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LIST OF ACRONYMS

BAU	Business As Usual (scenario where the status quo is maintained)
BI	Brown Investment
BPW	Building and public works
Btu	British Thermal Unit
CEPOD	Centre for Policy Research and Development in Senegal
CFA	Franc of the African Financial Community
CGE	Computable General Equilibrium
CSE	Ecological Monitoring Centre in Senegal
DC	Disaggregated Consistency
DE	Directorate of Energy in Senegal
DEEC	Directorate for the Environment and Classified Establishments in Senegal
DPEE	Directorate of Forecasting and Economic Studies in Senegal
DSM	Demand-side Management
ECA	Economic Commission for Africa
EIG	Economic Interest Group
ERGE	Exploratory Report on the Green Economy of Senegal
ESPS	Poverty Monitoring Survey in Senegal
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GE	Green Economy (green investment scenario)
GE-Energy	Green Energy Economy (energy transition scenario)
GHG	Greenhouse gases
HDI	Human Development Index
IGES	Institute for Global Environmental Strategies
IUU	Illegal, unreported and unregulated fishing
LBC	Low-consumption lamp
LDC	Least developed countries
ME	Macroeconomic
MERN	Myanmar Environment Rehabilitation-Conservation Network
MGD	Millennium Development Goal
NAMA	Nationally Appropriate Mitigation Action
NASD	National Agency for Statistics and Demography
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PPP	Purchasing Power Parity
PPP	Public Private Partnership
PSE	Emerging Senegal Plan
SD	System Dynamics
SME	Small and Medium-sized Enterprise
SMI	Small and Medium-sized Industry
T21	Threshold 21
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
UNCSD	United Nations Conference on Sustainable Development (2012)
UNCED	United Nations Conference on Environment and Development (1992)
UNDESA	United Nations Department of Economic and Social Affairs

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EUROPEAN UNION

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FOREWORD

Under the leadership of His Excellency Mr Macky Sall, President of the Republic, Senegal has adopted the Emerging Senegal Plan (PSE), which aims to chart a new path of sustainable development for our country, to further stimulate our potential growth, creativity and entrepreneurial initiatives, and satisfy the population's strong aspirations to greater welfare.

This context is perfect for initiating national debate on the opportunities offered by the green economy as a new paradigm in sustainable development. Indeed, thanks to the fresh impetus introduced by the United Nations Conference on Sustainable Development (UNCSD), known as "Rio+20," the conditions seem to be right for our country to draw on all the anticipated benefits of implementation of the Rio+20 outcome document, including in the area of the green economy.

Furthermore, the highest institution in our country has expressed strong political will in this regard. In fact, during the Conference held in 2012, the Head of State called on his peers to adopt green governance, meaning governance centred on social and economic policies based on environmentally sound technology and production methods.

The international community's adoption of the green economy testifies to the hope that GE inspires in both developing and developed countries as a means of matching the needs of populations with the actual capacities of the planet's ecosystems.

However, it must be recognized that a green economy can only develop in an enabling environment. It also requires convincing macroeconomic arguments apt to motivate decision makers. Herein lies all the interest and relevance of this Exploratory Report on the Green Economy (ERGE), which is a unique document; this is where it has the power to stimulate reflection and incite to action.

As a least developed country (LDCs) and characterized by a fragile macroeconomic balance, Senegal will exploit its comparative advantages through a cautious and gradual approach. The ultimate objective is to align the course of our development with the principles of a green economy, i.e. using natural resources rationally and reducing waste, according to the carrying capacity of ecosystems. It therefore seems that committing to a green and inclusive economy is a matter of survival for the majority of Senegalese people who depend heavily on the existence of natural resources.

The conclusions of the ERGE are promising in terms of the vast numbers of opportunities that they reveal, which could be exploited to provide significant support for our development process in the short, medium and long term without any impact on their foundations. Therefore, I would like to thank UNEP for its technical and financial support, which has enabled us to identify these niches for growth, hitherto exploited little or not at all.

I sincerely hope that this report will open a new chapter in collaboration, not only between the Government of Senegal and UNEP, but also with all bilateral and multilateral partners committed to promoting a global green economy.

Like any human endeavour, it certainly has its limitations. However, it may be improved, provided that its readers take ownership of it and extend it, making improvements to transform it into a veritable tool aiding decision making.

Abdoulaye Balde
Minister of the Environment and Sustainable Development of the Republic of Senegal


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SUMMARY FOR POLICY MAKERS

INTRODUCTION AND OBJECTIVE

In 2012, Senegal recorded a growth rate of 3.6 per cent, 1.5 per cent higher than in 2011, but still below the 4.5 per cent average achieved during the period of economic growth from 1994 to 2005. Although the poverty rate declined to 46.7 per cent in 2011, down from 48.3 per cent in 2006, the number of Senegalese living in poverty increased by 10.6 per cent from 2006 to 2011, in real terms. More worryingly, the extent and severity of poverty has increased. In fact, Senegal is facing huge challenges in achieving a strong, sustainable and inclusive economy. Extreme poverty, unemployment, underemployment, the structural weakness of an economy largely dependent on natural resources, as well as the lack of capacity for growth and development, all of which are exacerbated by environmental deterioration, are obstructing efforts to make concrete improvements to the quality of life of a booming population. The green economy must be promoted if these barriers are to be removed.

This Exploratory Report on the Green Economy (ERGE) was created under the Green Economy Initiative launched by the United Nations Environment Programme (UNEP) in 2008. It aims to enable Senegal to seize the opportunities offered by the green economy. Firstly, it seeks to demonstrate, based on strong macroeconomic arguments, the merits of investing in sectors producing goods and services that add value to, or are respectful of, the environment. It then aims to give guidance on means of promoting green investments that benefit the poor in order to drive the "Emerging Senegal" strategic plan.

PRIORITY SECTORS

Natural resources, including agriculture, fisheries and water, have a decisive influence on Senegal's economic performance. They still form the basis of economic activities on which at least 60 per cent of the population directly depends, including many rural populations. They therefore contribute, decisively, to food security, employment, revenue generation and the national economy.

However, pressure on these resources is only growing, to the point that their intensive use is threatening economic security. It is important, therefore, to preserve the ecosystems supplying and renewing these resources so essential to the country. Therefore, agriculture, fisheries, forestry and water have been identified as sectors in which not only should natural capital be better integrated into private sector decision making, but in which a variety of policy measures should be implemented in order to change practices and ensure the sustainability of resources.

Beyond the intensive use of natural capital, the economy of Senegal is growing through carbon-inefficient technologies. Moreover, this growth is largely sustained by behaviour that generates a massive accumulation of waste. Therefore, energy efficiency and the transition to the use of renewable energy, as well as waste management, should also be priority action sectors in the green economy.

GREEN INVESTMENTS

The transition to a green economy should provide significant benefits for Senegal. Quantitative analyses of this study show that the environment must be considered a determining factor in production, value, economic stability, and long-term prosperity; one which will put Senegal on a path of development that will preserve, improve and, if necessary, rehabilitate natural capital as a crucial economic asset and source of economic and public benefits, especially for poor people whose livelihoods and security depend on nature. The effects of additional green investments in different areas are described briefly below.

Economic development

Greening the Senegalese economy should generate a higher gross domestic product (GDP) growth rate. However, the multiplier effects of these investments are only expected to exceed the negative economic impact of the financing costs after three years, showing that the green scenarios (green investment and energy transition), besides their power to

preserve natural resources and reduce pollution, offer greater medium and long-term growth from 2012 to 2035 than the business as usual scenario.

It is estimated that the real GDP growth rate could reach 4.3 per cent in 2035 in the green scenarios, compared to 4.2 per cent in the brown investment scenario and 3.7 per cent in the business as usual scenario.

Agricultural production

Although the agricultural sector accounted for only 7.1 per cent of nominal GDP in 2012, agriculture plays a predominant socio-economic role in the lives of the Senegalese. It is still the main source of income for most rural households. Nearly 57 per cent of Senegal's population lived in rural areas and worked in agriculture in 2010.

Additional green investments in the agriculture sector will go towards the wider use of organic fertilizers, irrigation development, and the fight against desertification and soil salinization. In these scenarios, the volume of agricultural production is expected to increase by between 2.5 and 3.25 per cent between 2020 and 2035, as opposed to increases of over 2 percent in the business as usual and brown investment scenarios.

With these green investments, agricultural productivity would have improved by 1.8 tons/hectare by 2012 and would exceed 4.2 tons/hectare in 2020. This improvement would be lower in the brown investment scenario (3.5 tons/hectare in 2030) and the business as usual scenario (3.4 tons/hectare in 2030).


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Greening is expected to reduce degraded land areas by 37 per cent in the green investment scenario and 15 per cent in the energy transition scenario. Consequently, there should be an expansion in arable land of 3.93 to 4.04 million hectares from 2012 to 2030. Conversely, the brown investment and business as usual scenarios would lead to a reduction in arable land.

Forestry Sector

Forestry activities accounted for 1.1 per cent of GDP in 2010, i.e. 6.4 per cent of primary sector GDP in the same year.

Green investments in the forestry sector are intended to reduce deforestation and increase reforestation. Greening would increase forest cover, currently standing at around 8,200 hectares, by a little over 6 per cent by 2025 and nearly 28 per cent by 2035, relative to the business as usual scenario. This would improve soil quality and water availability, both of which would improve agricultural productivity, and increase carbon sequestration.

Energy

Substituting investments in energy sources with high carbon emission rates with investments in clean energy would increase the penetration of renewable energy in electricity production by 30 per cent in the green investment scenario and 60 per cent in the energy transition scenario by 2035, which translates to an increase in the use of renewable energy of over 19 per cent and almost 47 per cent, respectively, for the same year, relative to business as usual.

This expansion in renewable energy is expected to create between 7,600 and 30,000 green jobs in the renewable energy industry.

Improvements in the availability of green energy should also enable the development of biofuels, with a production of 100 Btu and 400 Btu respectively, for the 2035 green scenarios.

Fight against poverty

Poverty indicator trends in Senegal suggest that the absolute number of people living in poverty increased by over 10 per cent between 2005

and 2011, even though the poverty rate declined. Observations also indicate strong regional disparities, since the poverty rate is higher in rural areas.

The results of the simulations of this study show that green investment can play a vital role in the fight against poverty. Indeed, the proportion of the population living in poverty should fall below the 20 per cent threshold in 2035 in the green scenarios, while in the business as usual scenario the proportion would be slightly over 20 per cent and 24 per cent respectively, during the same year. In addition, the green economy would reduce the poverty gap between rural and urban areas.

Green investments will also lead to a 10 per cent to 30 per cent increase in access to sanitation, and nationwide waste collection by 2035.

Finally, nutrition levels and the amount of calories consumed by the Senegalese would be highest under the green investment and energy transition scenarios, due to higher agricultural production and yields.

In short, making more efficient use of resources, as part of an approach that recognizes the value of natural capital and integrates it into market dynamics, i.e. the green economy, will be crucial for growth, employment and poverty reduction in Senegal. Action taken toward these goals, through an annual investment of only 2 per cent of GDP in the green transformation of these key areas, should open up significant economic opportunities. It should improve agricultural productivity, thereby increasing agricultural production from 2.5 per cent to 3.25 per cent depending on the scenario, compared to the 2 per cent forecast for the business as usual scenario. Forest cover should increase by 6 per cent in 2025 and by 28 per cent in 2035, and renewable energy should represent 30 per cent to 60 per cent of the energy mix. These results will lower environmental costs and boost competitiveness. The need to develop products and services in the renewable energy sector will give further impetus to technological innovation and job creation. In fact, between 7,500 and 30,000 green jobs would be created by green investment by 2035. These types of investments will also reduce the poverty rate and improve populations' nutritional status and access to sanitation, thereby contributing to improvements in living conditions for the Senegalese.

THE ROLE OF GOVERNMENT

In order to promote the transition to a green economy, the State, which has a major role to play, should also see that a range of complementary policies and programmes are implemented in the priority intervention areas presented above, the objective being to create the incentives needed to stimulate private sector action and behavioural change in the population.

TOWARDS A GREEN ECONOMY

Senegal can benefit from various existing or forthcoming financing tools, sources and programmes, both nationally and internationally, to implement its transition to a green economy, while prioritizing the creation of a coherent policy framework, the development of green investments and public markets for green products, and improved communication with the public.

1 INTRODUCTION

1.1 THE GREEN ECONOMY IN SENEGAL

Sustainable development is defined as development that "meets the needs of the present population without compromising the ability of future generations to meet their own needs". It represents a huge challenge for Senegal. Extreme poverty, unemployment, underemployment, the structural weaknesses of an economy largely dependent on natural resources, and the lack of capacity for growth and development, all of which are exacerbated by environmental deterioration, are obstructing efforts to make concrete improvements to the quality of life of a booming population. To promote a green economy, these barriers need to be removed.

Senegal's vision of a green economy is based on various analyses and actions undertaken after the Rio Conference (1992), but it is primarily based on the findings of the Rio + 20 Conference (2012). The green economy is defined as "an economy that improves human well-being and social equity while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011). In its simplest form, it is characterized by low carbon emission rates, rational use of resources and social inclusion. Although the concept of a green economy does not replace that of sustainable development, it is becoming more widely accepted that achieving sustainable development depends on a good economic approach. In other words, the ultimate aim of the green economy is sustainable development. It aims to establish a framework within which policies, institutions and methods of governance are aimed at managing natural resources rationally and reducing environmental risks, in order to achieve strong, sustainable and inclusive economic growth.

The transition to a green economy must play a leading role in efforts to ensure sustainable development and fight poverty. In practice, the green economy: promotes the growth of income and employment; reduces poverty through public and private investment in natural capital; contributes to lower carbon emissions and pollution; improves efficiency in the use of energy and resources, and prevents biodiversity losses and degradation of the services provided by ecosystems. Considering how the environment is a determinant of economic growth and human well-being, the green economy helps to preserve, improve and, where necessary, rehabilitate natural capital as a critical economic asset and source of public benefits, especially for the poorest, whose livelihoods and security depend on nature.

1.2 RESEARCH PROCESS AND OBJECTIVES

This ERGE was created under the Green Economy Initiative launched by UNEP in 2008. It aims to enable Senegal to seize the opportunities offered by the green economy. Firstly, it seeks to demonstrate, based on strong macroeconomic arguments, the merits of investing in sectors producing goods and services that add value to, or are respectful of, the environment. It then aims to give guidance on means of promoting green investments that benefit the poorest populations.

This report is the result of a participatory process involving: (i) a collaborative approach from the Ministry of the Environment and Sustainable Development in Senegal (MEDD) and the Ministry of Economy and Finance (MEF), especially between the Directorate of Environment and Classified Establishments of the MEED, the MEF Directorate of Development Strategies and Centre for Policy Research and Development; (ii) the establishment of a Technical Interministerial Committee on the green economy, whose meetings have provided not only data on sectoral policies, measures and statistics, but also comments and suggestions; and (iii) the organization of a national workshop to launch the work of developing the ERGE and a national validation conference to formalize the document. Both conferences brought together representatives of administrative institutions, the private sector and civil society, as well as relevant technical and financial partners.

After analysing the macroeconomic situation and economic challenges, the report makes a macroeconomic assessment of the opportunities and challenges for green investment in priority sectors likely to offer the greatest potential for the transition to a green economy. It then provides a number of ideas and recommendations that can help to improve policies, programmes and projects, laws and regulations, as well as institutions that can provide an incentive framework for more favourable investments that will lead to revenue production, growth and economic stability, as well as resilience to natural hazards.

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2 MACROECONOMIC PROFILE AND GLOBAL ECONOMIC CHALLENGES

2.1 MACROECONOMIC PROFILE

From 1994 to 2005, the Senegalese economy grew at a relatively fast pace, with an average GDP growth rate of 4.5 per cent. The decline in economic performance experienced by the country between 2006 and 2009, expressed as an average growth rate of 3.5 per cent, took place in an international context marked successively by rising energy and food prices, and difficulties caused by the global financial crisis. In 2010, Senegal's growth rate reached 4.2 per cent, due to the vigorous service sector and the implementation of targeted macroeconomic policies in the context of a partial recovery of the global economy. It stabilized at 2.1 per cent in 2011 due to poor agricultural performance and a tense pre-election period. In 2012, encouraged by good agricultural performance and enjoying the positive impacts of improved electricity supplies, the economy grew by 3.6 per cent.

The national economy consists of: (i) a primary sector (15 per cent of GDP, 50 per cent of the active population), which remains vulnerable to natural conditions and the volatility of world prices; (ii) secondary activities (21 per cent of GDP), based on the extraction and processing of phosphates, food processing, construction and the cement industry, and (iii) a service sector (64 per cent of GDP, including the 19 per cent from public services), which remains largely informal.


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In 2012, growth was mainly supported by the agricultural sector, the vigorousness of which was due to the 9.6 per cent increase generated by industrial agriculture (+18.2 per cent), food crops (+17.2 per cent), poultry farming (+6.3 per cent) and traditional fishing (+5.9 per cent) and, to a lesser extent, by the service sector, which recorded growth of 3.7 per cent, mainly due to transport, telecommunications and financial services. Macroeconomic developments have been less favourable than predicted for the secondary sector, where growth was only 0.9 per cent, despite the positive impact of implementation of the Energy Restructuring Plan on electricity generation. This reflects the decline in the sub-sectors of mining and quarrying, edible fat processing, meat and fish processing, tobacco manufacture, construction and building materials.

Inflation has been volatile in recent years, standing at 1.7 per cent in 2012, compared to 4.3 per cent in 2011, mainly because of falling prices in the primary sector, following successful agriculture results. It should fall again in 2013 to stabilize at 2.3 per cent. However, recent developments (bad harvests and rising oil prices) makes the achievement of this goal uncertain.

The fiscal balance deteriorated in 2012 to 5.8 per cent of GDP, due to substantial investments mobilized for an emergency contingency plan in the electricity sub-sector, and to finance road and airport infrastructure. In terms of trade balance, the current account deficit deteriorated sharply in 2012, reaching 10.3 per cent of GDP, compared to 7.9 per cent in 2011, due to Senegal's high levels of energy and food dependence, which greatly worsened the trade balance.

2.2 SOCIAL PROFILE

Senegal's population was estimated at just over 12.4 million in 2010, of which 50.4 per cent were women and 42.9 per cent lived in cities. Although mortality rates have declined sharply, the fertility rate remains high, with an average of 5 children per woman of childbearing age[1]. The net migration rate remained negative in 2010 (-10.7‰). The high level of urbanization of the population (42.9 per cent) may be attributed to the deterioration of rural living conditions. Over 40 years (1960-2000), annual urban population growth stood at an average of 4.1 per cent, while annual demographic growth only averaged 2.7 per cent.

The rural exodus has mainly affected young populations, with under-fifteens accounting for more than 43.7 per cent of the total population, while those aged 65 and over constitute only 2.5 per cent. This results in a relatively high demographic dependency ratio (85.5 per cent). Despite this heavy burden on adults, the average labour market participation rate remained stable at around 54 per cent, instead of increasing. The unemployment rate increased from 8 per cent to 14 per cent of the labour force between 1995 and 2010, while the economic inactivity rate would have been 49 per cent and the underemployment rate 41 per cent; direct consequences of falling employment in rural areas due to the frequency of rain shortages, droughts and the grey and parallel economy in urban areas.

The poverty rate fell to 46.7 per cent in 2010, compared to 48.3 per cent in 2005. However, the number of Senegalese living in poverty increased by 10.6 per cent from 2005 to 2010, in real terms. More worryingly, the depth and severity of poverty have increased, suggesting that the poorest people were most affected by the poor performance of the economy caused by the financial crises between 2005 and 2009 (NASD, 2013).

Table 1 compares some human development indicators (HDI) for Senegal observed during the years 2000 and 2012. Although all the indicators show improvement, the pace of these improvements remains modest. The United Nations Development Programme (UNDP) report on human development ranks Senegal 154th out of 186 countries in 2012, indicating a rather weak national human development scenario (UNDP, 2013). In fact, in 2012, more than half of Senegal's adult population was illiterate, almost half had no access to improved sanitation facilities and one third still had no permanent access to water resources.

TABLE 1. HUMAN DEVELOPMENT IN SENEGAL, 2000 AND 2012

Indicators	2000	2012
HDI* (value)	0.405	0.470
GDP per capita (2005 $PPP**)	1,527	1,737
Life expectancy at birth (years)	55.8	59.6
Adult literacy rate (per cent of population aged 15 and over)	39.0 (2002)	49.7 (2010)
Population with access to:		
Water resources (per cent of population)	66	72
Sanitary facilities (per cent of population)	45	52
Infant mortality rate, under 5 years old (per 1,000)	130	69
Health expenditure per capita (current USD)	21	60
Percentage of the population living on less than $1.25 per day (PPP**) (per cent of population)	44.2 (2001)	29.6 (2011)

*HDI: Human Development Index
**PPP: purchasing power parity

Sources: World Development Indicators (World Bank, 2013); Human Development Index (HDI) (UNDP, 2013).

2.3 ENVIRONMENTAL IMPACT

Due to its geographical position, Senegal benefits from diverse natural resources. These still form the basis of economic activities, on which at least 60 per cent of the population directly depends, including many poor rural populations who derive food, fuel, building materials, animal fodder, medicinal plants and income from them. Natural resources contribute decisively to food security, employment, revenue generation and the national economy. Soil and water resources underpin agricultural activities, the role of which is crucial to the national economy. The same applies to renewable resources, including wood and non-timber forestry products, wild fish and crustaceans, and non-renewable resources such as minerals for energy production and product manufacture.

However, constant pressure on water, grazing, fishery, forestry and soil resources accentuates their scarcity and/or degradation, which in turn contributes to climate change. These changes exacerbate the process of impoverishment and make populations, especially rural populations, more vulnerable, reducing the country's long-term economic potential. For example, overexploitation of fishery resources and the degradation of their natural environment leads to the depletion of some fish species and reduced availability of marine products. Similarly, rain shortages and droughts dry up surface water and lower the water table.
For example, the flow of the Senegal river decreased by 35.7 per cent between 1981 and 1989; the water table, which fell between 5 m and 10 m on the north coast, receded to between 15 m and 20 m in the south of the country (MEPN 2010). Furthermore, the combination of low rainfall and drought and the heavy human and environmental impact of drilling has resulted in both depletion of the water table and its contamination with seawater to the west of the country. Consequently, salinity levels of up to 130 ‰ were recorded in the Saloum river in the aquifer under the salt marshes.

Pressures on the soil, especially deforestation and land clearance by bush fires, among other things, in order to extend cultivation and the production of charcoal and mineral resources, combined with natural factors such as water and wind erosion, have


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resulted in bare, saline or even alkaline soil across much of the country. In the South, the salinity of watersheds and the bush fires which degrade forest areas greatly reduce soil fertility, which in turn prevents shrub and tree savannas and forest resources from fully recovering. Thus, in 20 years, the area of forest has decreased by 9.4 per cent and species diversity has fallen by 30 per cent (DEEC, 2010). The diminished vegetation cover is no longer able to completely fulfil its role as a protector: surface waters dry up and water tables fall, leading to the salinization and acidification of soils and valleys. In 1991, soil salinization would thus have affected 30,000 hectares in the Senegal delta, 90,000 hectares in the Saloum estuary and 400,000 hectares in the Casamance basin.

Moreover, despite an elasticity of 0.7 between 2000 and 2005, suggesting an average increase in the volume of greenhouse gas emissions, slightly slower than the rise in the level of GDP, the carbon

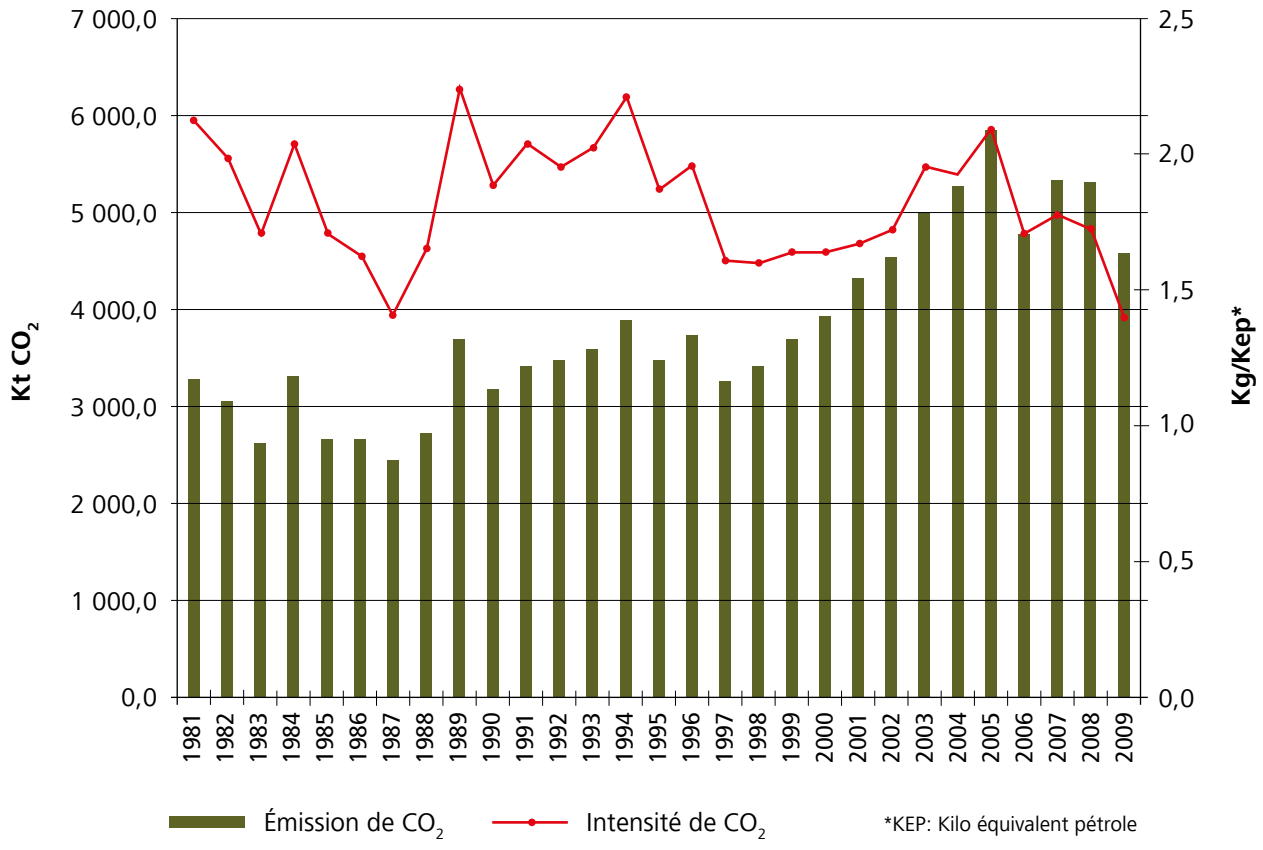
intensity (kg per kg of oil equivalent energy use) remained very strong: in 2005, the creation of a dollar of GDP in Senegal was accompanied by 2.8 kg of CO_2 emissions. Figure 1, which shows CO_2 emissions and CO_2 intensity in Senegal from 1981 to 2009, indicates a rising trend. CO_2 emissions reached their highest level in 2005, but declined the following year. CO_2 intensity has been very volatile, peaking in 1989 and declining to its lowest level in 2009.

CO_2 emissions are mainly due to emissions from the burning of fossil fuels (67.6 per cent). However, CH_4 (methane) and N_2O (nitrous oxide) also contribute to greenhouse emissions. The drivers of methane and nitrous oxide emissions in Senegal are deforestation, changes in soil use, waste and industrial processes. (World Bank, 2013).

2.4 POLICY AND INSTITUTIONAL LANDSCAPE

The Ministry for the Environment prepares and implements the policies adopted by the President of the Republic in the areas of environment and sustainable development. To enable this ministry to exercise full responsibility, two cross-sectoral structures were created following the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (1992): (i) the High Council of Natural Resources and Environment, responsible for ensuring the coherence of the legal and institutional framework, as well as harmonizing the actions of the different players involved in the management of natural resources; and (ii) the National Commission for Sustainable Development, the mission of which is to inform the authorities on sustainable development.

FIGURE 1. CO_2 EMISSIONS AND INTENSITY IN SENEGAL



Source: World Development Indicators (World Bank, 2013).

Since decentralization, local authorities have been responsible for protecting and managing the environment and natural resources, under the control of the decentralized administrative authorities and in close collaboration with the technical services responsible for managing environmental issues.

A huge range of legislation, under different administrations, governs management of the environment and biodiversity in Senegal. However, there is often a lack of coordination between land policy, agriculture, forestry, mining, energy, hunting and wildlife, fisheries, urban development and housing, and tourism. Plans based on the recommendations of international conferences and treaties on the environment, such as the National Environmental Action Plan and the National Strategy for Sustainable Development, have been developed according to a participatory and multidisciplinary approach.

Sustainable development initiatives result from the strategic guidelines of environmental policy, which are translated into technical programmes and administered under the Medium-term Sectoral Expenditure Framework.

The implementation of these programmes should ultimately lead to achievement of the sectoral objectives set by the 2009-2015 letter on sectoral environmental policy and natural resources in terms of: (i) promoting the rational management of natural resources and conservation of biodiversity; (ii) fighting desertification and safeguarding fauna and flora; (iii) fighting pollution, nuisances and risks; (iv) protecting the marine and coastal environment; (v) adding value to wild resources; and (vi) promoting sustainable patterns of production and consumption in all development sectors.

However, the environmental sector suffers from a lack of financial and human resources, and a lack of synergy in its operations to tackle environmental problems, with, in particular, the absence of an across-the-board management mechanism suitable for the environment.

3 IDENTIFICATION OF KEY SECTORS FOR THE GREENING OF THE ECONOMY

This Exploratory Report on the Green Economy (ERGE) in Senegal has chosen to work on the six key sectors that have high potential for growth, job creation and poverty reduction at a national level, and are able to contribute to the development of a green economy in Senegal. These sectors are agriculture, fishing, forestry, water resources, renewable energy (or energies) and energy efficiency, and waste management.

TABLE 2. PRIORITY SECTORS FOR SENEGAL

Sector	per cent of GDP	Employ-ment	Growth	Challenges	International Trade	Additional information
Agriculture	7.1	56.7 per cent of the total population	2.9 per cent between 2005 and 2012	Declining rainfall Insufficiently exploited potential of irrigable land Access to credit and high-quality inputs	Cereal imports (rice, wheat and traditional cereals), up to 9 per cent of GDP	This sector is the basis of production activities and is the main source of income for most rural households
Fishing	2.2	Between 1.6 and 2 million Senegalese	Marked by declining production	Economic decline of fishing communities Decreasing exports Exacerbation of sea conflicts over access to resources	2nd source of foreign exchange for the country (19.8 per cent of export revenues)	Fish accounts for about 40 per cent of the total consumption of animal protein in Senegal
Forestry	1.1	20,000 people	Deforestation rate: 2.3 per cent between 2005 and 2010	Systematically and significantly undervalued in official statistics Strong anthropogenic pressures (e.g. demographic growth, mining operations and land clearance for agricultural purposes)	Exports of forestry products: 26.7 billion CFAF in 2011	84 per cent of household energy consumption comes from wood
Water resources	–	–	–	Persistent drought and desertification Overexploitation and resource management problems Pollution	–	10.5 per cent of the electricity produced in Senegal comes from hydropower
Energy	2.4	–	–	Access to energy services (44 per cent of households do not have access to electricity) Underutilized renewable energy The energy sector was responsible for 95 per cent of CO_2 emissions in 2000	Fossil fuel imports Exports of petroleum products (the country's largest source of public revenue) Dependence on thermal power for electricity generation	Final energy consumption in Senegal is dominated by biomass (45 per cent) and fossil fuels (44 per cent)
Waste management	–	–	–	More than three quarters of the population do not have access to any waste disposal service	An average of 11,200 tons of metals recovered from landfills are exported each year, while the potential is about 19,500 tons per year	2,438 tons of solid waste is collected every day in the municipalities

Sources: NASD (2013 a,b), DE (2008), DEEC/MEPN (2010)

3.1 AGRICULTURE

Although the agricultural sector accounted for only 7.1 per cent of the nominal GDP in 2012, compared to 6 per cent in 2011 (DPEE, 2013), agriculture plays a predominant role in the socio-economic life of Senegal. It is still the basis of production activities and is the main source of income for most rural households. Nearly six in ten Senegalese (56.7 per cent) lived in rural areas and worked in agriculture in 2010, according to the Poverty Monitoring Survey in Senegal (ESPS) 2010-2011.

Agricultural activity has been marked by a decline since 1980. The decline in peanut production over the last 30 years, for a long time the main driving force behind economic growth in Senegal, is illustrative of this crisis, which affects almost all major production. Thus, despite crop diversification, the average growth rate of the agricultural sector was only 2.9 per cent between 2005 and 2012. The reasons for the wide-spread slump, which is characterized by a decrease in both productivity and the land areas cultivated, are numerous and relate closely to control of the key factors governing the development of modern agriculture: earth, water, seeds, equipment and credit.

Although the climatic context is characterized by declining rainfall and, mainly, poor spatial and temporal distribution of rainfall, rain-fed agriculture accounts for 94 per cent of cultivated land, or 65.8 per cent of all cultivable land. The significant potential of irrigable land remains underutilized. Furthermore, given the business challenges, this mode of operation is still rudimentary, with an almost total lack of mechanization. Access to credit and high-quality inputs are also recurring problems.

The sector remains fragmented due to the fact that agricultural production is carried out by small family farms. In order to compensate for the decline of the peanut sector, the lack of regulation, and frequent droughts, agriculture has undergone structural changes with the adoption of short-cycle crop varieties and product diversification; although these measures have hardly received any support, the farms continue, but often prove to be too small to be financially viable. As a result, agricultural revenues have declined in all sectors (except the horticultural sector), which has had the effect of making extreme poverty and malnutrition endemic in certain rural areas.

Senegalese agriculture does not guarantee rural producers sufficient revenues to live with dignity and invest in improving their production. Indeed, 57.3 per cent of the rural population is poor and the rural poor represent 69.3 per cent of the country (ESPS 2010-2011). This reality causes migration to urban areas, which results in a transfer of poverty, decreasing production and increasing devaluation of the peasantry, resulting in a vicious cycle leading to the destruction of the sector.

Senegalese agriculture cannot meet the current food needs of the country. Therefore, imports of cereals (rice, wheat and traditional cereals) are needed to meet almost 40 per cent of the nation's needs. Food imports thus account for more than 9 per cent of GDP and consist mainly of rice (32.8 per cent), wheat (16.3 per cent) and dairy products (14.2 per cent). Despite domestic production and imports, food supplies do not cover the minimum nutritional needs of a large part of the population, especially in rural areas. This structural food deficit is periodically aggravated by the effects of droughts and other environmental factors.

Thus, by continuously adapting to growing demographic pressures, often confusing or anti-productive agricultural policies and unfair import competition, Senegalese agriculture has "developed" to the detriment of safeguarding natural resources, disrupting the ecological balance of an environment that is highly affected by climatic events. The soil, naturally deficient in organic matter, is subject to different erosion processes (cf. above) and continuous culture systems, with low or no fertilizer use. In addition to being fragile, organic matter is scarce and is subject to multiple uses, which contributes to the decline of fertility. In addition, overgrazing and trampling have led to the disappearance of grass and tree cover, as well as soil compaction.

Agricultural sector guidelines address not only the eradication of hunger and the reduction of poverty, but also sustainability. Therefore, it is necessary to apply agricultural techniques that conserve soil and water and continuously maintain and improve genetic resources, while increasing productivity and improving farmers' incomes. Therefore, in terms of conservation, efforts must focus on promoting natural fertilizers and bio-pesticides, improving rice cultivation and animal feed, as well as spreading agroforestry techniques. With the opening of European organic markets to exports (mangoes, beans, bananas, dried fruit, etc.), the development of agroecology is an opportunity to develop organic agriculture in Senegal and a means to promote the diversification of crops, including short-cycle varieties.

3.2 FISHING

Fishery and aquaculture sectors accounted for 2.2 per cent of GDP in 2012. The fishery sector, which experienced a long period of expansion, is undergoing a crisis. Total marine production has increased ninefold over the last 45 years. Marine catches, which peaked in the late 1990s, have begun to fall despite the increase in fishing activity.

Between 1982 and 2006, the pirogue fleet tripled its capacity and the output of traditional fisheries increased by 20 per cent. High market value species have been in sharp decline since 2007, and the production of low market value fish, intended for the production of fish oil and fish meal, represents 25 per cent of catches.

Sea fishing generates about 600,000 direct and indirect jobs. The majority of these relate to post-capture activities, including the fish trade and small-scale processing, in which the female workforce plays a key role. Meanwhile, inland fisheries and aquaculture employ about 80,000 and 2,000 people respectively.

Fishing is currently the second largest source of foreign exchange after petroleum products, with 19.8 per cent of export revenues. Fishery revenues amounted to 116 billion CFA francs in 2010, compared to 113 billion CFA in 2009. This 2.7 per cent increase was achieved despite a decline in exports of 26.2 per cent (122,610 tons in 2009 to 90,509 in 2010).

Between 1.6 million and 2 million Senegalese depend primarily on fishing. Fish amounts to about 40 per cent of total animal protein consumption in the country, an average of 28 kg per capita per year. For the most part, it comes from traditional fishing, which provides almost all of the fish consumed locally. Small pelagic fish play an important role in the food strategy, constituting the most accessible source of protein for the poorer strata of the population.

Despite the importance of the sector in economic and social terms, and despite countless potential opportunities, Senegalese fisheries are going through a serious crisis marked by a decline in production. The effects are felt at all levels: depletion of fishing communities; risk of a fish supply shortage; decrease in the sector's contribution to GDP; fall in high value catches; decline in exports; lower profitability and earnings; exacerbation of conflicts between fishermen at sea over access to resources, and increasing dependence of fishing fleets and Senegalese companies on the fishery resources of neighbouring countries.

Between 1988 and 2003, for example, catches of demersal species, which account for most of the added value in the sector, suffered an average decline of 32 per cent, which increased slightly between 2003 and 2006 to reach 33 per cent. Similarly, exports of fishery products fell by 26 per cent. The profitability of traditional and industrial fishing units, and the income of operators and companies in the industry, have also felt the effects of the socio-economic crisis. In the industrial sub-sector, processing plant closures are becoming more common (23 companies between 1999 and 2006), while the National Accreditation system is constantly threatened, mainly due to the difficulties of maintaining the quality of products processed in Senegal.

The causes of this crisis are more anthropogenic than natural. Under the impetus of public development policies based on a sectoral-production approach, a national traditional and industrial fleet was gradually introduced,

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as well as large-scale industrial processing capacities to meet the high demand, especially internationally, for fish products. Thus, in the absence of adequate and coherent policies for the sustainable management of exploitable resources, overfishing and degradation of the marine environment have become common. While coastal erosion is present at different (sometimes very high) levels, coastal pollution, whether domestic, industrial or agricultural, is almost total. For demersal species, whose biomass has declined by a fifth since the 1950s, cephalopods and pelagic resources, both coastal and oceanic, are overexploited. Furthermore, the rise in illegal, unreported and unregulated (IUU) fishing is causing the destruction of marine habitats due to trawling in the area reserved for traditional fishing, dredging rocky bottoms and the use of explosives.

Thus, to reconcile the objectives of growth, poverty reduction and protection of fishery resources, the authorities opted for efficient management of these resources, particularly through the control and management of fishing capacity by controlling access to fishery resources, made possible by the introduction of fishing licences and a concessions system for access rights to fishery resources. The State has also committed itself, in this context, to adjusting fishing capacities to suit the fishery potential of Senegal; progressively establishing fishery development plans; promoting the integrated management of coastal zones; fighting marine pollution and all forms of environmental degradation in coastal areas; strengthening and adapting fishery research, and optimizing fishery surveillance methods. National fishery development policies also focus on meeting domestic demand; better exploitation of the production and promotion of aquaculture products; strengthening and improving the skills of industry professionals, essential factors in the planned reforms and achievement of the sector's sustainable development objectives; the provision of financial instruments sufficient to simultaneously meet both investment and farming needs, by using sustainable resources on the one hand and ensuring the financial viability of fisheries on the other.

3.3 FORESTRY

Forestry activities accounted for 1.1 per cent of GDP in 2010, i.e. 6.4 per cent of primary sector GDP in the same year. In absolute terms, forests contributed 70 billion CFAF to the growth of the country in 2010.

Senegalese forests, however, are consistently and substantially undervalued in national official statistics, which only take into account about one third of the actual production of the forestry sector, the other two thirds remaining unaccounted for. Direct exploitation of forestry represents a turnover of 20 billion CFAF per year and provides 20,000 jobs.

Timber forestry products (fine wood, construction timber, etc.) and non-timber (gum, nuts, forest fruits, etc.) products are exploited for commercial purposes by the people and by traders. Cashew exports reached 50,000 tons in 2011, worth 16 billion CFAF, equal to 7 per cent of Africa's production. Approximately 900 tons of gum arabic are exported each year for around 1 billion CFAF. Total Senegalese exports of forestry products represented 26.7 billion CFAF in 2011, 20.6 per cent more than in 2010.

The forest generates public revenue both nationally and locally. The taxes levied on timber products are similar to fees, and vary according to the hundredweight or cubic metre and whether or not the zones are developed. The development of non-timber products is also beneficial to the state due to the payment of forestry taxes (100 CFAF/kg), local taxes (120-150 CFAF/kg), market taxes (72 CFAF/kg) and unspecified taxes (2.3 CFAF/kg)[2]. The forest tax is 70 CFAF/kg for gum arabic and 40 CFAF/kg for other gums.

The forest sector plays a vital role in the country's economic development. Forest resources are a major source of energy for Senegalese households: 84 per cent of household energy consumption comes from the forest. Despite proactive butane introduction and substitution policies, wood biomass remains the most economical source of energy for consumers. Therefore, it is an important energy source for poor households and is used by more than a third of Senegalese households.

Forest areas play an important role in food security: fruits, leaves, roots and game represent significant nutritional resources, and many plants are used in medicines. In addition, the forest provides the main materials for making domestic utensils, as well as roofs and fences. It is often the poorest families who are dependent on the exploitation of forestry products. These people are often landless or have limited capital. Moreover, forest areas are often the only grazing areas in the dry season.

Consequently, Senegalese ecosystems are heavily affected by the inherent pressure of high demographic population growth. They are subjected to the combination of worsening weather conditions and strong anthropogenic pressures primarily associated with frequent and violent bush fires, abusive use of timber resources, overgrazing, opencast mining and land clearances for agricultural needs. These disturbances to ecosystems have led to gradual degradation of the vegetation cover (woody and herbaceous), an essential element for maintaining the balance of natural ecosystems, pastoral development and the population's living conditions.

In order to reverse the degradation of forest resources, the Senegalese government has pledged to continue its actions in the field of forest management, reforestation, and to prevent and fight against bush fires, particularly by creating and maintaining firebreaks. These actions had relatively positive results in 2010 compared to the previous year.

According to estimates by the Food and Agriculture Organization of the United Nations (FAO), the surface area of forest shrank by 2.3 per cent between 2005 and 2010, an average loss of 40,000 hectares per year. The forest receded at a rate of 45,000 hectares per year from 2000 to 2005. The pressure of overextraction most affected the timber and fine wood markets, which grew by 11 per cent and 16 per cent respectively in 2010 relative to 2009. Conversely, charcoal, firewood and timber extraction decreased significantly between the two periods. Overall, regeneration, reforestation and conservation efforts have resulted in an increase in the reforestation/deforestation ratio, which stood at 0.95 in 2010, compared to 0.78 for the previous year. The surface area burned by bush fires fell from 184,419 hectares in 2009 to 101,040 hectares in 2010, a decrease of 45.2 per cent. Thus, the amount of biomass consumed by these fires fell from 19,578,382 tons in 2009 to 7,436,577 tons in 2010 (CSE, 2010), a decrease of 62 per cent.

Strengthening these policies is essential both to ensure the long-term viability of the forest sector and to enable the State to recover a larger share of revenues. One of the challenges will be to strengthen the economic role of the forest, firstly by implementing a suitable taxation policy for forestry and timber concessions, combined with an improved forestry fee structure, including enforcement and collection, and secondly by developing product processing activities offering better commercial viability through the use of environmentally-friendly high technology. It will also involve improving conditions for the development of small and medium-sized forestry enterprises and industries (SMEs/SMIs) and directing the benefits of the tax system towards local populations, particularly the poorest. Forest and silvopastoral development plans, which must meet the major concern of forest policy - the sustainable development and management of natural resources in order to meet the needs of people, livestock and wildlife. These plans should be developed in a participatory manner in order to involve local populations in the management and control of forestry operations. Indeed, their implementation by local populations means that these populations can ensure that they have consistently wooded or developed areas for their forestry and silvopastoral activities.

3.4 WATER RESOURCES

Despite the ongoing structural changes in the country, there is still a close correlation between rainfall variability and GDP. In 2001, macroeconomic developments were less favourable than expected, due to the drought that ravaged the Sahel, which resulted in a drop in agricultural production, affecting the performance of the primary sector, which consequently recorded negative growth of -10.8 per cent in 2011.

Persistent drought and its corollary, desertification, lead to lower rivers and water tables, reduced plant cover, wind erosion and dune migration. Water resources therefore still represent a major constraint for rural people. Catastrophic hydrological events

such as droughts can have significant social and economic consequences. Worse still, widespread anxiety about the possible recurrence of such disasters leads to the depopulation of rural areas, feeds risk aversion and demotivates investors. Such negative sentiments can seriously compromise investment and growth across the entire economy, even in years when there is adequate precipitation.

To highlight the potential of arable land, Senegal is committed to pursuing an integrated water resource management policy in order to meet the diverse needs of the various sectors (irrigation, drinking water supply, replenishment, etc.).
The economic link between water and sustainable human development encompasses both the effects of water management policies and practices, efforts to increase supply, and the interactions between uses in the various sectors of drinking water and sanitation, hydropower and irrigated agriculture.
It is obvious that each sector is important, and that there are particular benefits in terms of well-being, growth, equity and the status of women.

Water consumption in Senegal totalled 25,800 million m^3 in 2005, while the total catchment was estimated at 2,219 million m^3.

Consequently, precipitation satisfies a large part of the demand for water.

According to the World Bank, agriculture is the most water-intensive economic activity. In 2002, agriculture alone extracted 93 per cent of all the water in Senegal's rivers, lakes and aquifers, while irrigated agriculture accounted for only four per cent of cultivated land. More efficient water management, possibly combined with the expansion of irrigated areas, could increase crop yields. This could boost employment and the wealth of auxiliary activities in the food sector and in non-agricultural activities.

At present, 10.5 per cent of the electricity produced in Senegal comes from hydropower. Hydroelectric facilities can contribute to economic growth by stimulating the development of capacities, since they increase the national supply of electricity and raise revenues from electricity exports.

In terms of drinking water, Senegal has already achieved the Millennium Development Goal (MDG) for access to safe drinking water in urban areas, with a rate of 97 per cent in 2009. The country is also on track in terms of access to sanitation in urban areas,

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with a rate of 63.8 per cent in 2009. Nevertheless, the access rates to safe water (73.6 per cent) and sanitation (28.9 per cent) in rural areas are still below the target values set by the MDGs.

Water use is responsible for various kinds of environmental problems, which resource management must take into account. Dams and irrigation schemes in place have led to the risk of alkalinization (due to changing hydrochemical levels), eutrophication of certain bodies of water (such as Lake Guiers), pesticide pollution, invasion by aquatic vegetation, as well as soil compaction and soil salinization through chemical pollution from agricultural products. Furthermore, an average of 6,762 kg of organic pollutants are released into the water each year by industries including food processing (47.7 per cent), chemicals (22.5 per cent) and textiles (9.5 per cent).

Poor recharge rates, due to lack of rainfall, have caused aquifers to recede, promoting the advance of the saline mass; the heavy mineralization of groundwater makes it unfit for consumption and agricultural use; excessive water extraction from some aquifers exceeds their recharge capacity; nitrate pollution, particularly from the Mbeubeuss landfill site on the Cape Verde Peninsula and of the water table around the slums of Dalifort, Medina and Gounass in the suburbs of Dakar also constitute serious problems.

Also, Senegal has to manage its water resources more efficiently to sustain not only the various economic services on which it depends (irrigation, power generation, etc.), but also the livelihoods and welfare of the poorest, who are particularly vulnerable to the degradation of these resources. It is a question both of maintaining and improving the “natural infrastructure” (aquifer pockets, watersheds, lakes and wetlands), and managing water resources, taking into account the different types of environmental problems that could potentially result from the use of water.

To meet these challenges, governments will need to combine different regulatory, economic, technological and policy tools, and rely on voluntary commitments from the various players involved. These tools should aim to improve water quality monitoring systems, especially in irrigated areas; raise farmers' awareness and train them in irrigation techniques and the management of drainage water, as well as in the adoption of responsible cultivation techniques in terms of inputs; implement measures for the sale of fertilizers and pesticides and the conditions for their efficient use, including dosage and timing; introduce taxes on farmers and industrial polluters, as well as economic incentives for environmentally-friendly agricultural or industrial practices; increase the potential capture of rainwater through the soil and promote the collection of rainwater for domestic sanitation purposes.

3.5 ENERGY

Final energy consumption in Senegal is one of the lowest in the world, at 242.6 kg oil equivalent per capita in 2008. The energy consumed is essentially made up of biomass (45 per cent) and oil (44 per cent). The contributions represented by electricity and mineral coal consumed are 7 per cent and 4 per cent respectively. Wood fuels, virtually all of which are consumed by households, represent 54 per cent of the total energy consumption.

National production of modern energy services remains far below demand, representing only 2.4 per cent of GDP. It consists mainly of fossil energy. Renewable energy (solar, wind, hydroelectric and biomass) amounts to only 1.8 per cent. Senegal, which has no economically viable fossil fuel reserves, is forced to rely on hydrocarbon imports and intensive exploitation of its vegetation cover, which is already degraded, to ensure its supply of primary energy resources. In terms of supply, the Senegalese energy system is characterized, therefore, by a triple dependence: (i) on wood fuels, mainly for heating and cooking of household foods; (ii) on sources abroad for the supply of hydrocarbons; and (iii) to a lesser extent, thermal energy for the production of electricity.

Economically, this triple energy dependence led Senegal, during the energy crisis of 2006 to spend 53.7 per cent of its export earnings on imports of petroleum products, causing a 52 per cent increase in spending relative to 2000, for a change in demand of 6 per cent. This trend has continued,

with a dependency rate of 56.6 per cent in 2011, increasing the country's energy insecurity.

Being a platform for the redistribution of petroleum products provides significant revenue for the Senegalese economy. Its exports, consisting of locally refined products and re-exports of finished products, totalled 176.5 billion CFAF in 2011, compared to 215.9 billion in 2010. In addition, energy products make up one of the largest sources of revenue for the country. In 2011, they generated 225.5 billion CFAF in public revenues, or 17.1 per cent of total tax revenues.

At a social level, access to energy services remains problematic. Despite advances in electrification, 43.5 per cent of Senegalese households still do not have access to electricity. While 87.8 per cent of urban households are connected to an electricity network, this is not the case for 73.4 per cent of rural households, according to the Demographic and Health and Multiple Indicator Cluster Survey (NASD, 2013a).

As a result, 64.3 per cent of households use wood resources to meet their energy needs (NASD, 2013a). More than four million m^3 of wood are extracted annually, causing vegetation cover to recede. Furthermore, the energy sector is still responsible for nearly all CO_2 emissions (95 per cent in 2000). For all greenhouse gas (GHG) emissions, expressed as CO_2 equivalent, the 2000 inventory reveals a major contribution from the energy sector, at 49 per cent of GHG emissions, or 8,276.6 gigagrams (Gg) of CO_2 equivalent. Furthermore, the taxation system for petroleum products does not encourage the consumption of clean products, particularly in terms of excise duties on petroleum products: the Security Fund for Imported Petroleum Products taxes white products at 35 CFAF and black products at 25 CFAF. However, the Energy Support levy can be seen as a green tax, to the extent that it applies only to gasoline, diesel, fuel oil 180 and fuel oil 380, at a rate of 15,000 CFAF per ton or per cubic metre (Decree No. 2011-170 dated February 3, 2011).

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In general, renewable energies, particularly solar, are only used in diversified projects, being integrated into various economic and social programmes such as the rural electrification programme. The situation is the same for coal, biomass and biofuels. A number of technologies, including the use of agricultural residues and agro-industrial products for domestic energy purposes, the use of agricultural products (jatropha) for fuel and the production of ethanol-based fuels (fuel gel) are being trialled in Senegal.

Similarly, the differing experiences of energy efficiency currently witnessed in construction, industry, wood and coal, are based on projects of limited visibility and impact, due to the approach adopted. This mainly involves projects aimed at capacity building and developing national expertise; upgrading industrial and service industry facilities to meet environmental and energy efficiency standards, as well as pilot actions and technical and financial support to implement the recommendations of audits.

Senegal's New Energy Policy is essentially based on the main objective of ensuring energy supplies for households and major economic sectors, under optimal conditions and at the lowest cost, while increasing people's access to modern energy services and reducing the energy vulnerability of the country (DE, 2008). Nevertheless, the lack of implementation, or delays in the implementation, of policies and measures adopted to change the energy system exacerbates, in a context of increasing demand, the country's energy dependency and negatively impacts on the environment and climate.

However, the country's energy situation requires both greater contributions to energy production from renewable energy sources and the promotion of energy efficiency. Senegal's renewable energy sources (solar, wind, hydropower and biomass) have significant potential. A catch-up programme for investments in energy infrastructure would increase the deployment of renewable energy, improve energy efficiency and provide support for new technologies.

In this context, a clear legislative and regulatory framework should be established to facilitate investment by private players in the renewable energy sector. There is already a renewable energy law[3]. This law regulates the production of electricity through renewable energy in Senegal. However, the decrees for its implementation are being enacted slowly.

Other instruments can be used to promote the development of renewable energy, including phasing out fossil fuel subsidies and introducing an emissions tax. New academic and professional renewable energy training mechanisms should be implemented.

Actions to be taken or reinforced to improve energy efficiency include: the widespread use of solar thermal applications and energy-saving lights in existing public housing and new local authority installations; optimizing the management of public lighting in local communities; preparing demand-side management (DSM) actions in the context of SME and SMI upgrade programmes; promoting public transport; using energy-saving lights, liquefied petroleum gas and improved stoves in households.

3.6 WASTE MANAGEMENT

In Senegal, 2,438 tons of solid waste is collected every day in the municipalities, or 0.5 kg per resident per day. This waste mainly comprises organic waste (44 per cent), paper (10 per cent), plastic (3 per cent), glass (3 per cent), metals (1 per cent) and other types of waste - textile, electronic, medical, industrial, etc. (39 per cent) (Bhada-Tata and Hoornweg, 2012).

Nevertheless, the corresponding collection rate is only 21 per cent nationally (Bhada-Tata and Hoornweg, 2012). Thus, more than three quarters of the population does not have access to any waste disposal service. Less than a quarter of the population is served by 'authorized' but unregulated landfills. The largest of these is Mbeubeuss, which receives nearly 475,000 tons of waste per year.

Mechanical means, often poorly suited to both the country's city streets and the nature of the waste, are used for home waste collection, the removal of waste deposited in transit sites, bins and dumpsters, and direct disposal in landfill. In areas without collection services, home pre-collection systems are set up by people or private groups, using draught animals. However, the services provided by these resources are not always available or regular, so 'ad-hoc' landfills have developed in all inhabited areas of the country. The majority of the waste produced by the population is thus disposed of outside official channels and does not arrive at official landfills.

Landfill remains the main means of disposing of collected waste. Incineration, composting and other biological treatments remain the exception. Landfills are also used for biomedical and industrial waste, even though these are considered hazardous. They are unenclosed and have no adequate system for treating liquids resulting from the decomposition of waste (leachates) and landfill gases. Their operation is therefore neither planned nor implemented in the interests of the environment or the lives of the population.

Although plastic waste recovery experiments have been conducted, the main formal initiatives for solid waste recovery concern compost production. In any case, there is no industrial sector covering this field. However, the waste in landfills, homes and, more frequently, in unserved areas is separated and recovered. Plastic and glass bottles, jars, pots and plastic bags in good condition, scrap iron, shoes and other items that can be refurbished are recycled by households or resold.

According to the Sustainable Management Programme for waste and urban sanitation (2002), an average of 11,200 tons of metals recovered from landfills are exported each year, while the potential is about 19,500 tons per year. The greatest demand is for iron (50.0 per cent), cast iron (43.8 per cent), aluminum (0.6 per cent) and other metals (1.3 per cent), and usually outstrips supply. The potential reserve of waste plastics for the Dakar region is estimated at just over 9,000 tons per year. Over 60 per cent of plastic waste is collected from landfills, and about 35 per cent from households. However, the plastic waste generated by processing industries, calculated at between 500 and 800 tons per year, is recovered directly by these operations.

According to the African Institute of Urban Management, Mbeubeuss receives an average of 3,500 people per day, composed mainly of gleaners, with a strong presence of women and children. Their activities generate nearly 13 million CFAF daily. Upstream, waste collection and transportation services provided under public-private partnerships (PPP) with local authorities, generate work for thousands of people (1,703 in the Dakar region, for example).

Those communes that subsidize their household waste collection service spend an average of 10 per cent of their budget on cleaning expenses. The fee for household waste collection, which is the main source of financing for the collection and treatment of household waste, is insufficient to cover the expenses incurred for the removal of waste. Furthermore, a portion of the money from the waste management sector is paid directly by households to certain unofficial players (pre-collection groups in the form of associations or economic interest groups [IEG]), thereby bypassing any accounting and monitoring by the municipalities.

More satisfactory management, regulation and surveillance measures are therefore required in order to make waste management a factor in pro-poor sustainable growth. Therefore, it is important to provide each region with at least a level 2 technical landfill site, supported by an action plan to reduce the amount and the toxicity of waste by promoting methods and techniques for reducing, recycling and recovering waste prior to its disposal by environmentally sound means. In this regard, a regulatory system must be developed and implemented to reduce waste production, such as regulations concerning packaging, waste sorting and landfill disposal. It may also be possible to introduce economic instruments to encourage economic players, through changes in relative prices, to adopt behaviour that prevents the production of waste. Community waste recovery initiatives should also be facilitated by fiscal measures.

4 GREENING SCENARIOS

This section examines the macroeconomic effects of greening the Senegalese economy at a national level using the SD-Threshold 21 (T21) modelling tool.

4.1 DESCRIPTION OF THE MODEL, HYPOTHESES AND DATA SOURCES

Lack of infrastructure is recognized to be the main obstacle to access to basic services and improvements to quality of life in many developing and emerging countries. Therefore, the national development plans in these countries often involve large investments to finance infrastructure projects. However, while the need to address the lack of infrastructure is indisputable, these projects are often characterized by little or no consideration for their effects on local society and the environment.

Researchers and practitioners have developed a number of tools to aid national planning. A recent UNEP report identified a number of these models, namely: “Disaggregated consistency” (DC), computable general equilibrium (CGE), macroeconomic (ME) and System Dynamics (SD). Each of these models has its strengths and weaknesses.

The ME approach, which, by combining macroeconomic identities and behavioural equations, provides a sound analysis tool for macroeconomic policy, omits the long term to treat only the medium term.

CGE and DC models mainly focus on economic aspects (UNEP, 2011). Some new editions of the EGC method, however, include social and environmental indicators. Nevertheless, the socioeconomic aspects of development planning are addressed more appropriately in the Systems Dynamics (SD) models.

Structured to analyse complex and dynamic systems, SD models are based on a representation of the systems that relies as much on stock (or accumulation) and flow variables, as on auxiliary variables which may be constants or parameters, or incorporate logical relations or even functions.

An SD-Threshold 21 (T21) model was applied at a national level to analyse the green economy in Senegal. The subsections below introduce the generic part of the T21 model and the structure and sections of the Senegal-GE T21 model.

4.2 THE T21 MODEL: GENERIC FRAMEWORK

The T21 model is a dynamic, integrated and non-spatial model. It is based on the System Dynamics (SD) method and has a structure allowing it to take account of economic, social and environmental factors within a coherent and integrated framework. It was designed to analyse multi-sectoral development strategies in the medium and long term. However, this model is not regionalized. Therefore, any change in the economy and social characteristics, as well as environmental impacts associated with changes in the spatial structure, are not explicitly represented. Similarly, the model does not specifically address the responsibilities and reactions of the various players, particularly government authorities.

The T21 model reflects the dependence of economic production on 'traditional' resources such as labour and physical capital. It also enables natural resources such as energy, forestry zones, soil, fish and water to be accounted for as production factors. The driving force for growth is therefore the accumulation of capital (physical, human and natural) through investment, also taking into account the depreciation and depletion of capital stocks. It is thus well suited to analysis of the impact of investment plans, covering both public and private commitments.

The T21 model is designed for full and participatory development planning. “This model:

- integrates economic, social and environmental factors;
- represents the important elements of complexity - feedback, nonlinearity and delay - which are

fundamental to the proper understanding of development issues;
- is transparent in its structure, its assumptions, its equations and its database, and constitutes a participatory analysis tool used to reach a consensus in policy debates;
- is flexible enough to be adapted to different qualified users and according to the specificities of the country;
- simulates the consequences of alternative policies in the medium and long term;
- allows easy comparison with the business as usual scenario and supports advanced analytical methods, such as sensitivity analysis and optimization". (Züllich et *al.,* 2012)

The basic version of the T21 model includes: (i) economic factors, including production sectors (agriculture, industry and services), public revenue and expenditure, income and household savings, international trade; (ii) social factors including population dynamics, education, health care, employment, infrastructure, distribution of revenues; (iii) environmental factors including land use, water supply and demand, energy supply and demand, and carbon emissions. This version also takes into account the relationships between these sectors to generate comprehensive scenarios.

4.3 THE SENEGAL GE T21 MODEL

The Senegal GE T21 model was developed by adapting the generic model to represent the main concerns of Senegal. The components of the green economy are integrated, with the support of various stakeholders, by expanding priority areas and adding green strategies to the model. This version of T21 models the Senegalese economy as a whole in order to highlight the key relationships between production and the key national stocks of natural resources. Figure 2 is a schematic representation of this integrated approach for Senegal.

To facilitate understanding of the model, the three spheres representing society, economy and environment are subdivided into sectors including a number of modules. Table 3 provides an overview of areas, sectors and modules in the Senegal GE T21 model. The model is calibrated to reproduce the period between 1980-2012; simulations have been run for the period 2012-2035.

FIGURE 2. SCHEMATIC STRUCTURE OF THE SENEGAL GE T21 MODEL

Source: Tan and Assuad (2014).

TABLE 3. MODULES, SECTORS AND SPHERES OF THE SENEGAL GE T21 MODEL

Society sphere	Economy sphere	Environment sphere
Population sector	**Production sector**	**Land sector**
1. Population**	14. Total production and revenue	29. Land**
2. Fertility	15. Agriculture**	**Water sector**
3. Mortality	16. Livestock and forestry production	30. Water demand
Education sector	17. Industries (excluding mining)	31. Water supply
4. Primary education	18. Services (excluding mobile telephony)	**Energy sector**
5. Secondary education	**Household sector**	32. Energy demand
Health sector	19. Households	33. Energy supply
6. Access to basic health care	**Government sector**	**Emissions sector**
7. HIV/AIDS	20. Government revenues**	34. Fossil fuels and greenhouse gas emissions
8. Orphans and children with HIV	21. Government expenditure**	**Sustainable development sector**
9. Nutrition	22. Investment and public consumption	35. Ecological footprint
	23. Balance and public financing	
Infrastructure sector	24. Public debt	
10. Roads		
Employment sector	**Rest of the world (ROW) sector**	
11. Employment	25. International trade	
12. Availability of work and unemployment	26. Balance of payments	
Poverty sector	**Investment sector**	**Green economy indicators and policies**
13. Revenue distribution	27. Relative prices	45. MDG
	28. Investments	46. Human Development Index (HDI) and Gender-related Development Index
Additional sectors for Senegal	**Additional sectors for Senegal**	47. Growth rate
36. Migration*	40. Fishing*	48. Strategy variables*
37. Education level of migrants*	41. Mines*	49. Green economy actions*
38. Higher education*	42. Mobile telephony*	50. Green economy indicators*
39. Health care structure*	43. Remittances*	51a. Renewable electricity generation*
	44. Decentralization and good governance*	51b. Employment in renewable energy production*

* Other sectors in the Senegal GE T21 model
**These are existing sectors with additional components in the Senegal GE T21 model

Source: Tan and Assuad (2014).

4.4 INVESTMENT SCENARIOS

To examine the economic, social and environmental effects of greening the Senegalese economy, the model chosen analyses potential macroeconomic impacts resulting from the annual investment of 2 per cent of GDP over the coming decades, in four different scenarios: (i) business as usual, (ii) green investment (GE), (iii) energy transition (GE-Energy), and (iv) brown investment (BI). The distribution of green investments in different sectors is shown in Table 4.

TABLE 4. DISTRIBUTION OF GREEN INVESTMENTS AND GREEN POLICY OBJECTIVES BY SECTOR

Sectors	Structure of green investments according to each scenario		Policies
	GE (per cent)	GE-Energy (per cent)	
Agriculture	12.5	5.0	• Reduction of salinization/desertification • Substitution of chemical fertilizers and pesticides
Forestry	12.5	5.0	• Sustainable forest management • Reforestation • Substitution of wood energy with gas energy
Water resources	12.5	5.0	• Control of rainwater (reservoirs) • Water reuse • Increased water productivity
Energy production	12.5	50.0	• Production of renewable energy (solar, wind and hydroelectric) • Substitution of wood energy with gas energy • Bioenergy production: biofuel and biogas
Energy efficiency	12.5	5.0	• Increased energy efficiency (in industry, construction and transport)
Waste	12.5	5.0	• Waste collection
Administrative expenditure	25.0	25.0	
Total	**100.0**	**100.0**	

In the business as usual (BAU) scenario, the model is first calibrated to an initial quantified representation (1980-2012) of the Senegalese economy and then extrapolated for the trajectory of the national economy over the period 2012-2035, replicating past trends and assuming no fundamental changes in policy or external conditions.

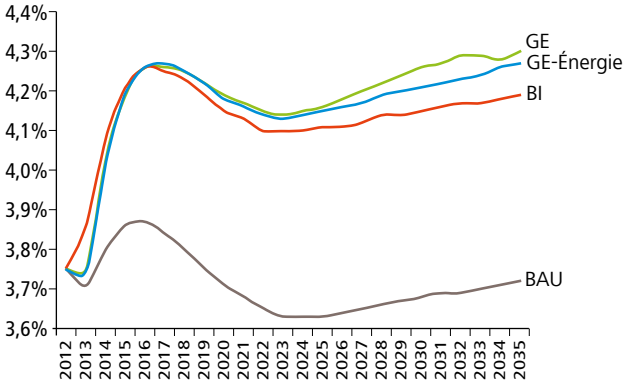
The two green scenarios (GE and GE-Energy) assume an annual increase of 2 per cent of GDP in green investments from 2012 to 2035. In the GE scenario green investments are distributed equally across all sectors. In contrast, in the GE-Energy scenario priorities are driven by sectoral policy objectives, with the emphasis on energy transition. Consequently, a higher share of GDP is allocated to energy efficiency (in industry, construction and transport) and the remaining part is shared equally among the other sectors.

These green scenarios are contrasted with the brown investment (BI) scenario, in which the same amounts of investments are simulated but allocated according to current trends in energy consumption and the use of natural resources. Specifically, the BI scenario assumes that no additional capital will be allocated for the promotion of renewable energy, agriculture will continue to depend on chemical fertilizers and deforestation will not be curbed. In other words, growth will be achieved through the exploitation or even the overexploitation of resources.

4.5 PRESENTATION AND DISCUSSION OF KEY FINDINGS

In the short, medium and long term, growth is stimulated by additional annual investments. The multiplier effects of these investments are only expected to exceed the negative economic impact of the financing costs from 2015 onwards, showing that the green scenarios (GE and GE-Energy), besides their power to preserve natural resources and reduce pollution, offer greater medium- and long-term growth from 2012 to 2035 than the business as usual (BAU) scenario (Figure 3). Real GDP in USD (at constant 2001 prices) should be $14 trillion in the GE and GE-Energy scenarios, $13.9 trillion in the BI scenario and $12.6 trillion in the BAU scenario[5].

FIGURE 3. GDP GROWTH RATES IN THE FOUR SCENARIOS

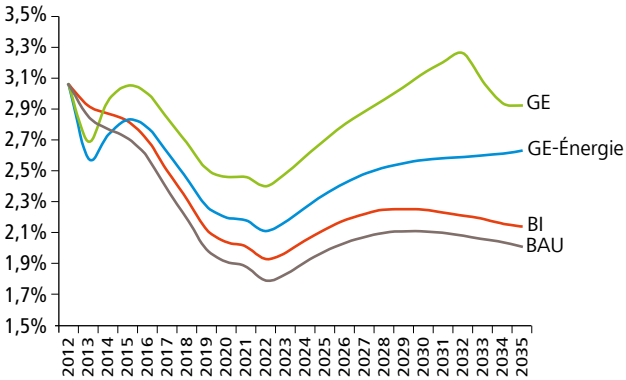


BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

In the green scenarios, the additional investment in the agriculture sector will go towards the wider use of organic fertilizers, irrigation development, and the fight against desertification and salinization. In these scenarios, the volume of agricultural production is expected to increase by between 2.5 and 3.25 per cent between 2020-2035, as opposed to an increase of more than 2 per cent in the business as usual (BAU) scenario (Figure 4).

FIGURE 4. AGRICULTURAL PRODUCTION GROWTH RATE

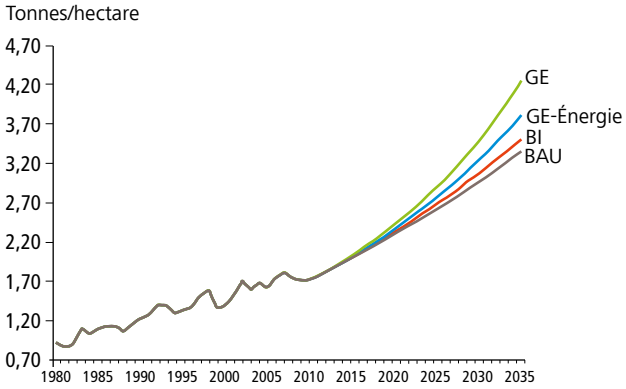


BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

This progress is mainly due to a higher yield per hectare in green scenarios, associated with the quality of cultivated land and the development of irrigation. In the GE and GE-Energy scenarios, performance improves from 1.8 tons/hectare in 2012 to 4.2 tons/hectare and 3.8 tons/hectare respectively, by 2030 (Figure 5). The improvement is relatively lower in the BI (3.5 tons/hectare in 2030) and BAU (3.4 tons/hectare in 2030) scenarios.

FIGURE 5. AVERAGE AGRICULTURAL YIELD IN THE FOUR SCENARIOS

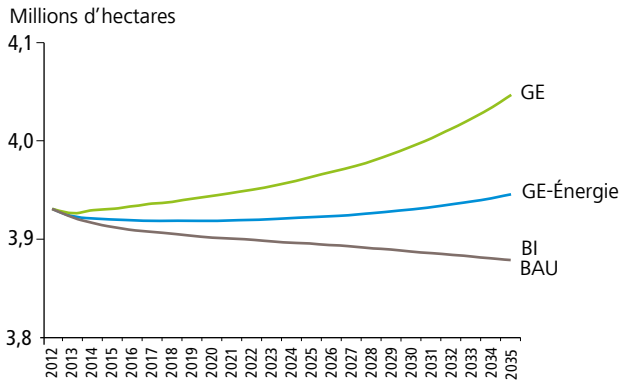


BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

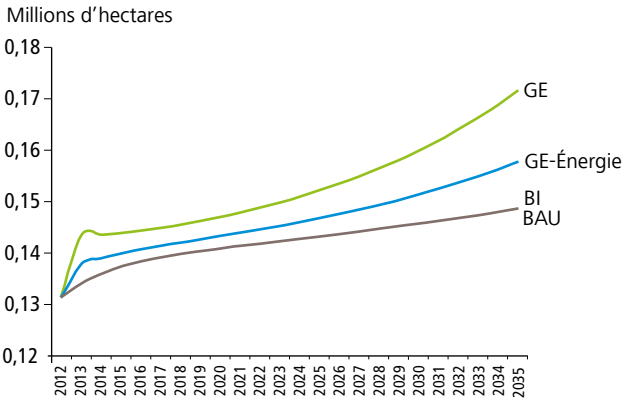
Green investment should stimulate a reduction in degraded land of 37 per cent (0.17 million hectares) in the GE scenario, and 15 per cent (0.07 million hectares) in the GE-Energy scenario. Consequently, there should be an expansion of arable land, from 3.93 million hectares in 2012 to 4.04 million hectares in 2030. There should not be any change in the GE-Energy scenario, but there would be a reduction in arable land in the BAU and BI scenarios (Figures 6 and 7).

FIGURE 6. AVAILABILITY OF ARABLE LAND



BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.
Source: Tan and Assuad (2014).

FIGURE 7. RECOVERY OF DEGRADED LAND

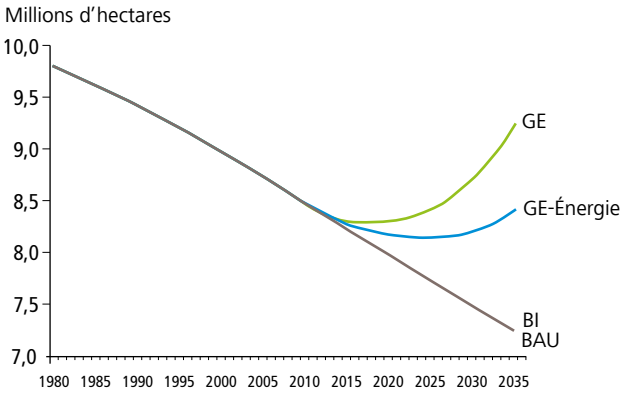


BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.
Source: Tan and Assuad (2014).

In relation to the increase in agricultural yields and the recovery of degraded land, the greening of agriculture should lead to a reduction in the amount of land used for agriculture, in contrast to what would be possible if current strategies were maintained (BAU and BI scenarios), in order to meet other needs, such as the production of biomass for energy. Therefore, in terms of nutrition levels, the amount of calories consumed by the Senegalese should be highest in the two green scenarios (GE and GE-Energy). Furthermore, the increased efficiency of the agricultural sector in the green scenarios would reduce the demand for water for irrigation by about one-fifth compared to BAU and BI scenario estimates, which would decrease the pressure on groundwater and surface water in the medium and long term.

In green economy scenarios, green investments in the forestry sector are intended to reduce deforestation and increase reforestation. The transition to a green economy would increase forest cover, which is currently close to 8,200 hectares, by a little over 6 per cent by 2025 and nearly 28 per cent by 2035, compared to the BAU and BI scenarios (Figure 8). This would improve soil quality and water availability, both of which would improve agricultural productivity, and increase carbon sequestration.

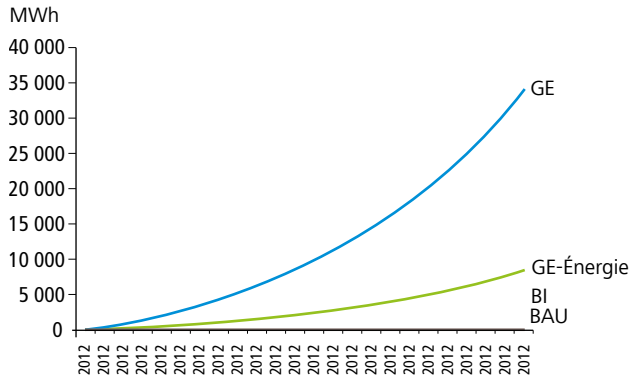
FIGURE 8. FORESTRY ZONE IN THE FOUR SCENARIOS



BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.
Source: Tan and Assuad (2014).

Substituting investments in energy sources with high carbon emission rates with investments in clean energy would increase the penetration of renewable energy into electricity production by 30 per cent in the GE scenario and 60 per cent in the GE-Energy scenario by 2035, which translates to an increase in the use of renewable energy of over 19 per cent and almost 47 per cent by 2035, relative to the BAU and BI scenarios. Figure 9 provides an overview of the effects of additional green investments in solar and wind energy, while Figure 10 shows total renewable energy production.

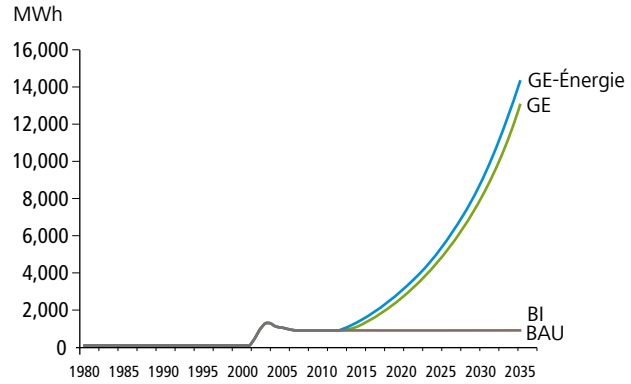
FIGURE 9. EFFECTS OF ADDITIONAL GREEN INVESTMENTS IN THE PRODUCTION OF SOLAR AND WIND ENERGY



BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

FIGURE 10. TOTAL RENEWABLE ENERGY PRODUCTION

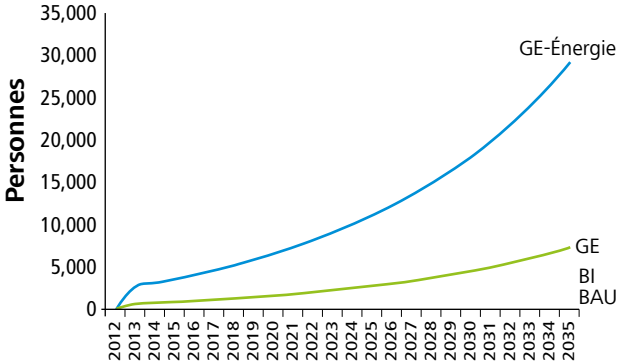


BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

This expansion in renewable energy production is expected to create between 7,600 and 30,000 green jobs in construction and the renewable energy industry (Figure 11).

FIGURE 11. ADDITIONAL GREEN INVESTMENTS AND THE CREATION OF GREEN JOBS (IN THE RENEWABLE ENERGY SECTOR)

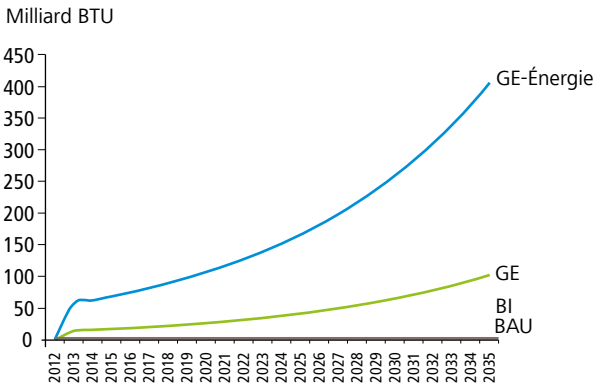


BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

Improvements in the supply of green energy should also enable the development of biofuels, with a production of 100 Btu and 400 Btu for the GE and GE-Energy scenarios respectively, by 2035 (Figure 12). However, the 30,000 and 123,000 hectares, respectively, of additional land that would be required would be largely offset by the arable land recovered in the context of green agriculture.

FIGURE 12. BIOFUEL PRODUCTION



BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.

Source: Tan and Assuad (2014).

In addition, the reduction of the share of firewood in the energy balance would lead to the consumption of 3.5 and 14 billion Btu of butane gas, in the GE and GE-Energy scenarios, respectively, by 2035.

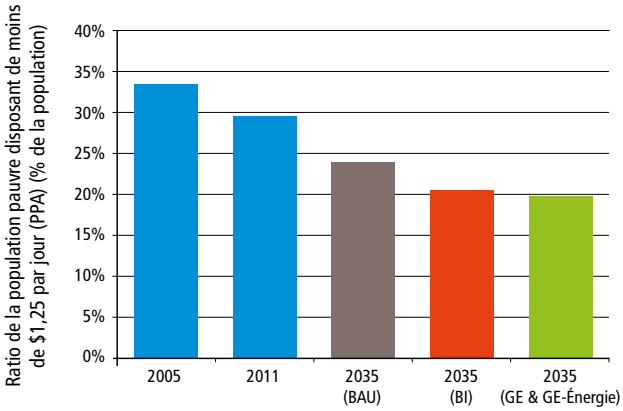
This would increase Senegal's dependence on fossil fuels, although this would be offset by the increased production of biofuels and renewable energy.

Consequently, imports and consumption of fossil fuels, as well as CO_2 emissions associated with the consumption of these fuels, would be slightly higher in the green scenarios (GE and GE-Energy) than in the BAU and BI scenarios, while emissions from the use of firewood would be reduced.

Moreover, electricity imports would also begin to decline because of the increased capacity of renewable energy, allowing the country to export electricity from 2034 onwards.

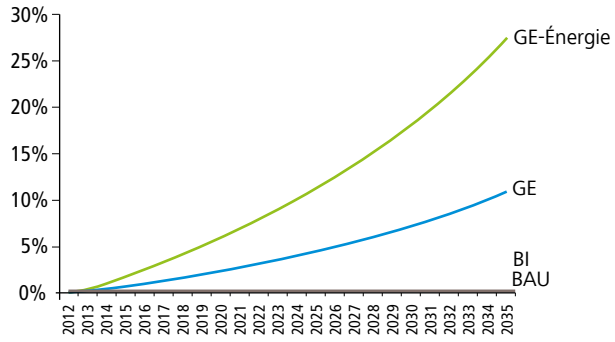
Senegal poverty trend indicators suggest that while the poverty rate has declined, the absolute number of poor increased by over 10 per cent between 2005 and 2011. There are also considerable regional disparities: poverty is higher in rural areas (NASD, 2013). A green economy can play a vital role in the fight against poverty. A key feature of the green economy is its ability to offer various options for economic development and the fight against poverty, without eroding the country's natural resources. This is a necessity in low-income countries such as Senegal, where environmental goods and services are a major component of the livelihoods of poor rural communities and where the environment and its services protect them in the event of natural disasters and economic shocks (UNEP, 2011). The results of the simulations of this study indicate that green investment can play a vital role in the fight against poverty. The proportion of the population below the poverty line would fall to below 20 per cent by 2035 in the green scenarios. In the BI and BAU scenarios, the proportion would be slightly more than 20 per cent and 24 per cent respectively (Figure 13).
In addition, the green economy should reduce the poverty gap between rural and urban areas. Finally, green investments would lead to improved access to sanitation, from 10 per cent to 30 per cent, and nationwide waste collection, thus contributing to improvements in living conditions for the Senegalese population (Figure 14).

FIGURE 13. EFFECTS OF GREEN INVESTMENTS ON POVERTY



Source: World Development Indicators (World Bank, 2013); Results of the simulations of this study.

FIGURE 14. EFFECTS OF GREEN INVESTMENTS ON ACCESS TO SANITATION



BAU: Business as usual scenario; GE: Green investment scenario; GE-Energy: Energy transition scenario; BI: Brown investment scenario.
Source: Tan and Assuad (2014).

5 POLITICAL CONDITIONS FAVOURABLE TO THE TRANSITION

Given its level of development and its wealth of natural resources, greening the course of growth of the Senegalese economy is dependent on an action framework with the general objective of putting in place incentives and institutions that increase welfare: improving resource management and boosting productivity, attracting economic activity to areas where it will produce the greatest benefits to society over time and creating new ways of achieving the first two objectives. This action framework essentially consists of regulatory policies that influence the direction of growth; market-based instruments; the ability to find the necessary financing for the development of climate change resistant infrastructure, and the governance and institutional capacity to implement public sector reforms.

5.1 LEGAL FRAMEWORK, STANDARDS AND TARGETS

Regulatory policies can both promote green growth and improve the mechanisms already in place. However, they must be designed with a view to complementarity and support for economic and fiscal instruments (see subsection 5.2 below), in order to:

- encourage better use of resources and reduce emissions;
- promote competition on product markets;
- promote the development of trade and foreign direct investment;
- ensure consistency of policy and regulatory certainty.

This is to reduce regulatory and economic risks, and increase the confidence of investors and markets. Thus, whether they are results-based or require the use of a particular technology, well thought-out regulations can bring significant net benefits and are preferred by businesses, even when price offers a technically better solution.

Moreover, to improve the cost-effectiveness of the signals sent to investors and markets, it would be necessary, given the degree of informality in the economy, to remove obstacles to changes in consumer behaviour through information, education and communication.

5.2 MARKET-BASED INSTRUMENTS

Market-based instruments have the advantage, when properly designed, of being able to modify price signals by internalizing external factors. They can then create economic incentives that allow both to take advantage of all the potential of reducing environmental damage for a given cost in terms of resources, to promote and guide green innovation.

Tariffs may be levied on environmental damage in the form of tradable permits (quotas) or taxes. However, the choice between permits and taxes is complex. In practice, although licensing systems generally work well to control emissions from pollution sources of a certain size, taxation seems a more appropriate way to deal with small, scattered sources of pollution such as households, farmers and small businesses.

Taxes are usually good incentives to reduce CO_2 emissions and use natural resources more efficiently, not to mention that they also stimulate innovation. Tariffs on natural resources can be considered an immediate solution without any drawbacks, which promotes, firstly, the sustainable management of resources and, secondly, increased tax revenues for public authorities, helping to finance education, health care, infrastructure development and the fight against poverty. Furthermore, it is important that instruments anchored to the market should also play a role in tax reforms focused on growth.

5.3 FINANCING

The lack of basic infrastructure, particularly in the energy, water, transport and communications sectors, constitutes a major obstacle to green growth in Senegal. By lifting this constraint, Senegal would afford itself the possibility to progress rapidly

by acquiring infrastructure that is greener, more efficient and more resilient to climate change. Therefore, it is important for the country to adjust the composition of its investment streams favourable to green infrastructure.

In this regard, it should reduce the regulatory risk compromising the appeal of investments in infrastructure, without removing the incentives to manage them. Public-private partnerships (PPPs) are one of the tools available in the field: the presence of a business partner helps to reduce regulatory risk.

To support the development of the country by way of substantial, regular and stable financing mechanisms intended only for the financing of development generally and business in particular, Senegal has just created FONSIS, an innovative sovereign fund, the first of its kind in the world: the country will invest in targeted sectors within the country (energy, infrastructure, industry, agriculture and real estate), targeting employment and import substitutions.

In terms of public financing, official development assistance (ODA) for environmental purposes is an important source of capital for investment. In addition, nationally appropriate mitigation actions (NAMAs) allow developing countries to contribute to the global effort to reduce greenhouse gas emissions through support from industrialized countries.

Similarly, South-South cooperation in financing, as a complement to official development assistance, can also generate new sources of financing for production and green economic infrastructure, and stimulate private investment in the necessary infrastructure to enable greener growth in Senegal.

5.4 INSTITUTIONAL AND POLICY FRAMEWORK

In its search for a rational balance of responsibilities between socio-economic players, in order to ensure sustainable economic and social progress, Senegal has decided to make the private sector the driving force behind economic growth. In return, the state is responsible firstly for establishing a framework and an environment conducive to the growth expected in the private sector, defining economic strategies and social and environmental polices in a participatory manner, and secondly for providing assets such as equipment and infrastructure, health facilities, education, training and innovation. Therefore, Senegal must persist in its efforts to improve its current national planning system in order to eliminate the inconsistencies, duplication and lack of coordination that characterize it, while also integrating green growth strategies.

In terms of good governance, Senegal must both strengthen its leadership in the design, development, implementation and monitoring of policies, development programmes and projects, and improve and enhance the participation of socio-economic players. Finally, it is also necessary to continue to ensure that development is managed closely through consistent devolution and decentralization, and strengthening the rule of law and democracy.

6 CONCLUSIONS

Senegal would be able to make the transition to a green economy while also ensuring sufficient growth to maintain or accelerate its sustainable development process.

This report shows that it is necessary to consider the environment as a determining factor in economic production, value, stability and long-term prosperity, that will put Senegal on a development path that will preserve, improve and, if necessary, rehabilitate natural capital as an asset and crucial source of economic and public benefits, especially for poor people whose means of subsistence are dependent on nature.

The analysis in this report reveals that the development of a green economy in Senegal would promote the growth of revenues and employment better than the current economic model, while contributing to a reduction in carbon emissions and pollution, improving efficiency in the use of energy and resources, and preventing loss of biodiversity and degradation of the services provided by ecosystems. Current policies, by contrast, are responsible for depleted resources and high levels of carbon emissions, and will, if pursued, exacerbate risks, shocks and shortages.

According to this report, an approach inspired by the green economy in Senegal would aim to integrate natural capital more effectively into the market, through agriculture, water and forestry resources, but also to implement a variety of policy measures which would change practices and ensure the sustainability of these resources. These measures should also apply to waste management, energy efficiency and the transition to renewable energy, which are also priority action areas for a green Senegal. For each of these policy areas, actions that could have adverse effects on employment and living standards should be accompanied by appropriate mitigation actions (research, workforce training, transition programmes, etc.).

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In agriculture, this would include practices and technologies that would maintain soil quality by limiting the use of chemical pesticides and herbicides, and reducing post-harvest losses. In terms of fishing, greening would require the withdrawal of subsidies and the implementation of multiple control measures (permits, quotas, marine parks, etc.) in order to reduce fishing intensity.

For water resources, this would mean legal guarantees of access to clean water and the development of policies to reduce wastage and promote conservation of the ecosystems on which the water supply depends. As for greening the forestry sector, this would be based on the implementation of sustainable forest management, as well as reforestation actions. In terms of energy, efforts should focus on promoting renewable energy and bioenergy, and improving energy efficiency in industry, construction and transport.

Four key factors in the greening of an economy have been identified, which promote the transition to a green economy through these various actions: voluntary mechanisms, regulation, public spending and fiscal tools. Various financing sources could be used, such as private investment (particularly through the creation of PPPs), emerging sovereign wealth funds, ODA, funds for the fight against climate change (NAMA, the Adaptation Fund and the Green Climate Fund), as well as the establishment of South-South partnerships.

By choosing these four factors, we suggest that the authorities focus on accumulation of capital, technological progress and structural changes favourable to green growth, and create an environment in which the development of green production and the growing demand for green systems strengthen each other mutually and create productive green jobs to reduce poverty.

Therefore, it is necessary to undertake these actions to promote the transition to a green economy by prioritizing the establishment of a coherent policy framework, increasing green investment, developing public markets for green products and improving communication with the public.

NOTES

[1]Senegal, 'Demographic and Health and Multiple Indicator Cluster Survey EDS V – MICS, 2010-2011 – Preliminary report', Agence nationale de la Statistique et de la Démographie, Dakar, Senegal, MEASURE DHS, IFC Macro, Calverton, Maryland, USA, June 2011.

[2]United States Agency for International Development (USAID) (2005), Étude de cas sur les produits naturels: le Laalo Mbepp au Sénégal.

[3]The law on renewable energies was promulgated in December 2010.

[4]The real economic values are measured in USD at constant 2001 prices.

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