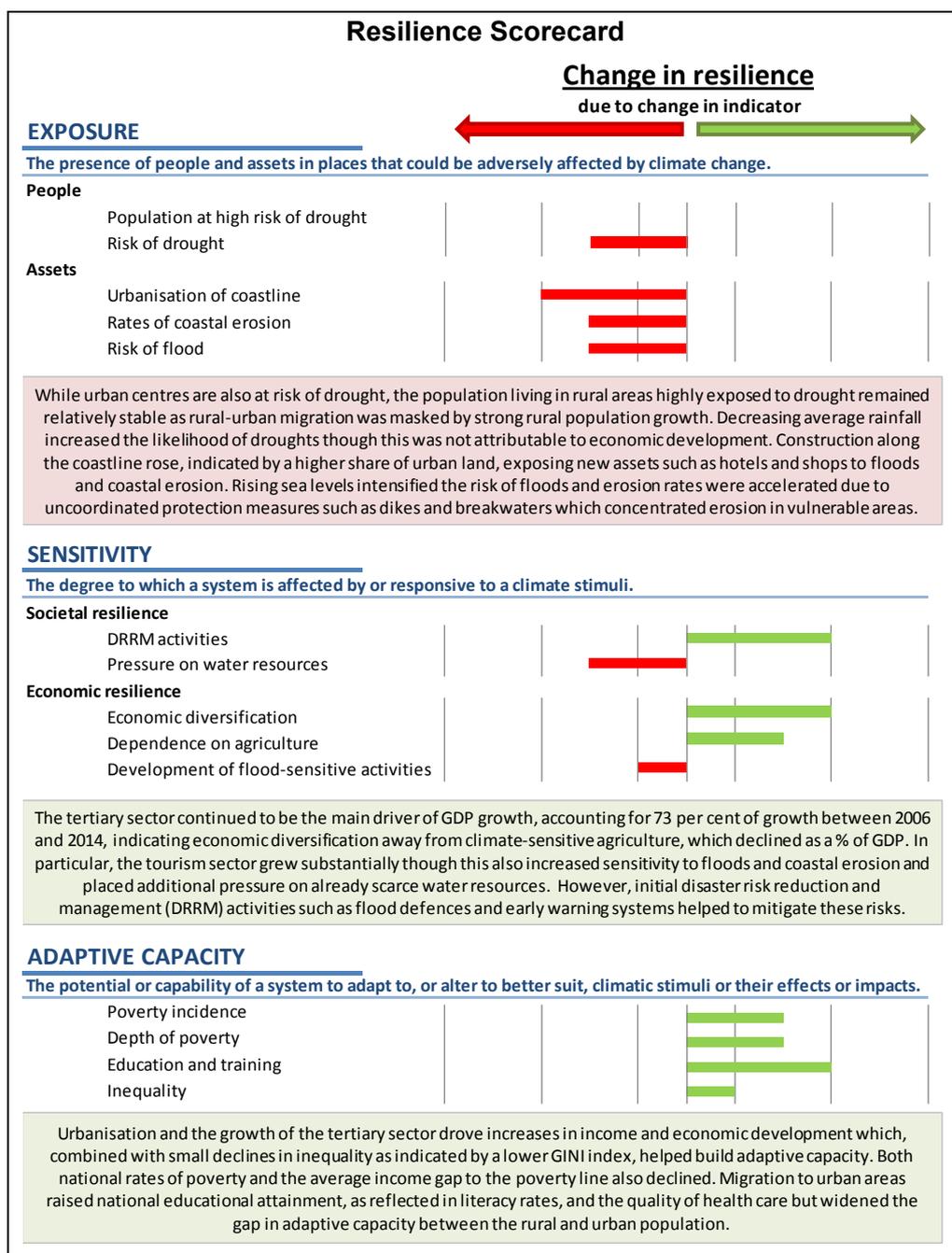
Summary – impacts of sectoral patterns on resilience

The development of beach tourism is highly concentrated and unplanned, and has led to a clear and important exposure of the sector to coastal erosion. The sector already suffers high consequences of erosion with the loss of beaches and damage to infrastructure. Hotels in the Petite Côte have been highly exposed to and affected by this phenomenon.

Tourism has provided opportunities for income diversification at all levels of the economy, from the national to the household scale. However, the sustainability of the tourism sector and this diversification is conditional. Tourism is highly dependent on the availability of water and, as competition for water and climate uncertainties both increase, reforms of water management will be crucial to reducing risks from drought.

Development of the tourism sector has also had important spillovers in terms of socio-economic development. Tourism has been an opportunity for the development of satellite economic activities (e.g. transport, handicraft) providing new and diversified sources of income to people and localities. Demand from tourism has also driven new crop and production choices in agriculture. The sector has led to a better welfare on average, with provision of health and education services. Hotels and restaurants have also contributed to the construction of protective infrastructure with various results. If, on average over the Senegalese economy, tourism has strengthened adaptive capacity, these benefits need to be weighed against the perverse consequences of concentrated beach tourism in the Petite Côte.

Impacts of sectoral and geographical patterns on resilience-



4 Discussion

4.1 Distributional impacts of economic change on resilience

Economic development has enhanced the immediate climate resilience of Senegal's people. In particular, those people who have migrated or adopted non-agricultural or non-pastoral activities have reduced their sensitivity to drought - the country's major climate risk. This reduction has relied on 3 important patterns: urbanisation, "coastalisation" and diversification of the economy.

These socio-economic transformations have also led to shifts in climate vulnerabilities. Specifically, they have led higher vulnerabilities to flooding and, in the long-term, to sea level rise. Climate risks are also not distributed equally among social groups:

- Some groups of particularly poor and/or marginalised people may not be able to take advantage of migration opportunities. In particular, the migration of males to seek employment means women and children remaining in rural areas bear the brunt of drought risk. Remittances can provide income and help women and children cope with drought risks but - as shown in the previous section - malnutrition and poverty prevalence remain high in these rural and remote areas. Moreover, the migration of young workers reduces the labour force available for agriculture.
- In urban centres, vulnerability to flood is also unequal. In general, poor and informal areas are more exposed and sensitive to flood events. By contrast, the formal and planned areas in the historic centre of Dakar are not as exposed to flood risks.
- Finally, seasonal and casual workers in agriculture and tourism are more sensitive to drought and floods events, and they also have the least job security. If drought reduces harvests, then there is less demand and employment for seasonal workers. Similarly, low tourism arrivals during 2013 meant some hotel managers did not hire their usual seasonal workers. These workers are therefore extremely vulnerable to a range of shocks and stresses on the economy, including climate events.

These findings suggest that the distribution of climate vulnerability is skewed towards people exposed to other sources of socio-economic vulnerability. The most vulnerable people - in terms of their exposure and sensitivity to climate risks - also have insecure sources of employment and income (economic vulnerability), and are more likely to live in informal settlements and be engaged in informal activities (legal vulnerability).

4.2 Policy drivers of economic patterns

The expansion of tourism in Senegal has been driven by a political determination to reduce drought sensitivity through diversification of the national economy, and supported by direct and indirect investments from national and international stakeholders. Policy decisions and investments have also contributed to the sector's geographical concentration in the coastal area. Combined with reduced financial and political support in recent years, these patterns of concentrated investments are also partly responsible for the tourism sector's current exposure and sensitivity.

The changes in political interest of national and international actors for the tourism sector have driven investments and financial support responsible for both the expansion and decline of the sector. Development of the tourism sector has been primarily driven by policy decisions at the end of the 1970's, and funded by national investments and World Bank support. Economic theory supported this choice of sectoral investment. As the tourism sector needs infrastructure, particularly transport infrastructure, to grow, investments have contributed to sectorial development and economic diversification. At the start of the 2000's, however, the sector lost political interest and support. Private touristic agents interviewed for this study all agree on this loss of interest by previous governments: *"since the time when the Ministry of Tourism was directed by Jacques Baudin and then Tidjane Sylla, no real tourism development strategy has been carefully identified, planned and implemented in Senegal. The country has suffered a constant change of ministers responsible"* (Rodriguez, 2015). This lack of interest and investment for a sector relying on subsidies (for integrated camping areas) and national transport investments such as roads and airports has contributed to the current poor performances. The sector has not made sufficient investments in maintenance or upgrading of important physical assets, and this has affected the quality of tourism products. Thus most of the investments (hostels and restaurants) in M'Bour and Petite Cote have never been renewed and are now considered old and expired.

The high vulnerability of the sector described above is also the result of a succession of political decisions. First, the development of the tourism sector was too concentrated both spatially and in terms of supply of services. The SAPCO and the authorities have concentrated their efforts and investments in small coastal areas entirely dedicated to tourism. This choice was made without any risk assessment. This first decision would have had no impact if the industry had benefited from a constant political interest pushing the sector to diversify its offer and its location. However, as the sector has been politically neglected in recent years, its vulnerability increased. No longer receiving public support, private actors then took uncoordinated decisions to optimise and protect their own interests and infrastructure. For instance, individual breakwater buildings have exacerbated the erosion of the coastal touristic areas.

More generally, and for the 3 patterns of economic development considered in this report, it appears that Senegal's economic development has not always been accompanied by a strengthening of social and legal frameworks. Economic incentives or major national investments have led to the concentration of people, activities and sector in climate sensitive areas, increasing their exposure. This was particularly due to the lack of legal constraints regulating buildings and land use. The absence of adequate urban planning at national and local level and the lack of economic and institutional means of decentralized authorities also contributed to the development of vulnerable infrastructure (exposed to climate risk).

New important policies could mitigate these vulnerabilities or avoid their repetitions in the future year.

The Plan Senegal Emergent (PSE)

Years of neglect by policymakers led to the risk of stagnation of Senegal's tourism sector. However, in the Plan Senegal Emergent (2014), the tourism sector is treated as an important component of the national economic development plan, backed up by state investment and accompanying policies. In the PSE, the Senegalese government supports a diversified touristic offer reinforced by climate sensitive investments. These choices should both reduce the exposure and the climate sensitivity of the sector. In the same time a reinforcement of human and financial capacities in the sector and a better exploitation of the tourism spill overs as planned by the PSE would help to reduce climate sensitivity and shape national adaptive capacity.

In the PSE, Senegal aims to become a leading tourism destination with 3 million tourist arrivals by year 2023. The plan identifies 2 to 6 new areas in which to focus tourism development, and aim at redeveloping existing sites with new activities. This includes diversifying the tourism offer with new products in the sea-side, ecotourism, culture and history, business and religious niches. The Plan of Integrated Tourism has a proposed budget of 165.8 billion FCFA. This budget is intended to cover land management, development of touristic sites and regional airports, it is also supporting infrastructure investment with the Airport building (Blaise Diagne International Airport) in 2015 and investments in regional airports in 2018. It is important here to underline that the Integrated Tourism areas are still though in a concentrated manner. It will be important that these cities do not reproduce the vulnerabilities visible in Saly for instance. Nonetheless, diversifying the offers, the tourism sector should be less affected by any kinds of shocks such as climate but also thus experienced by the sector in term of conflict or Ebola. The geographical diversity of touristic locations and the heterogeneity of customer profiles reduce the exposure of the sector to covariate shocks. For instance, the plan highlights the importance of small and integrated units in rural areas, two important factors for the future success of the tourism sector. Diversifying the tourism offer away from the basic product of beach holidays for Europeans should reduce the sector's exposure to one kind of shock (coastal erosion) and demand (European tourists). So it would help the sector to be more efficient in case of crisis from the demand or offer side.

Contrary to the past, future development will be based on integrated tourism plans that take into account coastal defences in the building plan and touristic activities implementation. These decisions should reduce current and future exposure of tourism infrastructures. The World Bank and Global Environmental Fund are also supporting new defences projects to try and improve environmental decision-making and investment in order to remediate some of the consequences from past mismanagement.

PSE also highlights the importance for better integration of touristic areas with their hinterlands, and preventing their emergence as economic enclaves. Improved local supply chains for food in restauration, and systematic professional training for young people, should encourage positive externalities of touristic areas development. Financing tool for tourism activities development, as well as strengthening human resources and capacity for the sector, improving the legal framework, environmental protection, and encouraging supporting are also integrated in the plan. Thus the tourism development could reinforce its adaptive capacity with a better the coping capacity (financing tool, integrated value chain) and a strengthened human resources (training and professionalization of national workers).

The support of activities such as cultural and handicrafts businesses related to tourism economy aims at better exploiting all potential externalities of the tourism on the other sectors. In the same way, PSE also plans to develop Dakar has a regional multiservice hub, supported by the tourism sector. This strategy and the investment of the new airport are in line with the perspective of sectoral stakeholders that intends to place tourism as driver of economic growth, employment, and foreign currency receipts. Investment in the new airport and the search for new income sources relying of the exploitation of tourism spill overs would reduce the sensitivity of the economy by attracting new forms of receipts less correlated to climate shocks.

Institutional capacity

Many of the challenges identified in this paper result from insufficient institutional capacity. These issues go beyond the presence of legal frameworks and policies, and encompass the capacity and ability of government offices for implementation.

For example, Senegal's climate adaptation plan implementation through sectoral policies. However, due to a number of constraints these rarely translate at the territorial level. In principle, decentralisation reforms should support implementation of climate adaptation policy at the local level. Following reform, local management will also govern touristic activities, give more responsibilities to the municipalities for land management, environmental management, tax raising, and managing public expenses. In practice there are likely to be significant challenges with improving performance. Human, technical and institutional capacities are likely to find implementing such a diverse new range of complex responsibilities very difficult.

Similarly, the lack of integrated coastal planning law and institutions has exacerbated an existing environmental problem. High rates of erosion now threaten both public and private infrastructure. Developing the coastal law would be an important first step, but it has been awaiting approval since 2009. Implementing the new legal framework would then require institutional, human and technical capacities to address the challenges of coastal management and risk reduction. The low political attention paid to the Coastal Act raises the question of whether these capacities will ever be put in place.

4.3 Vulnerability lock-in

Both for geographic and sectoral patterns, the issue of lack of legal land use framework has been underlined as an important barrier to a resilient climate development. This legal land use could avoid informal settlement, preserve fragile coastal zones, and prevent unplanned construction contributing to climate vulnerability. The economic patterns have also led to lock-in related to the water use.

The historical development of Dakar, to the detriment of Saint-Louis, happened historically for economic purposes. Dakar is a deep-water port and place of international trade since construction of the railway to Bamako. Saint-Louis' location prevented it from fulfilling this economic role, especially in term of sea trade. Yet Dakar's position on the Cap-Vert Peninsula places severe constraints on its demographic development, largely due to the city's topology. Limited space pushes newcomers and new informal development into flood-prone areas, constrains traffic access into and out of the city, and restricted water supplies are unable to meet high demand in this densely populated area. In Dakar geography is simultaneously an economic driver, a bottleneck in the city's development, and also indicates a possibly unsustainable lock-in of assets and investments. A lack of integrated land and water use planning to manage these geographical constraints is likely to become increasingly costly in the coming decade.

The tourism sector development is also highly vulnerable to the constraints on water supply. Although current supply doesn't seem to be a problem, increased competition for water between tourism and other sectors – particularly if coupled with increasing variability or reductions in water supply – could be a significant source of risk.

Water risk and geographic lock-in can be considered as consequences of the historical patterns described in the section 3. If consequences of these risks are low for the moment. Such a trap could be reduced and avoided in the future with a proper urban development developed at the national level and a recognition of the water management issue for social but also economic purpose (public and private sector) for economic development planning in drylands such as Senegal.

5 Conclusion

5.1 Key findings

The current development pattern of Senegal has been studied from two dimensions. From a geographical aspect, the country is the process of an important internal migration from rural inlands to urban coastal areas. From the economic point of view, Senegal is in a process of horizontal transformation. Senegal's tertiary sector is developing strongly, and this study focused on analyzing tourism as symbol sector of the economic tertiarisation..

Focusing on these two aspects Senegal's development has raised new exposure issues in urban centers and coastal areas. These changes often correspond to economic incentives, and they have often contributed to mitigating sensitivity by diversifying income sources and risk exposure. The trends analyzed indicate that as the economy has grown, better life conditions and welfare have contributed to stronger performance in indicators of adaptive capacity. The picture described here is more precise than the ND-GAIN index calculated at the national level but trends in term of exposure, sensitivity and adaptive capacity illustrate well the changes operate by these pathways.

Looking more in detail, current economic development has resulted in inequalities in exposure and sensitivity to climate. This is mainly due to an unbalanced economic development.

Analysis of the tourism sector has also underlined the limits of horizontal transformation for resilient development. The search for diversified tourism activities is one opportunity for to increase resilience. The tourism sector in Senegal is currently highly concentrated, concentrating exposure and sensitivity in one type of product, and a more diversified touristic offer is likely to be more robust. If diversification is an important condition for resilient economic development, the conditions is not sufficient is the transformation and the diversification is not operating at all scales (from the sector to the product). Recent impacts of the Ebola's crisis or Malian conflict on the tourism performance in Senegal illustrate the limit of a tertiary sector and tourism offer too concentrated.

5.2 Policy implications

Our analysis has raised several policy implications. Some of them are already integrated in the future Senegalese policy plans. We think important to underline:

- A clear legal framework on land use is essential in order to square a rapid and sometimes erratic economic development
- Economic diversification and horizontal transformation is a good opportunity for mitigating climate impacts, but new activity development always implies new risk exposure.
- An economic diversification which is not fully developed could be dangerous for risk exposure. A high concentration of assets and activity should be systematically accompanied by a climate risk assessment of their location

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- In term of planning for urbanisations in coastal areas, some policy recommendations formulated by the World Bank's report of coastal areas should help a better climate resilience, among them:
 - a strict control of ban on sand collection along the coastline,
 - a run-off management for new neighbourhoods or urban rehabilitation operations (planning laws imposing a non-aggravation of the downstream flow rates);
 - Drafting of master plans for sanitation, taking into account the new rainfall pattern and sea level assumptions;
 - Implementation of waste collection in order to improve the efficiency of the storm water drainage network.
 - Training to reinforce the awareness -raising program focusing on self-protection, with a particular focus on communication methods and on the technological means to be implemented
 - Reinforcement of the information regarding natural risks, to be offered to the population, the economic stakeholders (industries, businesses, services) and the administrations.

These policies implications are partly recognised by the Senegalese government. The adoption of the Coastal Act and the application of the PSE should support the climate resilient development of the country.

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Appendix

Appendix 1. Typology of tourism in Senegal

No formal tourism typology exist in Senegal, based on the interviewed performed we broadly distinguish three kinds of tourism as defined below.

Beach tourism: The beach tourism is the main contributor to tourism sector. Mainly concentrated on the coastal areas and more especially in the M'Bour department in the south of Dakar, la petite Cote, hosted all important hotel constituting the offer of this kind of tourism. The tourism is a beach tourism, highly concentrated, all hotel are in the Petite cote with a sea access, and they offer beach and swimming pools with daily excursion in small parks surrounding the areas. Tourism is organised with big tour operator and charter flights. Main clients are French or Spanish. The tourism is highly seasonal with a peak during European winter. More recently this tourism is compensate with a week-end tourism all along the year from rich people of Dakar. This week-end tourism constitutes one of the important perspective of development and complementarity for the sector. At the moment beach tourism is slowing down, victim of Ebola and regional insecurity environment but most of all by the coastal erosion. Beach tourism areas are La petite Cote, Cap Skirring and the Club Med Station in Casamance, in less extend Dakar offer also this kind of tourism infrastructures. The development of short term tourism from Dakar is an opportunity for the actor to compensate the loss of European tourists.

Urban tourism: Tourism in Dakar and Saint Louis is mainly a conference tourism. Last year Dakar has welcome important regional events (Rencontre de la Francophonie in 2014 for instance). The city has benefited of the regional instability to raise its status of regional pole (traditionally hold by Abidjian). Most of the touristic investment made in Dakar are oriented towards conference organisation and regional tourism (building of Conference hall in 2016 for instance). Obviously the return of stability and international institution to Abidjian lead the sector to find new type of offer. The sector and the PSE, are encouraging for instance cultural and historical tourism. City of Saint Louis for instance could more exploit its historical patrimony to this purpose.

Integrated Tourism and eco-tourism: The integrated tourism is an original form of tourism occurring in Senegal in the 1990's especially in Casamance. It consist in a tourism manage at the community level. Public authority were helping (by primary investment) community to welcome tourism in their village. All activities proposed and benefits were for the community funds. The community offered guiding tour/ restauration /handcraft to the tourism. This kind of activity has been totally abandoned in recent period because if necessitated important public investment to maintain the offer every year. Moreover tensions in Casamance blocked the development of this kind of tourism. The Integrated tourism corresponds exactly to the counter seasonal activity leading a source of income independent of drought which could constitute an excellent form of diversification of climate shocks. Unfortunately the sector has been vulnerable to political instability and lack of sustainability. The Integrated Tourism zone wish by the PSE aims at applying this kind of integrated approach in the beach zones. The recent development of economic lodge in Saloum islands region for instance can also been compared to a renewal of the integrated tourism activities. The village tourism are mainly located in the Saloum region (Palmarin).or Casamance, they are now doubling now by eco-touristic infrastructures. The rule of villagers' camp is a division of receipts/income between community members

Appendix 2. Breach de Saint Louis and its consequences

In Saint Louis, the Langue de Barbarie was breached to allow the Senegal River to run more freely into the sea and reduce the risk from river flooding. This followed a small but dramatic flood in 2003 that contrasted with previous years of drought.

The following season OMVS, the agency responsible for managing watersheds in Senegal, forecast severe floods. Memory of recent events and political pressures (fear of dramatic consequences) led to a decision to breach a long, thin sandy peninsula - the Langue de Barbarie – separating the river from the sea. The decision was taken without ecological or risk assessments, and implementation had significant impacts on the shoreline. The initial canal of 4m has grown into an immense breach of more than 6 km which is rising vulnerability of Saint Louis and nearby estuaries to coastal flooding from sea, among other impacts (Durand et al. 2010),

The left side of the river has become salinized, with important economic consequences for tourism and agriculture. Horticultural activities have suffered in particular, and some hotels have lost camping areas on the Breach. Reductions in mangrove surfaces in the Gondolas area and land losses in Dounbaba Dieye following the breach were also reported by local people.

In attempting to reduce the risk of river flooding, the breach led to major ecosystem changes and raised the Saint Louis city's sensitivity to coastal flooding and, in the long term, sea level rise (World Bank 2014). The breach of Langue de Barbarie example illustrates the key role of disaster risk management agencies and the need for comprehensive assessments of risk management decisions.

Figure 24: Evolution of the Barbary breach



Comments: From up-left to down-right: i).Breach just after opening (4 meters large), ii).two days after 80 meters, iii).3 weeks after the opening 330 meters large; IV).8 months after the opening 800 meters large. Sources: pictures from Durand et al. (2010).



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ISSN: 2052-7209

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Cover photo: Jeff Attaway, Dakar, Senegal.

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