



Science, Technology and Innovation in

SENEGAL



SCIENCE, TECHNOLOGY AND INNOVATION IN SENEGAL



ORGANISATION OF ISLAMIC COOPERATION
STATISTICAL, ECONOMIC AND SOCIAL RESEARCH
AND TRAINING CENTRE FOR ISLAMIC COUNTRIES

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ISBN: 978-975-6427-56-9

Cover design by Savaş Pehlivan, Publication Department, SESRIC.

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PREFACE

**His Excellency Ambassador Musa KULAKLIKAYA, Director General
Statistical, Economic and Social Research and Training Centre for Islamic Countries
(SESRIC)**



One of the most significant and challenging questions of development economics is why there are wide discrepancies in the welfare of countries. Varying economic growth rates may come out as a quick answer but this also triggers new questions such as why countries have uneven and different growth patterns. Despite the many studies found in the extant literature, economic development is a complex issue with linkages to multiple criteria that poses impediments in furnishing a generalized model applicable to each individual country. However, we all undoubtedly accept the impact of science, technology, and innovation (STI) as a key driver in economic growth is increasing ever than before

The history of industrial production chain exemplifies this impact and its different stages well. The industrial sector first mechanized, then massified, and then automated production respectively in the period between 18th and 20th century by using water/steam power, electric power, and electronics/information technology. We now witness the fourth wave of change in industry that merges dissimilar technologies with fuzzy boundaries among physical, digital, and biological spheres. We observe that the higher the technological advancement, the shorter the duration from one industrial production stage to another. This inversely proportional situation has unquestionably made the researchers adopt interdisciplinary approaches to cover the wide range of STI fields contributing to the economic development of countries.

In this respect, the Atlas of Islamic-World Science and Innovation Project has proved itself to be an exemplary international initiative with a simple aim in mind: To provide an insightful overview of science and science-based innovation across the selected countries in the Islamic-world. Based on the independent and authoritative assessment on each case country, the reports try to show how the national capabilities are transforming to catch the opportunities and remove the barriers to record progress in socio-economic and STI fields. The reports not only share the outcomes of analysis from selected sectors but also present key trends with an impact on progress of the selected countries from which policymakers, universities, business leaders and other stakeholders will benefit.

Inspired by the methodology of the previous Atlas Reports which were completed with the publication of the Final Report in December 2014, this independent Report has been prepared within the same concept of its predecessors and highly contributes to the visibility of the development of STI in Senegal. The Report acknowledges the encouraging STI trends in the country; while it also objectively points out to the fields to be focused from the policy design and implementation perspectives so as to sustain the economic development and competitiveness of Senegal.

Especially, as a prominent country with its social and political stability in West Africa, Senegal has the potential of a young population which is the basis for the formation of human capital. For equipping this next generation of the country with necessary skills of the 21st century, the government of Senegal is now in the process of consolidating, rationalizing and redeploying its

higher education and research system. To complement this effort on the policy side, Senegal has been one of the first countries in the region to enact a National Plan for the Development of Intellectual Property (NPDIP) which is to be strengthened by a National Council for Coordination and Development of Intellectual Property (NCDCIP) and a National Committee on Geographical Indications (NCGI). On the collaboration side, Senegal increases its technical cooperation linkages with regional and international institutions and also attracts many regional and international STI events for their organisation. As pointed out in the “Senegal 2035” Prospective Study, technological innovation is and always will be a key element for the diversifying the economic structure of the country.

I am confident that with the provision of sufficient funding, investment on infrastructure and human resources of the higher education sector, and continuous political ownership; Senegal moves forward to a technology-based future and knowledge-based economy. Additionally, the recommendations given in this Report will undoubtedly contribute to the endeavours of the national decision makers in their efforts for transforming the economy of Senegal.

I present my sincere thanks all the partners who have contributed in the preparation of this report including the Higher Education and Research Ministry, National Agency for Statistics and Demography, National Academy of Sciences and Techniques (ANSTS), particularly Mr. Ousmane A. Kane, Chairman of the ANSTS Commission of Relations with Partners, and all collaborators, for their constructive inputs, invaluable assistance and support.

Ambassador Musa KULAKLIKAYA
Director General
SESRIC

FOREWORD

**Professor Ahmadou Lamine NDIAYE, Chairman
National Academy of Sciences and Techniques of Senegal (ANSTS),
Past President of the African Academy of Science (AAS)**



The National Academy of Science and Technology of Senegal (ANSTS) is most honored for being selected to conduct the *Case Study of Senegal*, under the project sponsored by the *Organization of Islamic Cooperation (OIC)*, on the “*Atlas of Science and Innovation in the Islamic World*”, both as a National Research Partner and also through the appointment of Dr. Ousmane Kane, member of ANSTS, as Senior Researcher.

In line with its mandate and considering the great importance of this project, ANSTS was wholeheartedly committed to the fulfillment of this mission. In this respect, the Academy established a working group made up of ten members, from each of the four Sections as well as from its Scientific and Publications Commission and made the required arrangements for the conduct of field visits, with a view to meet all the stakeholders, for a harmonious and as comprehensive as possible data collection.

The intense data collection and investigation phase started early in the year 2012 and went on until April 2013. It included the conduct of interviews with several senior government officials, the main stakeholders from the academia and research world, business operators (public and private), the Civil Society, etc. This stage was completed by the collection and compilation of numerous and relevant documents.

The development of this paper was completed with the agreement of OIC by the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESERIC), a subsidiary organ of OIC. I would like to extend my heartfelt thanks to them.

I specially welcome the close collaboration between the Higher Education and Research Minister, himself a member of the Academy as well as all his collaborators, in his capacity as National Focal Point of the project. My thanks also to the National Demography and Statistics Agency (ANSD) and all the high-ranking personalities met in other ministries, universities, research centers or enterprises.

I am sincerely grateful to all these institutional partners and all the persons who have provided a support to the Academy in this huge project.

Finally, I would like to congratulate warmly the Senior Researcher, all the Working Group members of the Academy and all ANSTS staff whose abnegation and commitment were critical to the success of this work.

DISCLAIMER

This document was drafted for the Organisation of Islamic Cooperation (OIC). However, the ideas and opinions expressed herein are those of the Lead Researcher and the National Research Partner (ANSTS) and do not necessarily reflect the official positions of this institution, nor those of the Senegalese Government and the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC).

Furthermore, investigations and data collection that supported the general writing of this document started shortly before the advent of the new regime, which occurred in March 2012, and continued until April 2013. The document was completed in December 2013 and it was not possible to re-mobilize work teams on the ground to revise it thoroughly, given the evolution of data. However, a chapter entitled "Addendum" was prepared to report on the major changes that occurred.

ABBREVIATIONS

AAU	:	Association of African Universities
ADC	:	Community Development Agency
ADF	:	African Development Fund
ADIE	:	State Informatics Development Agency
ADPME	:	Small and Medium-Sized Business Development Agency
AfDB	:	African Development Bank
AIF	:	African Innovation Framework
AIMS	:	African Institute of Mathematical Sciences
AIPO	:	African Intellectual Property Organization
AIRD	:	Inter -Institutions Agency of research for development
AISI	:	African Information Society Initiative
AKIS	:	Agricultural Knowledge and Information System
AMCOST	:	African Ministers Conference on Science and Technology
ANAQ-SUP	:	National Authority for Quality Insurance in Higher Education
ANCAR	:	National Agricultural and Rural Advisory Agency
ANEV	:	National Agency for Eco-Villages
ANRSA	:	National Agency for Applied Scientific Research
ANSD	:	National Agency for Statistics and Demography
ANSTS	:	National Academy of Sciences and Techniques of Senegal
AOSTI	:	African Observatory for Science, Technology and Innovation
APE	:	Economic Partnership Agreements
APIX	:	Investments Promotion Agency
ARCT	:	African Regional Centre for Technology
ARIPO	:	African Regional Intellectual Property Organization
ART	:	Telecommunications Regulation Agency
ARTP	:	Posts and Telecommunications Regulatory Agency
ASADI	:	African Science Academy Development Initiative
ASC- UP	:	African Studies Center - University of Pennsylvania
ASDFP	:	Economic and Social Development Framework Plan
ASEPEX	:	Senegalese Agency for the Promotion of Exports
ASN	:	Senegalese Standards Association
ASPIT	:	Senegalese Industrial Property and Technological Innovation Agency
ASTII	:	African Initiative on Science, Technology and Innovation Indicators
AU	:	African Union
AUF	:	Francophone University Agency
BBA	:	Bachelor in Business Administration
BIC	:	Consolidated Investment Budget
BREDA/UNESCO	:	UNESCO Regional Office for the Development of Education in Africa (Dakar)
BSDA	:	Senegal Office for Copyright
CAAST-Net	:	Network for the Coordination and Advancement of Scientific and Technological Cooperation between the sub-Saharan Africa (SSA) and the European Union
CAMES	:	African and Madagascan Higher Education Council
CAP	:	Common Agricultural Policy (ECOWAS)
CCIAD	:	Dakar Chamber of Commerce, Industry and Agriculture
CDP	:	In Performance Contracts
CDSMT	:	Medium Term Sectoral Expenditure Framework
CEPOD	:	Development Policies Study Centre

CERAAS	:	Regional Study Centre for Improving Drought Adaptation
CERER	:	Renewable Energy Study and Research Centre
CERES-LOCUSTOX	:	Ecotoxicology Research Centre for the Sahel
CESAG	:	African Centre for Advanced Management Studies
CESE	:	Economic, Social and Environmental Council
CFJ	:	Judicial Training Centre
CGIAR	:	Consultative Group on International Agricultural Research
CHU	:	University Hospital Centres
CIDMEF	:	International Conference of Deans of Francophone Medical Schools
CIRAD	:	Centre for International Cooperation on Agronomic Research for Development
CNAES	:	National Dialogue for the Future of Higher Education
CNC DPI	:	National Council for Coordination and Development of Intellectual Property
CNDST	:	National Center for Scientific and Technical Documentation
CNERS	:	National Ethics Committee for Health Research
CNES	:	Senegal National Confederation of Employers
CNIG	:	National Committee on Geographical Indications
CNPDEST	:	National Steering Committee of the Project on Science and Technology Teaching Development
CNRA	:	National Agronomic Research Centre
CNRS	:	National Scientific Research Centre
CNRST	:	National Scientific and Technical Research Council
CNS	:	National Statistics Council
CODESRIA	:	Council for the Development of Social Science Research in Africa
CODIST	:	Committee on Development Information Science and Technology
COMSTECH	:	Standing Committee on Scientific and Technological Cooperation (OIC)
CONGAD	:	Non-Governmental Organization Council for Development Support
CPA	:	Consolidated Plan of Action for science and technology in Africa (AU/NEPAD)
CRE	:	Research and Test Centres
CREPOS	:	Centre for Research on Social Policies
CRES	:	Economic and Social Research Consortium
CRST	:	Centre for Research on Science and Technology, University of Stellenbosch, South Africa
CSE	:	Ecological Monitoring Centre
CSS	:	Senegalese Sugar Company
CTPS	:	Technical Committee on Statistics Programmes
D2IE	:	Domain for Economic Initiative and Innovation
DAPS	:	Analysis, Forecasts and Statistics Directorate
DBSA	:	Development Bank of Southern Africa
DCEF	:	Economic and Financial Cooperation Directorate
DDI	:	Debt and Investment Directorate
DER	:	Studies and Research Division
DGCI	:	General Directorate for International Cooperation
DGP	:	General Directorate for the Plan
DGP RE	:	Water Resources Management and Planning Directorate
DGRST	:	General Delegation for Scientific and Technical Research
DPEE	:	Forecasting and Economic Studies Directorate
DPES	:	Economic and Social Policy Document
DRDR	:	Regional Directorate for Rural Development
DSRP	:	Poverty Reduction Strategy Document

ECOWAS	: Commission of the Economic Community of West African States
EDS	: Demographic and Health Surveys
EISMV	: Inter-State School of Science and Veterinary Medicine
ENA	: National Administration School
ENA	: National School of Arts
ENDA-TM	: Third World Environment and Development
ENDSS	: National Health and Social Development College
ENEA	: National School of Applied Economics
ENFM	: National Maritime Training School
ENO	: Open Digital Spaces
ENP	: National Police School
ENSA	: National Agronomic High School
ENSETP	: Normal High School of Technical and Vocational Education
ENTSS	: National School of Social Workers and Specialist Workers
EPO	: European Patent Office
EPT	: Full-Time Equivalent
EPU	: Post University Learnings
ESMT	: Advanced Multinational School of Telecommunications
FASTEF	: Faculty of Education and Training Sciences and Technologies
FIRST	: National Scientific and Technical Research Incentive Fund
FMPO	: Faculty of Medicine, Pharmaceutical and Dental
FNRAA	: National Agricultural and Agribusiness Fund
FNRI	: National Fund for Research and Innovation
FPST	: Scientific and Technical Publication Fund
GAAS	: Ghana Academy of Arts and Sciences
GDT	: Sustainable Land Management
GOANA	: Great Agricultural Offensive for Food and Abundance
GPPRPIIT	: Grand Prix Award of the President of Republic for the Promotion of Invention and Technological Innovation
GPPRS	: Grand Prix Award of the President of Republic for Sciences
GTP	: Programmed Thematic Groups
HIPC	: Heavily Indebted Poor Countries
HIV/AIDS	: Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IAEA	: International Atomic Energy Agency
IAM	: African Institute of Management
IAP	: Inter Academy Panel
ICS	: Senegal Chemical Industries
ICT	: Information and Communication Technologies
IDB	: Islamic Development Bank
IDEP	: African Institute for Economic Development and Planning
IDH	: Human Development Index
IDRC	: International Development Research Centre
IFAN	: Fundamental Institute of Black Africa
IFPRI	: International Food Policy Research Institute
INP	: National Soil Institute
IPCC	: Intergovernmental Panel on Climate Change
IPD	: Dakar Pasteur Institute
IRD	: Research Development Institute
ISEP	: Higher Institutes of Vocational Learning
ISESCO	: Islamic Education ,Science and Culture Organization

ISFAR	: Higher Institute of Agricultural and Rural Education
ISM	: Higher Institute of Management
ISO	: International Standards Organization
ISRA	: Senegalese Agricultural Research Institute
IST Africa Project	: Regional Impact of Information Society Technologies in Africa project
ITA	: Institute of Food Technology
IUT	: Technology University Institute
JAPTI	: African Technology and Intellectual Property Day
JRSA	: Africa's Scientific Renaissance Day
KMA	: Knowledge Management Africa
LMD	: Licence – Master – Doctorate
LOASP	: Agro-Forestry-Pastoral Orientation Law
MAER	: Ministry of Agriculture and Rural Equipment
MBA	: Master in Business Administration
MCGCV	: Ministry for Culture, Gender and Living Environment
MCITAIE	: Ministry for International Cooperation, Air Transport, Infrastructure and Energy
MDGs	: Millennium Development Goals
MEF	: Ministry for Economy and Finance
MEFP	: Ministry for Economy, Finance and Planning
MEM	: Ministry for Maritime Economy
MEPN	: Ministry for Environment and Nature Conservation
MESR	: Ministry for Higher Education and Research
MESUCURRS	: Ministry for Higher Education, Universities, Regional University Centres and Scientific Research
MICS	: Multiple Indicator Cluster Survey on health and demographics
Min. Agric	: Ministry for Agriculture
MMIAI-PME	: Ministry for Mines, Industry, Agroindustry and Small and Medium-Sized Businesses
MRST	: Ministry for Scientific and Technical Research
MSHPP	: Ministry for Health, Public Hygiene and Prevention
NASAC	: Network of African Science Academies
NASIC	: Network of Science Academies in Islamic Countries (OIC)
NGO	: Non-Governmental Organisation
NISDEL	: New Sectoral Initiative for the Development of Livestock Breeding
OCAM	: Organisation Commune Africaine et Malgache
OECD	: Organisation for Economic Cooperation and Development
OHADA	: Organisation for Business Law Harmonisation in Africa
OIC	: Organisation of Islamic Cooperation
OMVS	: Organisation for the Development of the Senegal River
ONAS	: Senegal National Sanitation Office
ONU	: United Nations Organisation
ONUDI	: United Nations Industrial Development Organisation
ORAN	: African Regional Standards Organisation
PAES	: Higher Education Support Programme
PAFS	: Senegal Agro-Forestry Programme
PAIM	: Music Industry Support Programme
PAIPO	: Pan-African Intellectual Property Organisation
PASMI	: Mining Sector Development Programme
PATRIE	: Technical Support Platform to Research and Innovation for Economic Emergence
PAU	: Pan-African University

PDDAA	:	Detailed Programme for Agricultural Development in Africa
PDEF	:	Education and Training Development Plan
PDESR	:	Development Plan for Higher Education and Research in Senegal
PELT	:	Long-Term Water Project (2002-2007)
PEPAM	:	Millennium Drinking Water and Sanitation Programme
PIB	:	Gross Domestic Product
Plan REVA	:	Return To Agriculture Plan
PNAR	:	National Program for Self-Sufficiency in Rice
PNDA	:	National Agricultural Development Programme
PNDE	:	National Livestock Development Programme
PNDES	:	National Economic and Social Development Policy
PNDL	:	National Programme for Local Development
PNDPI	:	National Plan for the Development of Intellectual Property
PNSD	:	National Health Development Plan
PNIA	:	National Program for Agricultural Investment
PNSTI	:	National Science, Technology and Innovation Policy
PODES	:	Economic and Social Development Framework Plan
PPA	:	Purchasing Power Parities
PIIP	:	Private Investment Promotion Project
PRACAS	:	Program for Acceleration of the rate of Senegalese agriculture
PRBE	:	Biomass Energy Regional Program (ECOWAS)
PREDAS	:	Programme for the Promotion of Domestic and Alternate Energies in the Sahel
PRI	:	Industrial Deployment Policy
PROMETRA	:	Promotion of Traditional Medicines
PSAOP	:	Agricultural Services and Producer Organisation Support Programme
PSE	:	Sectoral Water Project
PSE	:	Senegal Emerging Plan
PST	:	Scientific and Technological Potential
PTIP	:	Three-Year Public Investment Programme
R&D	:	Research and Development
RGPHAE	:	General Census of Population, Housing, Agriculture and Livestock
SAED	:	National Society for the Development and Exploitation of Senegal and Falémé Rivers
SCA	:	Accelerated Growth Strategy
SDE	:	Water Company
SENCHEM	:	Senegal Chemical Industries Production Trading Company
SERST	:	State Secretariat for Scientific and Technical Research
SESRIC	:	Statistical, Economic and Social Research and Training Centre for Islamic Countries
SME	:	Small Medium Entreprises
SNEEG	:	National Strategy for Gender Fairness and Equality
SNISI	:	National System for Scientific Information and Innovation
SNRASP	:	National Agro-Silvo-Pastoral Research System
SODEFITEX	:	Textile Fibre Development Company
SONES	:	Senegal National Water Company
SPIA	:	Industrial and Agricultural Products Company
STAG	:	Science and Technology Advisory Group
STEMS	:	Science, Technology, Engineering and Mathematics
STI	:	Science, Technology and Innovation
Sup de Co	:	Dakar Advanced College of Commerce
SWOT	:	Strengths, Weaknesses, Opportunities, Threats

TBS	Gross Enrolment Ratio
TMI	Infant Mortality Rate
TMIJ	Infant Juvenile Mortality Rate
TMJ	Juvenile Mortality Rate
UADB	: Alioune Diop University of Bambey
UAP	: Union Agricultural Policy (WAEMU)
UCAD	: Cheikh Anta Diop University of Dakar
UCSPE	: Economic Policy Coordination and Monitoring Unit
UFR	: Training and Research Units
UGB	: Gaston Berger University of Saint-Louis
UNDP	: United Nations Development Programme
UNECA	: United Nations Economic Commission for Africa
UNESCO	: United Nations Educational, Scientific and Cultural Organization
UNISPAR	: University-Industry-Science Partnership Programme
USAID	: United States Agency for International Development
USSEIN	University of Sine Saloum El Hadj Ibrahima Niasse
USSK	University of Sine Saloum in Kaolack
UT	: University of Thiès
UVS	Virtual University of Senegal
UZIG	: University of Ziguinchor
WAEMU	: West African Economic and Monetary Union
WARC	: West African Research Centre
WARDA / Africa Rice	: West Africa Rice Development Association / Africa Rice Centre
WB	: World Bank
WECARD	: West and Central African Council for Agricultural Research and Development
WHO	: World Health Organisation
WIPO	: World Intellectual Property Organisation
WP4	: Work Package 4
WTO	: World Trade Organisation

METHODOLOGY AND ACKNOWLEDGMENT

This project was conducted by the following leading participants:

- Higher Education and Research Ministry (MESR), a National Focal Point (NFP), constituting the National Benchmark;
- Senegal National Science and Technology Academy (ANSTS), in its capacity as National Research Partner (NRP), responsible for data gathering and analysis. For this purpose, the ANSTS has set up a team consisting of members from all its sections (see Box 1); and
- Dr. Ousmane Kane, former Executive Director of the African Regional Technology Centre (CRAT), former Director General of the Senegal Food Technology Institute (ITA) and Chairman of the Commission on Relations with ANSTS Partners, in his capacity as Lead Researcher (LR), responsible for drafting the document.

Box 1: ANSTS Task Force

Chairman: Prof. Ahmadou Lamine Ndiaye, President

Coordinator: Prof. Doudou Ba, Permanent Secretary

Members:

- Prof. Oussaynou Dia, Scientific and Publications Commission (Chairman);
- Prof. Cheikh Bécaye Gaye, Section of Basic and Applied Sciences, and Innovation;
- Dr. Mamadou Guèye, Agricultural Sciences Section;
- Dr. Jean-Pierre Ndiaye, Agricultural Sciences Section;
- Prof. Mohamed Guélaye Sall, Health Sciences Section;
- Prof. Abdoulaye Samb, Section of Basic and Applied Sciences, and Innovation (Chairman) ;
- Dr. Rokhaya Sène, Economic, Social and Legal Sciences Section;
- Prof. Mamadou Lamine Sow, Health Sciences Section.

The NRP and LR initially prepared an outline of the current situation, by collecting data from interviews and documentary reviews with key targeted officials. This was followed by a critical, constructive and cross-referenced analysis of the qualitative and quantitative survey results in national scientific and technological potential, and a survey of relationships with the country's political, administrative, economic and sociocultural sectors.

However, in drafting the report, great importance was attached, above all, to going beyond a simple description of the current situation. The problems encountered in implementing Science, Technology and Innovation (STI) policy have also been examined in depth and specific proposals put forward with a view to improving the current situation, in particular in regard to the legal framework and other measures that need to be taken. The study also examines the necessary changes, in light of internationally-acknowledged optimal practices, so that current policy in Senegal for promoting STI can be improved.

Finally, this report has been evaluated by the partner institution, as well as by a Peer Review Committee (see Box 2).

Box 2: Peer Review Committee
Members: <ul style="list-style-type: none">- Pr Bhen Sikina Toguebaye http://sev.ucad.sn/index.php- Dr. Almamy Konte, African Observatory for Science, Technology and Innovation Indicators- Dr. Moctar Toure http://africaharvest.org/board.php

We would like to express our sincere thanks to the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC), the Organization of Islamic Cooperation (OIC) and the high authorities in the Ministry in charge of Research in Senegal for the trust placed in us to carry out this work.

We would like, in particular, to show our sincere thanks to Mr. Fahd Ndiaye of the National Agency of Statistics and Demography of Senegal, for the statistical support.

We also would like to thank all the high officials in Senegal who have welcomed us to their institutions and generously provided us with ample information and documentation, as well as those whose relevant comments have helped us enrich the preliminary drafts of this document.

1. INTRODUCTION AND SUMMARY

1.1 GENERAL CONSIDERATIONS

Universally acknowledged as being among the driving forces behind economic, social and cultural development, Science, Technology and Innovation (STI), as recalled by UNESCO (2008) and a Special Resolution of the General Assembly of the United Nations (UN, 2005), currently constitute, more than at any other time, the major paradigms associated with the progress and advancement of humanity. Among their diverse applications, they play an effective part in reducing poverty, preventing and curing disease and conserving the environment which, all together, improves the general well-being of peoples.

Thus, for a long time and by an abundant scientific production, prominent Senegalese intellectuals, like Professors Cheikh Anta DIOP (1960, 1988) and Amadou Mahtar MBOW (1976, 1982, 1987), have shown that Science and Technology should be the mainstays of Africa's economic and social development. Which, again recently, has been recalled by Ebrima Sall, Executive Secretary of the Council for the Development of Social Science Research in Africa (CODESRIA), according to whom *"the black continent can only take off thanks to the development of scientific research"* (Le Soleil of 06 February 2013). What also makes Professor Ahmadou Lamine Ndiaye, President of the National Academy of Sciences and Techniques of Senegal (ANSTS) say that *"Science, Technology and Innovation are thus powerful development tools that no society can currently save itself"* (Ndiaye A. L., 2013).

Therefore, Professor Mary Teuw Niane, Minister of Higher Education and Research, has well stated that *"It is important for any country that aspires to economic emergence, to have a good Science, Technology and Innovation (STI) policy"* (Niane, 2013).

In this respect, the predominant role played by technological research, as well as the one in social sciences and the entire innovation process, in competitiveness and in boosting business productivity means that, in future, they will be even more important. This phenomenon has acquired even more urgency as a result of globalisation, with its corollary of free economic and trade interchanges, and the imperatives of "sustainable development" and the "green economy", demanding "clean" production that does not affect the health of consumers, while conserving the environment, without aggravating the process of climate change. Africa's overall and longstanding development, like in any region of the world, should therefore be based on the triptych **Economy-Energy-Environment**, named as the "E3 dimension" of Sustainable Development. However, in this continent, two other dimensions which are of cultural and social nature, play a very important role and have to be taken into due consideration for any development policy and process (Kane, 2011).

In this new era, development paradigms are characterized by the major incidence of information and communication technologies (ICTs) as well as of those of other emerging technologies, such as Biotechnologies, nanotechnologies, Genomics, etc. Thus, modern development models are mostly based on "knowledge economy". This is why technological innovation, deriving mainly from the application of research results, has become a major tool for competitiveness, power and domination, especially for achieving market penetration and positioning.

However, technological progress, the essential support for economic and social development of a country or a region, must derive from an interdisciplinary, multi-sectorial and holistic approach,

backed by sound planning and rigorous management. It is therefore imperative for any government to set up a strong research and innovation strategy, closely integrated into a voluntarist national scientific and technological policy which itself is firmly grounded in the country's overall macroeconomic policy. This policy needs appropriate legislative, structural and organisational frameworks, of course with the provision of significant resources for increasing the potential of scientific and technological research that generates "technological packages", as well as strong valuation and production structures, so that these packages are transformed into goods and services useful to the population.

Finally, Science can serve as "a gateway to understanding" (Schweitzer and Sobouti, 2009), since it paves the way to understand others (Sobouti, 2009) and many successes in building international bridges through Science are reported (Neureiter, 2009).

This is why the African Union (AU) has written science and technology into its constitution and continues to reaffirm their roles as drivers of economic growth during its various summits.

The Organisation of Islamic Cooperation (OIC) and its various subsidiary organs are far from being at a loss. Thus, at the 3rd extraordinary session of the summit conference (*Makkah*, 2005), the Ten-Year Action programme of the OIC was adopted to take up the challenges of the *Ummah* (Islamic Community) for the 21st century. For this purpose, each country was strongly urged to aim to allocate at least 1% of GDP to funding R&D by 2015. Aware of the opportunities offered by STI and having fully assessed the stakes involved in sustainable human development in the *Ummah*, the OIC, through Vision 1441, has backed a new initiative aimed, among other things, at helping its Member States to establish national STI policies.

Therefore, the political will to make Science and Technology the major vectors for Africa's endogenous and self-sustained development is not lacking. Thus, several countries have set up full ministries responsible for Scientific and Technical Research. These highly-praiseworthy initiatives have certainly consolidated those taken at national level and facilitated significant progress, but there is still a lot to do, since a veritable innovation dynamics that closely links research to the development process is still weak.

The judicious use of STI should also serve as a major lever for helping Senegal, like all African countries and the *Ummah*, to stand on an equal footing in the emergence dynamics and promotion of a society based on knowledge, know-how and know-being, hailing the supremacy of grey matter over raw materials.

1.2 THE CONCEPT OF INNOVATION

The economics of innovation has been closely associated, for some time, with processes of technological innovation and change, and its focus has been on the kinds of inventions that happen in research organizations, universities or firms engaged in R&D. However, it should be noted that the definition of innovation is broader, since it can take into account other forms: social, organizational, financial, and even political. Thus, the concept of innovation system has helped transform "the R&D economy" to become the "innovation economy", by expanding to non-technological learning process (Cozzens and Sutz, 2012, cited by Ellie Osir, 2012).

In this regard, IDRC has recently launched an important program on "*Innovation, Technology, and Society (ITS)*", focusing on the "*governance of transformative technologies*" and supporting "*innovation for inclusive development*". This programme gives due consideration to cross-cutting issues, such as intellectual property regimes, critical gender implications, the impacts of new and

emerging technologies. It also considers the role of science granting councils in developing countries, together with knowledge-sharing and utilization for awareness in public debates.

Thus, Innovation has many meanings which can carry on a “business model” generating an approach, a process, a product and/or a result. Therefore, there is a need to re-orient innovation towards key societal and human developmental challenges, such as poverty alleviation, food insecurity, emerging infectious diseases, the negative effects of climate change and other natural disasters, by linking innovation policy directly to social policies.

For this study, we will stick to technological innovation for which the OECD produced some benchmark publications (Oslo and Frascati Manuals), worthy of our attention. According to this organization, “*an innovation is the development of a new product which is more performant, to provide the consumer with a new good or service*” (OECD, 2002; Eurostat/OECD (2005)).

Schumpeter, who theorised a lot on this subject (1912, 1939, 1942), with the introduction of the concept of “innovation clusters”, differentiated five types of innovation: i) the manufacturing of new goods; ii) of new production methods; iii) opening up a new outlet; iv) the use of new raw materials; and v) a new work organisation.

Thus, technological innovation is universal and, in Senegal, like as anywhere else, each operator or stakeholder involved in its process should consider himself or herself as a link in a long chain of solidarity and sharing, whose role is indispensable to the overall operation of the national innovation system, dedicated to meeting the major development challenges of the country.

According to the Ministry in the charge of Research, “*in Senegal, the challenges to be dealt with by the efficient use of science and technology are many. They include: i) increasing the impact of the research results on the economy; ii) increasing the proportion of innovative businesses in the industrial fabric, and iii) development of a synergy among education, research, innovation and business*” (MESUCURRS, 2011).

Senegal case study, is intended to outline the major strategic orientations that would allow the Republic of Senegal to equip itself with a real National Science, Technology and Innovation Policy (NSTIP). This policy will, in particular, endeavour to drive an effective dynamics, likely to promote the country’s emergence and endogenous, integral and sustainable development, whilst consolidating its regional and international scientific and technological cooperation, especially within the context of the OIC.

After a brief summary, the chapters will be presented in the order of **i) Mapping; ii) People; iii) Places; iv) Business; v) Culture; vi) Sustainability; vii) Collaboration** and **viii) Prognose**. However, since Senegal has its own specific features and expectations, the topics discussed cannot in all respects be embodied in this model, insofar as more importance is attributed to the institutional framework, human resources and programmes.

1.3 SUMMARY OF CHAPTERS

1.3.1 MAPPING

This chapter describes Senegal in terms of its geographical position in Africa. In addition to its rivers, political and social situation and the ethnic, linguistic and economic realities of the country, followed by a description of its scientific and technological governance, with its history, before presenting the structural Research coordinating framework. In this respect, the chapter

describes how the Higher Education and Research Ministry (MESR), the Presidency of the Republic and other Ministries manage research, taking responsibility for various research centres or technical institutions.

The organisational framework for research carried out in public universities and national, regional and international centres is also described, before the legal aspects governing the MESR and R&D institutions. This is followed by a discussion of the crucial issue of funding for Senegalese STI/R&D, and the country's research productivity on an overall and sectoral basis. Finally, the chapter covers the bright spots of the last few years, in terms of the economy and sociocultural impacts, agriculture and agribusiness, and finally the health sector. Other salient facts relating to the promotion of Science through the *Grand Prix* Awards made by the President of the Republic for achievements in Science and the promotion of invention and technological innovation are also mentioned.

1.3.2 PEOPLE

This chapter emphasises the youth and ethnic diversity of the Senegalese population and indicates its regional distribution, showing the predominance of the Dakar region, with 21% of the country's total population. This is followed by a discussion of the gender concept, embodied in the new regulatory provisions in force regarding equality. Furthermore, the important issue of Education and Training is discussed through Higher Education and Technical and Vocational Training.

The human resources of the universities and research centres, both public and private, are also covered. In addition, the general situation and organisation of the health system are described in terms of both public and private sectors, before dealing with the epidemiological profile, presenting a number of diseases, with special attention to HIV/AIDS, malaria and tuberculosis.

1.3.3 PLACES

This chapter covers research implementing structures, through the institutional framework and the conduct of research programs. It describes the higher education and research institutions, whether public, private, sub regional or regional, such as the universities and major colleges, as well as the unifying roles of doctoral schools. National research centres specialising in agriculture, agribusiness, health, social and human sciences or in other sectors such as energy, water, mines and the environment, are then described. The same approach is applied to regional and international centres for training and technological research, agriculture and agribusiness, health, the environment and the social and human sciences.

Moreover, a number of technological institutions are also described, some of which are working in innovation and adding value to research.

1.3.4 BUSINESS

After pointing out the importance of the link between research and development for the Industrial Redeployment Policy (PRI) and the specificities of universities, this chapter discusses the issue of adding value to research results, describing first their nature and modes of expression, their stakes and challenges as well as the overall problems of technological innovation in Senegal.

A number of business opportunities are then described, in particular science parks, incubator facilities and business nurseries, such as the INNODEV project of Cheikh Anta Diop University

(UCAD), the BIOPOLE project of the National Agency for Applied Scientific Research (ANRSA) and the D2IE project at the Gaston Berger University, St-Louis (UGB).

1.3.5 CULTURE

This chapter first shows the diversity and enormous richness of Senegal's cultural heritage, with data on the number of cultural institutions, sectors, agents and events. Religions and belief systems are then discussed, in particular Islam, Christianity and traditional religions.

The political and administrative organisation is then outlined, with descriptions of the Republic's institutions: Legislative Power, Executive Power, the Economic, Social and Environmental Council and the Judicial Authorities.

As for the administrative, territorial and local organisation, Senegal comprises fourteen (14) regions grouping together forty-five (45) departments, subdivided into districts, communes, rural communities and villages or neighbourhoods.

1.3.6 SUSTAINABILITY

The crucial issue of sustainability, associated with the impact of Science, Technology and Innovation, is discussed from the viewpoint of key sectors of the economy, with all its components, including agriculture, fishing, livestock, manufacturing, crafts, tourism, services, etc. The same approach is taken to other fundamental sectors, such as energy, the environment, water and sanitation.

Various national policies are then described, in particular those for scientific research and innovation, agriculture and agro-food, health and the environment

Moreover, a number of mobilizing projects and programmes are described, in particular those implemented by the Higher Education and Research Ministry (MESR). Finally, this chapter analyses the situation and prospects of various scientific and technological research sectors.

1.3.7 COLLABORATION

Initially, we discuss collaboration on a national scale, still handicapped by inter-institutional partitioning and lack of communication between researchers and political or economic decision-makers. However, this chapter does show some grounds for optimism, especially for agricultural and agro-food research, with the setting up of the National Agricultural and Agro-food Research Fund (FNRAA) and the advent of the National Agricultural, Forestry and Pasture Research System (SNRASP).

In addition, collaborations with subregional, regional and international institutions are described.

1.3.8 PROGNOSIS

This chapter first presents a SWOT analysis of Senegalese research, both in terms of general considerations and specific features, relating to the provision of higher education, research in agricultural sciences, food and the environment, the health sciences and the economic, social and human sciences.

The advent of the National STI Policy (PNSTI) is then discussed in terms of general considerations relating to human capital and issues of gender and the brain drain, the legal framework, funding and how programmes and projects are run. Furthermore, the specific major

elements associated with implementing the PNSTI are considered, followed by the prospects and general recommendations.

Finally, general recommendations are presented within the framework of the national prospects for Senegal, then for the *Ummah* and the regional and international prospects.

2. SECTORAL CHAPTERS

2.1 MAPPING

2.1.1 GENERAL CONSIDERATIONS

Senegal is a western sub-Saharan African country between 12°41 and 16°41 north and 11°21 and 17°32 west. Almadies is the westernmost point of the African continent. Senegal extends over 196,722 km², more than a third of the area of France. It is bordered to the north and north-east by Mauritania, to the east by Mali, to the south by Guinea-Bissau and Guinea-Conakry, and to the west by the Atlantic Ocean and the islands of Cape Verde, lying 560 km off the coast. Finally, Senegal surrounds Gambia, which forms a quasi-enclave within the country, penetrating over 300 km inside its territory on both sides of the Gambia river. Maps 1 and 2 show Senegal’s location in Africa and its neighbouring countries.



Map 1: Position of Senegal in Africa



Map 2: Senegal and neighbouring countries

(Source: Worldatlas)

Senegal is crossed by five rivers and their tributaries: the Senegal (from which the country takes its name and forming the frontier with Mauritania and Mali), the Gambia, the Casamance, the Sine and the Saloum. There is also a series of watercourses that are more or less ephemeral, oxbow lakes, backwaters and bolongs (watercourses that dry up in the dry season).

In the particular case of the Senegal River, in 1972 the countries through which the river passes (Mali, Mauritania and Senegal) set up the Organisation for the Development of the Senegal River (OMVS) to develop the river basin and use its resources rationally for energy production, shipping and irrigation.

Senegal was founded in 1960 as a secular, democratic and social republic, guaranteeing the equality of all its citizens before the law, with no discrimination based on origin, race, gender or religion and respecting all belief systems.



Map 3: Administrative Map of 14 Senegal’s Regions
Source: ANSD, 2011-c

Its official language is French and the main national languages are Wolof, Pulaar, Serer, Diola, Malinka and Soninke. The country’s motto is “One people, one aim, one faith”.

Since the Law 2008-14 dated 18 March 2008, Senegal has 14 regions illustrated by the Map 3. Ranked 155th out of 187 countries according to the Human Development Index established by the UNDP (2011) and one of the Heavily Indebted Poor Countries (HIPC), Senegal still belongs to the group of countries with low development.

Poverty prevalence is still very high in Senegal. However, according to the UNDP, the proportion of individuals living below the poverty line has fallen from 57.1% in 2001 to 50.6% in 2005. With regard to households, the proportion living below the poverty line has also seen a significant drop, falling from 48.5% in 2002 to 42.6% in 2005 (UNDP, 2005).

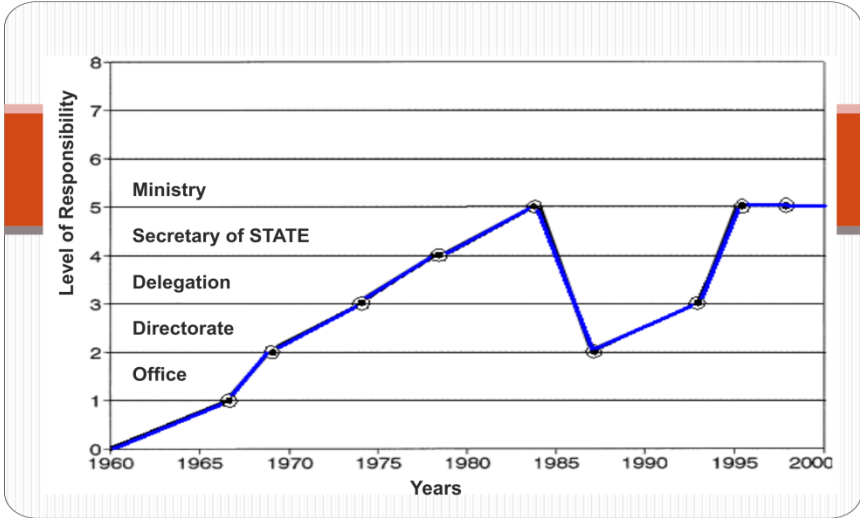
2.1.2 SCIENTIFIC AND TECHNOLOGICAL GOVERNANCE

In 1960, when Senegal achieved independence, agreements with France transferred the ownership of a number of research institutions, guaranteeing them extensive support for their activities. At the same time, Senegal gradually set up the tools for its scientific and technological emancipation, reorganising the research sector both politically and institutionally. Below is a brief history of these changes, specifying the structural, organisational and legal frameworks within which Scientific Research and Technological Innovation are administered.

2.1.2.1 Brief History

The Governing Body responsible for promoting the development and governance of the National System for Scientific and Technical Research has undergone various ups and downs. Its evolution during the first forty years after independence is shown in Figure 1, indicating an initial phase of steady progress in its level of responsibility.

Figure 1: History of the Governing Body for Scientific and Technological Policy in Senegal



Adapted by Kane, 1997; based on information provided by Mr. MBOUP, Delegate for Scientific and Technical Affairs at the time

The first attempt to institutionalise the system of governance for science and technology was made in 1960, when a research and technology coordination office was set up, reporting to the Council Presidency. In 1966, an executive office for Scientific and Technological Affairs was set up, and replaced in 1970 by the Scientific and Technical Affairs Directorate, administered by the State Secretariat in charge of the national plan, reporting to the Prime Minister.

In 1973, the General Delegation for Scientific and Technical Research (DGRST) was set up, reporting directly to the Prime Minister. It had authority over all centres carrying out research within the country (whether national or foreign, universities or otherwise). This institution was very active, conducting a survey on the country's scientific and technical potential (PST) and undertaking the "structuring of the sector". It encouraged university research and collaboration with public institutes, within a framework of ordinary laboratories (built around their equipment resources). It also initiated a study for the creation of a Researcher Status (Gaillard and Kane, 2009).

In 1979, the DGRST was transformed into the State Secretariat for Scientific and Technical Research (SERST), which in 1983 became a full ministry, the Ministry for Scientific and Technical Research (MRST). This Ministry was abolished in January 1986. Its activities were then partially transferred to a new Technical and Scientific Affairs Directorate (DAST), initially within the Planning and Cooperation Ministry, then transferred to the National Education Ministry, before being attached to the Ministry for State Modernisation, which became the Ministry for Modernisation and Technology.

The Ministry of Scientific and Technical Research (MRST) was re-established in 1994 and has survived since then, but more often combined with Higher Education or other sectors such as Biofuels or Renewable Energy, but invariably with "scientific research" functions relegated to background. Since April 2012, the research sector has been in the hands of the Higher Education and Research Ministry (MESR).

These frequent changes are mostly due to political considerations but considerably affect the stability of this Ministry. Moreover, due to the frequency of strikes in higher education, the greatest attention of government authorities is devoted to this sector, at the expense of research. In this regard, it should also be noted that the diagnostic study conducted by the National Steering Committee of the Project on Science and Technology Teaching Development (CNPDEST), established by Ministerial Decree dated 16 February 2004 and placed under the aegis of the ANSTS, noted among other things, the lack of monitoring and consistency of pedagogical projects (case of BSTs¹), planning and organizational problems, as well as many dysfunctions which, according to Professor Abdoulaye Samb, Vice Coordinator of CNPDEST, *"are, alas, most often the result of a lack of shared national vision of the place of science and technology teaching in the educational system"* (Samb, 2013).

2.1.2.2 Structural Framework and Research Coordination

The Ministry of Higher Education and Research (MESR) supervises all the research that is being conducted throughout Senegal. However, a number of other ministries and public bodies are also responsible for and coordinate various research sectors and centres. In addition, some research sectors, such as agriculture and agro-food, are coordinated by a number of ministries. Thus, the Senegalese Institute for Agricultural Research (ISRA), the Institute of Food Technology (ITA) and the universities are, respectively, under the auspices of the Ministries responsible for Agriculture, Industry and Higher Education.

Obviously, proper coordination of the nation's scientific research and its effective management by the MESR are largely dependent on the coherence of government action, in particular with regard to collaborations and information exchanges with the ministries responsible for the other research centres.

¹ BSTs: Centers where secondary school experimentations are conducted on the basis of common use of resources.

2.1.2.2.1 Management by the Ministry of Higher Education and Research (MESR): The MESR “is undergoing a process of organisational change, with a stronger will to involve the department as a driving force in the management and coordination of research policy in order to strengthen its impact on all sectors of activity in the economic and social life of the country. Furthermore, administrative facilities for governance are to be boosted by the creation of a General Research Directorate “(MESR, 2012).

As universities supervisor, the Ministry of Higher Education and Research (MESR) monitors research going on there, particularly in health sciences, basic sciences (mathematics, chemistry, physics, biology, etc.), the applied sciences (process engineering) and the social and human sciences (linguistics, history, law, economics, etc.). In addition, the role that the public universities are playing in agricultural and agro-food research for development is becoming increasingly extensive.

The holding of the National Consultation on the future of Higher Education, followed by the holding of the Presidential Council on Higher Education, the first of its kind since the access of Senegal to Independence, were special opportunities for the Ministry of Higher education and Scientific Research (MoHESR) and for this sector. A reform dynamics was thus instilled and a roadmap for the next ten years was defined for higher education and research in Senegal. They deal with eleven (11) presidential guidelines related to the following focus areas (MoHER-2013-d)

- Redirect the higher education system towards science, technology, short professional training;
- Place Information and Communication Technology (ICT) at the heart of the development of higher education and research to improve access to higher education and the system's efficiency;
- Improve the steering of the higher education & research system and reform the governance of public higher education institutions ;
- Establish a peace culture within public higher education institutions ;
- Promote the career of teachers, researchers and the administrative, technical and service staff ;
- Make the student the actor of his training, promote his success and improve his living conditions ;
- Enhance the university map to promote access, diversify the training offer and ensure the quality of higher education ;
- Boost research and innovation ;
- Improve the management of university budgets and resources through the establishment of modern and transparent procedures and mechanisms; and
- Invest in higher education and research to the extent of this new ambition.

In this respect, the MoHER has designed a Higher Education and Research Development Strategy (HERDS) 2013-2022 and a Higher Education and Research Development Plan (HERDP) 2013-2017.

Moreover, the National Agency for Applied Scientific Research (ANRSA), created in 2008 under the direct aegis of the Presidency of Republic, has recently been linked to the MESR. It is working on “*transforming knowledge and know-how into products, goods and services, and producing skill centres and niches of opportunity in strategic sectors,*” such as biotechnology.

In addition, flagship projects such as the Science and Technology Park, the African Centre for Research and Applications (CARA) and the Islamic Centre for Advanced Scientific Research (CIRSA), are also managed by the ANRSA.

2.1.2.2.2 Management by the Ministry of Agriculture: The Ministry of Agriculture, in charge of agricultural policy, is supported mainly by the Senegalese Institute for Agricultural Research (ISRA), the National Soil Institute (INP) and the Plant Protection Directorate (DPV) which is equipped with entomology and nematology laboratories. Furthermore, in 2000 the Ministry of Agriculture initiated setting up of National Agricultural and Agro-food Research Fund (FNRAA), the main mechanism in Senegal for funding agricultural and agro-food research projects. *Also it is worth noting the role of the Ministry of Agriculture in the advent of the National Agro-Silvo-Pastoral Research System (SNRASP) whose objective is to create and foster dialogue among all stakeholders in the agricultural and food sector, to establish a real synergy in all actions to undertake.*

2.1.2.2.3 Management by the Ministry of Health: National health policy is implemented by the Ministry of Health and is based essentially on developing the following major priorities: access to health services and nutrition, health personnel, health infrastructure, maternity services, health for children and young people, and finally, HIV/AIDS, tuberculosis and malaria (MEF, 2012).

The Ministry is responsible for the governance of human health research, with the technical support of the Studies and Research Division (DER) attached to the Health Directorate and the National Ethics Committee for Health Research (CNERS), whose endorsement is essential for any project to related health research. It has prepared a National Research Plan (2009-2012) based on the priorities in the 2009-2018 National Health Development Plan (PNDS).

2.1.2.2.4 Management by other Ministries: *Several other Ministries have technical, administrative and/or financial responsibilities in respect of the various entities conducting research. This is particularly the case for the following:*

- The Ministry of Industry and Mines, which looks after mining research (SSPT, ICS, PASMI, etc.), oil and gas research (Petrosen, SAR, etc.) and agro-industrial research (ITA);
- The Ministry of Water, which looks after hydrogeological research (PEPAM, etc.);
- The Ministry of Environment, which looks after research on environmental monitoring and knowledge of the dynamics of and changes in existing ecosystems (CSE, etc.);
- The Ministry of Information and Communication (ARTP, etc.);
- The Ministry of Economics and Finance, responsible for the various structures conducting studies and research (ANSD, DPEE, CEPOD, DGP); etc.

2.1.2.2.5 Management by the Presidency of the Republic: Agencies reporting directly to the Presidency of the Republic also participate in research management. An example is the case of the Agency for State Informatics Development (ADIE) which participates in defining the e-government electronic administration strategy of the State of Senegal, whose aims are to equip the State with an information system and decision-making tools, to provide citizens and businesses with a decentralised interface for accessing the Government Intranet, to preserve and secure State archives in electronic memory and to define the performance indicators for the information systems deployed and monitor and evaluate them.

2.1.2.3 Organisational Framework

The above historical review shows that, on an institutional level, Senegal was not slow in setting up a Governing Body for scientific research. Thus, the State has gradually put in place a system for monitoring the development of scientific research and technological innovation.

Anticipation of the practical benefits of research led to the need for closer ties and dialogue between the universities, research centres and institutes, industry and the various economic sectors. Furthermore, whilst in full compliance with the Government's political guidelines on economic and social development, the research centres reporting to the various Ministries have their own Boards of Management and draft all their own strategic plans. Therefore, when talking about the organisation and implementation of research at public institutions, we need to differentiate the universities from the other centres.

2.1.2.3.1 Research at Public Universities: There are currently five public universities in Senegal: Cheikh Anta Diop University (www.ucad.sn), Gaston Berger University (www.ugb.sn), University of Thiès (www.thies.univ.sn), University of Ziguinchor (www.uni-zig.sn) and University of Bambey (www.bambey.univ.sn). In overall terms, research at Senegal's public universities is conducted by research lecturers, whether working in research teams or not, based on projects and programmes that are often determined by academic imperatives, career concerns or funding opportunities. However, the ways in which research is organised differs from one university to another.

Furthermore, the institutionalisation of the academic model on three levels (LMD²) has led to a new way of organising teaching at the universities, reconfiguring the higher degrees based on the three qualifications (LMD), as well as research programmes in a Doctoral School framework comparable to international systems. Research projects can take various forms, depending on the competences of these schools (Dia *et al.*, 2012):

- basic research of a fundamental or technological nature;
- finalised or applied research, above all technical and intended for industry;
- research in pedagogical and methodological education sciences, meant for teaching

2.1.2.3.2 Research at other National Centres: Outside the universities, public research in Senegal is conducted at a number of national centres working on agricultural and agro-industrial research (INP, ISRA, ITA, DPV Laboratories); medical research, mainly at University Hospital Centres (CHU) under the auspices of the Health Ministry; research in the social and human sciences and finally, research in other fields such as energy at the Renewable Energy Study and Research Centre (CERER) and the environment at the Ecological Monitoring Centre (CSE) and the Ecotoxicology Research Centre for the Sahel (CERES).

2.1.2.3.3 Research at Regional and International Centres: Under bilateral and multilateral cooperation agreements, Senegal is home to a number of African centres and regional centres of foreign and multilateral institutions conducting research activities in permanent partnership with a panel of Senegalese, regional or international institutions. Setting up shared sites (such as the UCAD/IRD international campus) is particularly helpful for promoting synergies and strengthening of these partnerships.

Thus, these institutions develop or fund numerous research programmes in Senegal. Among the most important are the Central and Western Africa Regional Office (BRACO) recently closed

² LMD: (Licence-Master-Doctorate) according to European standard LMD

down of the International Development Research Centre (IDRC), the Regional Office of the World Bank in Dakar, UNESCO's Dakar Regional Office for Education in Africa (BREDA) and the African Regional Centre for Technology (ARCT). Several foreign and international institutions present in Senegal also conduct research activities here, in partnership with Senegalese institutions. This is the case for the Development Research Institute (IRD), the Centre for International Cooperation on Agronomic Research for Development (CIRAD), the Dakar Pasteur Institute (DPI) and a team of researchers from Africa Rice (formerly WARDA), based in Saint Louis.

2.1.2.4 Legal Framework

The legal framework governing MESR and R&D institutions comprises a number of Laws, Decrees or Orders:

- **Laws** generally govern the founding of institutions, such as the Dakar Technopole, UADB, UT and UZIG, or changes in the statutes of existing institutions (ITA, ISRA, etc.). By way of example, law n° 97-13 of 02 July 1997 relates to the founding of institutions of a scientific and technological nature and specifies the associated rules governing their organization and operation.
- **Decrees** generally relate to the rules governing the organization and operation of research institutions and the attributions of the Research Governing Body, often as a result of various cabinet reshuffles. An example is Decree 2011-443 of 30 March 2011, relating to the founding and rules governing the organization and operation of the General Directorate for Higher Education.
- **Orders** generally cover the provisions specified by the Ministry within the framework of the reorganization and operation of its internal bodies. An example is Ministerial Order n° 1704 dated 18 February 2009, relating to the creation and rules governing the organization and operation of Research and Test Centres (CRE).

2.1.3 FUNDING OF SENEGALESE STI/R&D

2.1.3.1 General Budget of the Research Governing Body

In 2009, the merger of the Ministry of Higher Education and the one of Scientific Research that led to the Ministry of Higher Education, Universities, Regional University Centers and Scientific Research (MESUCURRS). The changes resulting from the merging of the respective operating and investment budgets are shown in Table I, showing that the amount allocated to investment is relatively low.

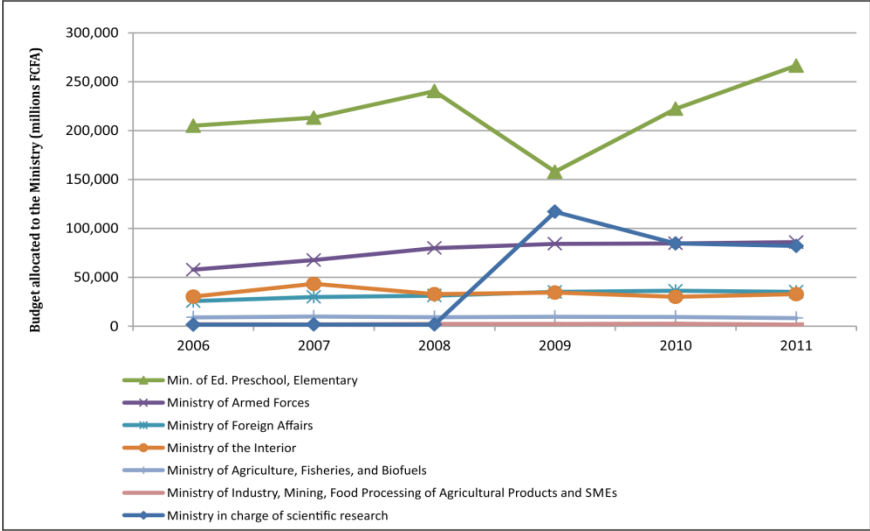
Table I: Ministry Budgets (million FCFA)

Million FCFA	2006	2007	2008	2009	2010	2011
Ministry of Scientific Research						
Operating Budget	1 665	1 760	1 747	1 868	*	*
Investment Budget	700	871	3 871	871	*	*
Budget	2 365	2 631	5 618	2 739	*	*
Ministry of Higher Education, Universities, Regional University Centres and Scientific Research (MESUCURRS)						
Operating budget	*	*	*	115 265	84 625	82 103
Investment budget	*	*	*	8 211	4 806	7 200
Budget	*	*	*	123 476	89 431	89 303

Source: 2006-2011 Finance Laws, Ministry of Economics and Finance (www.finances.gouv.sn); Traitments Ndiaye F. (2013)
* Previous or after the existence of the said Ministry

Moreover, Figure 2 shows that the proportion of the total budget (operating and investment) allocated to higher education and research is higher than that allocated to agriculture, foreign affairs and the interior, and is almost equal to the funds allocated to the armed forces. However, over the last few years it has been going down.

Figure 2: Budget Figures (operating and investment) for Each Ministry (million FCFA)



Source: 2006-2011 Finance Laws, Economy and Finance Ministry (www.finances.gouv.sn); Treatments Ndiaye F. (2013)

2.1.3.2 Funding for Higher Education and Public Research

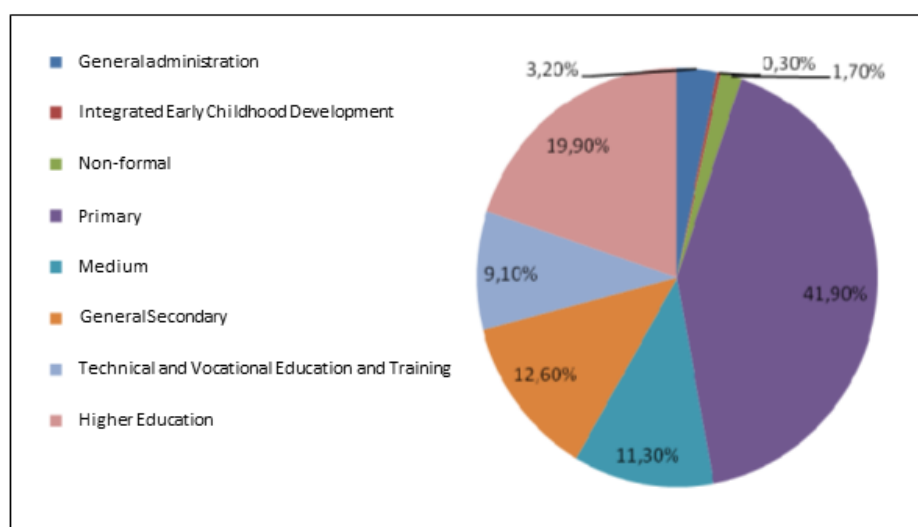
The way in which the budget is prepared and the structure of expenditures, combined with the workload distribution between activities for teaching and those for research, makes it difficult to estimate the part of budget allocated to Research. It is the same for expenses assigned to the operation or investment, particularly for infrastructure. Thus, the budget is included overall in the general funding allocated to Higher Education, which is in itself included in the funding released to the education and training sector. For this reason, we have to consider the entire sector.

2.1.3.2.1 Funding for Education: In terms of funding, the public operating expenditure allocated to education has seen a regular increase in terms of implementation (MEF, 2012). Over the last few years, the Senegalese government has allocated 40% of the national operating budget to education (ANSD, 2011-c). However, this budget still remains inadequate compared to the scale of the needs of the sector (MEF, 2011-c). In 2008, the overall funding for education represented 5.1% of GDP, on which 24.5% was spent on Higher Education (Urama et al., UNESCO Science Report 2010, chap. 14).

2.1.3.2.2 Budgets: According to MESR (2012), in 2008, overall expenditure allocated to research was over 22 billion CFA Francs, with 57% from the State, 38% from abroad and only 4% from local businesses. In overall terms, the budget for research stands at 0.35 to 0.5% of GDP. This leaves us still a long way from implementing the numerous recommendations and resolutions of the African Union (OUA/UA) and the OIC, in terms of raising the level of research funding to 1% of GDP.

The amount spent on Higher Education, at 19.9% of the total budget for the education sector, is in second place, after primary education which, at 41.9%, is the State’s highest priority. Figure 3 shows the 2010 distribution of funds spent on all the subsectors of education and training (ANSD, 2011).

Figure 3: Funding Spent in Each Subsector



Source: ANSD, 2011

Furthermore, note that, as shown in Table II, considerable progress was achieved between 2000 and 2010 in terms of the budget for higher education and grants, with an extremely significant increase in the number of grant-aided students taking courses both within Senegal and abroad.

Table II: Evolution of Higher Education Budget (in CFA Francs) and of the Number of Grantees (2000 vs 2010)

Budget/Students		2000	2010	% Change
Higher Education Budget		22 278 880 256	100 050 281 920	+ 349%
Grants Budget	Senegal	3 105 523 000	30 066 215 305	+ 868%
	Abroad	1 990 124 256	9 187 305 000	+ 361%
	Total	5 095 647 256	39 253 520 305	+ 670%
Number of Grant-Aided Students	Senegal	15 816	57 821	+ 266%
	Abroad	1 363	5 574	+309%
	Total	17 179	63 395	+ 269%

Source: MESUCURRS, 2010

As for the year 2011, according to PODES (2012-2017) with a budget of about 89,300 millions CFA francs higher education represents 25.4% of the total budget allocated to education. There were 60,000 grantees in Senegal in 2010-2011 (MEF, 2012). Higher education does constitute one of Senegal priorities and represents 8% of the country budget as compared to overall nearly 4% average continent wide (Dia *et al.*, 2012).

In 2012, the higher education system, as a whole, has mobilized financial resources in the amount of 119 199 138 930 billion CFA francs. Such amount represents 1.62% of the national wealth of that same year and reflects the significant efforts made by the Government of Senegal for financing higher education (MESR, 2013). However, of this budgetary allocation, 89.6% is spent on staffing, operation and routine transfers, to the detriment of investment (8.1%), education and above all, research. Decentralised public communities invested practically nothing in research, and investment from the national private sector was fairly half-hearted. In contrast, bilateral and multilateral institutions were strong contributors to research funding through special agreements.

According to projections, in accordance with the budgetary framework of the State, the public funding of higher education and research expenses should increase to 149 billion in 2017 (MER, 2013-c)

2.1.3.3 Funding Mechanisms in Place

2.1.3.3.1 General Situation

- **Mechanisms within the Ministry of Economy and Finance (MEF):** The MEF incorporates the Directorate of Economic and Financial Cooperation (DCEF), a national directorate that drafts the Three-Year Public Investment Programme (PTIP) and prepares the Consolidated Investment Budget (BCI).
- **Mechanisms within the Higher Education and Research Ministry (MESR):** The MESR has set up the National Scientific and Technical Research Incentive Fund (FIRST) and various other instruments for funding and supporting research:
 - FIRST is a competitive fund mobilizing intervention credits allocated by the State to the Ministry for Scientific Research. As a means of funding projects, FIRST is also an instrument for supporting and structuring the research sector. Many R&D projects have been funded (twelve in 2008 and thirteen in 2010), all in priority fields, such as agriculture, agribusiness, health, livestock and mathematical modeling.
 - Other funding instruments: In addition to the FIRST fund, the MESR has other ways of raising funding, such as the Scientific and Technological Publication Fund (FPST), and Programmed Thematic Groups (GTP). Furthermore, a significant part of the grants awarded to universities under the transfer budget can finance research activities.
 - Finally, through international scientific and technological cooperation, the MESR also obtains considerable research funding. This is the case, for instance with the IAEA, UNESCO, USAID and WAEMU.
- **Other National Mechanisms:** In his speech at the Solemn Session 2015 of Senegal National Academy of Science and Technology, Professor Doudou Ba, Permanent Secretary of ANSTS, indicated also other mechanisms (Ba, 2015). These are namely :
 - The support program for the promotion of female Teachers-Researchers of Senegal, aimed at funding : i) thesis projects to be finalised in Senegal or overseas; ii) the publication projects with a view of a registration on CAMES list; iii) participations in juries of defence outside Senegal of female Teachers-Researchers from categories A and assimilated; and iv) participations in scientific meetings;
 - Financing on own resources of public or private teaching institutions and R&D organizations generating resources, one portion of which is invested in STI. These resources will essentially be generated by registration fees, the sale of expertise, service provision, research contracts, sales of publications, income from property and real estate assets, museum entrance fees, support funds etc.;
 - Study travels ;
 - Research premiums and indemnities ;
 - Scholarships for doctoral students ; Prizes awarded by the President of the Republic for Science and the promotion of Technology Invention and Innovation ; and
 - The Prize for the best thesis from national doctoral schools, initiated by ANSTS to reward the best theses from the Doctoral schools of Senegalese Universities.

- **Subregional and Regional Mechanisms:** A number of funding organizations working on a subregional or regional level play an active role in funding R&D and innovation in Senegal. These include the IDRC, IDB and various other organizations.

IDRC: The International Development Research Centre (IDRC, <www.crdi.ca>) is a Canadian State corporation founded in 1970 to help developing countries find solutions to their own problems. Through its former Regional Office for Central and West Africa (BRACO) in Dakar, opened in 1972, it granted funding for promoting knowledge production and change, in particular by supporting on-site researchers, providing project support and helping build capacity for research institutions. BRACO has funded numerous projects in Senegal. The most recent include the project for “Consolidating ANSTTS and its Programmes” and the subregional project run by the AAU on “University Governance”, incorporating an important module on developing research projects, which has benefitted the UCAD and UGB. However, following restructuring, the BRACO is closed down and its activities have been relocated to Nairobi.

Islamic Development Bank (IDB): The Dakar Regional Office of the Islamic Development Bank covers a number of countries in the subregion, including Benin, Burkina Faso, Cote d’Ivoire, Gambia, Guinea Bissau, Guinea, Mali, Niger, Senegal, Sierra Leone and Togo. The Bank cooperates with Senegal on energy, transport, agriculture, promotion of Islamic finance, education and modernisation of the Daaras (Coranic Schools). The IDB has diversified and increased ITS assistance towards capacity-building, training, acquisition of equipment and the creation of S&T infrastructure, organising international technology transfers, supporting research institutions and activities related to research issues. Moreover, the IDB has launched a “Merit Scholarship Program” providing considerable help to scientific disciplines, and has already supported a number of scientific events (forums, seminars and conferences) held in Senegal. Furthermore, in 1422H (2001), the IDB set up a programme for awarding the Prize for Excellence in Science and Technology, and two Senegalese institutions have received awards in the 3rd category: the Institute of Food Technology - ITA (2007) and the Senegalese Agricultural Research Institute - ISRA (2012).

Other Subregional and Regional Mechanisms: Table III outlines the subregional and regional funding structures that support research and development and/or innovation in Senegal.

Table III: Regional and Subregional Funds for Funding Research

Fund Name	Description	Managing Organisation	Sectors concerned	Amount	Beneficiaries	Access	Source
WAEMU Fund for Research	A fund of FCFA 3 billion for funding research in the Union's Member States. The fund was set up within the global programme for supporting higher education launched in 2007, with a total of FCFA 18 billion and is already providing support for 12 centres of excellence.	West African Economic and Monetary Union (UEMOA)	Unspecified	FCFA 3 billion (CAD 6 million)	Researchers (individuals or groups)	Competitive Fund	www.ouestaf.com/L-Uemoa-valancer-un-Fonds-de-3-milliards-FCFA-pour-financer-la-recherche_a2294.html
Fund to Aid the Promotion of Invention and Innovation (FAPI)	A fund set up for aiding the African Intellectual Property Organization (OAPI) to perform its mission of adding value to the patents that it issues and efficiently responding to the new strategy of Member States to achieve greater integration of inventions and innovations into the development process.	African Intellectual Property Organisation (OAPI)	Technological inventions Innovations	Unspecified	Inventors, researchers and innovators in OAPI Member States Industrial and craft businesses Public and private research laboratories	On request	http://www.wipo.int/meetings/fr/doc_details.jsp?doc_id=14934
African Development Bank (AfDB) Research Grants	Grants to promote and strengthen ties between African science and technology institutions. The aim is to fully satisfy high-level science and engineering requirements in sub-Saharan African countries, and also to promote fair access to higher education and research, fostering conditions for creating a centre of excellence.	African Development Bank (AfDB)	Science and Technology (S&T)	USD 15 million (CAD 15.5 million)	African University of Science and Technology (AUST) International Institute of Water Engineering and the Environment (2iE)	Grant	http://knowledge.cta.int/fr/Dossiers/Demandes-d-innovation/Le-financement-de-l-agriculture-et-du-developpement-rural/Nouvelles/La-BAD-debloque-15-millions-de-dollars-EU-pour-la-science-la-technologie-et-l-enseignement-au-Nigeria
Small Grants Programme	Launched in 1988, the small grants programme funds researcher thesis work for field research and also provides awards for bibliographies, course manuals and reviews.	Council for African Social Sciences Research Development (CODESRIA)	Social Sciences	USD 100000 (CAD 102 500) Grants to working groups in 2009	Young researchers	Grants and competitive fund	http://www.codesria.org/spip.php?rubrique6&lang=fr
In-depth Research Grants Programme	The in-depth research grants programme was conceived to strengthen and promote a culture of intensive and extensive reflection in African universities.						
Thesis Prize	Since 2002, three prizes have been awarded every year for the best doctoral theses produced in Africa.						
ROCARE Programme Interdisciplinary Research Grants	A programme for educational research capacity-building, launched in 2010 by the West and Central African Educational Research Network (ROCARE) and higher education institutions in member countries. The aims of the programme are: To train young researchers in research methodology; To strengthen ties between ROCARE and higher education institutions; To strengthen collaborative ties.	West and Central African Educational Research Network (ROCARE)	Education	FCFA 3 million (CAD 6 000) (per project in 2010)	Doctoral students Young researchers Lecturers Administrators	Competitive fund	www.ernwaca.org/web/spip.php?article492 www.rocare.org/grants/booklets/Subventions-ROCARE-booklet-FR.pdf
Research Development Programme	A fund set up by CEDEAO/ECOWAS to support research based on the needs expressed by member countries.	West African Health Organisation (OOAS), Economic Community of West African States (CEDEAO)	Health	Unspecified	West African Health Organisation (OOAS)	Grants	www.wahooas.org/spip.php?article298&lang=fr
African Equipment Fund for Science, Technology and Innovation	A fund aimed at motivating inventors and innovators and encouraging the development of sustainable industries and businesses in Africa.	Economic Commission for Africa (UNECA)	Research Innovation	USD 50000 (CAD 518000)	Individual entrepreneurs Research centres	Competitive fund	www.scidev.net/en/news/fund-aims-to-turn-african-science-ideas-into-business.html

Source: CRDI/IDRC-Focus Africa (2010)

2.1.3.3.2 Sectoral Research

2.1.3.3.2.1 Funding for Agricultural and Agro-food Research

- **National Agricultural and Agro-food Research Fund (FNRAA):** The National Agricultural and Agro-food Research Fund (FNRAA) is a funding and management mechanism for coordinating and organising agricultural and agro-food research to better administer the aims of the agricultural, forestry and pasture development policy. The FNRAA has set up and manages a specific projects financing system through three mechanisms for: i) strategic and applied research; ii) R&D; and iii) Technology Development and Dissemination. The FNRAA, through its Scientific and Technical Committee, is also a provider of services for the American USAID/ERA project (Education and Research in Agriculture), aiming to build institutional and human capacity in education and agricultural research. This project entails partnerships with the private sector to set up a sustainable agricultural system, adapted to agricultural knowledge and information systems (AKIS) for boosting yields, profitability, economic growth and food security in Senegal.
- **Other Sources:** In Senegal, funding for public agricultural and Agro-food research also comes from several other sources, including funds allocated by the Senegalese Government, contributions from technical and financial partners, loans from development banks and the sale of products and services.

Between 2000 and 2008, the major technical and financial partners of the Senegalese Agricultural Research Institute (ISRA) were the World Bank, European Union, African Development Bank (AfDB), USAID, France, several international agricultural research centres that funded the Consultative Group for International Agricultural Research (CGIAR) and the West and Central African Council for Agricultural Research and Development (CORAF/WECARD). As for the Institute of Food Technology (ITA), since 2000, it is benefitting of and important funding from the World Bank, within the framework of the Agricultural Services and Producers Organisations Support Programme (PSAOP).

2.1.3.3.2.2 Funding for Research in Health: Funding for health research comes mainly from outside resources (technical and financial partners) mediated by various health programmes.

The state funding is intended primarily for operation and support staff, whereas that of partners goes mostly to operating expenditures and investment. As for local communities and populations, they contribute to the funding of recurrent costs of health facilities. The main programmes benefit from significant financial resources, 80% of which goes to 3 programmes: HIV/AIDS (30%), Expanded Vaccination Programme - PEV (26%) and malaria (24%).

At university level, research funding from own funds is almost non-existent. Most of the funds allocated to research come from the lecturers' personal initiatives, especially for research projects in partnership with teams from the North. The impact of the national private sector on research activities is very low.

2.1.3.3.2.3 Funding for Water Sector Research: At the end of December 2011, the overall volume of funding taken up for the Millennium Drinking Water and Sanitation Programme (PEPAM) over the 2005-2011 period was FCFA 427.242 billion. The majority of projects were focused on both water-related construction, and studies and engineering consultancy, and the percentages allocated to actual research varied from one project to another.

2.1.3.3.2.4 Funding for Private Research: By way of example, we have taken private agricultural and agribusiness research. The investment figures for 2008 indicate that over 40% of investments were made by companies involved in horticulture. According to Stads and Sène, in 2008 Senegalese private businesses invested on average 0.3% of their turnover in R&D.

Private organisations that conduct research activities aimed at development include the Ecological Monitoring Centre (CSE), whose aim is to develop tools for assisting in decision-making on environmental monitoring and knowledge of the dynamics and changes occurring in natural ecosystems.

2.1.4 SENEGALESE RESEARCH PRODUCTIVITY

At applied research centres, scientific production consists mainly of standard documentation: annual technical reports, technical data sheets and communications at meetings and international seminars. Institutes such as the Senegalese Agricultural Research Institute (ISRA) and Food Technology Institute (ITA) have developed a scientific publication policy that has involved creating a multiplicity of periodicals. Few papers are published in scientific journals with acknowledgement of reviewers, which is detrimental to research lecturers of universities for whom this type of publication is decisive for their career plans.

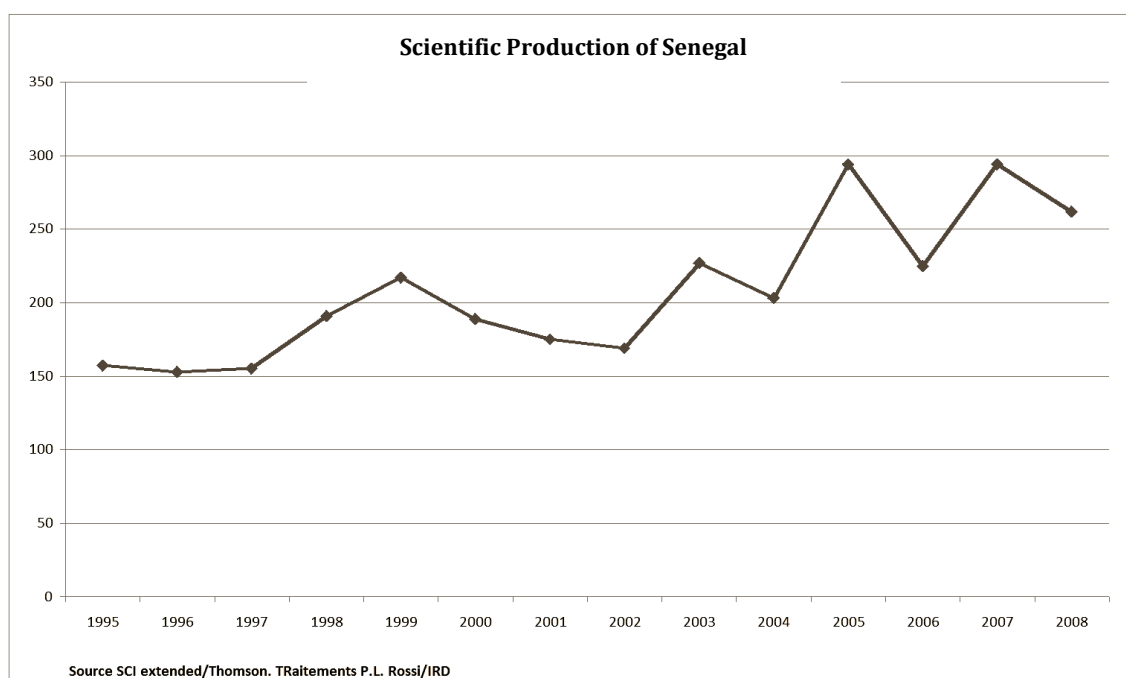
However, with the adoption of the African and Madagascar Higher Education Council (CAMES) system as standard for the assessment of researchers at all educational and research institutions, there has been an increase in the number of publications from these institutions appearing in international journals with acknowledgement of reviewers.

2.1.4.1 Overall Productivity

The overall scientific production of Senegal is only appreciated here through scientific publications indexed in international databases (SCI extended, WOS and SCImago). Therefore, it is not indicative of the exact productivity level, since many articles are published in local or institutional journals and a number of papers are presented in international seminars, colloquiums, workshops or conferences.

As shown in Figure 4, this production, between 1995 and 2008, was certainly modest and its development followed a peak-and-trough pattern, but there is a consistent trend towards an overall increase in the number of publications indexed in the SCI expanded list (Gaillard and Kane, 2009). From an initial figure of just over 150 references in 1995, total indexed scientific production increased to just under 300 references in 2008.

Figure 4: Scientific Production in Senegal: Number of Publications Indexed in the SCI Expanded List (1995-2008)



Source : (In Gaillard and Kane, 2009)

According to SCImago database, the total number of publications in 2011 is 521. In fact, the institutional capacity-building in R&D / training through the creation of public universities and research centres, recruitment of teachers and researchers, enrolment of some 5,000 doctoral students, has resulted in a new dynamics in scientific and technological production, as shown in Table IV. (Dia *et al*, 2012).

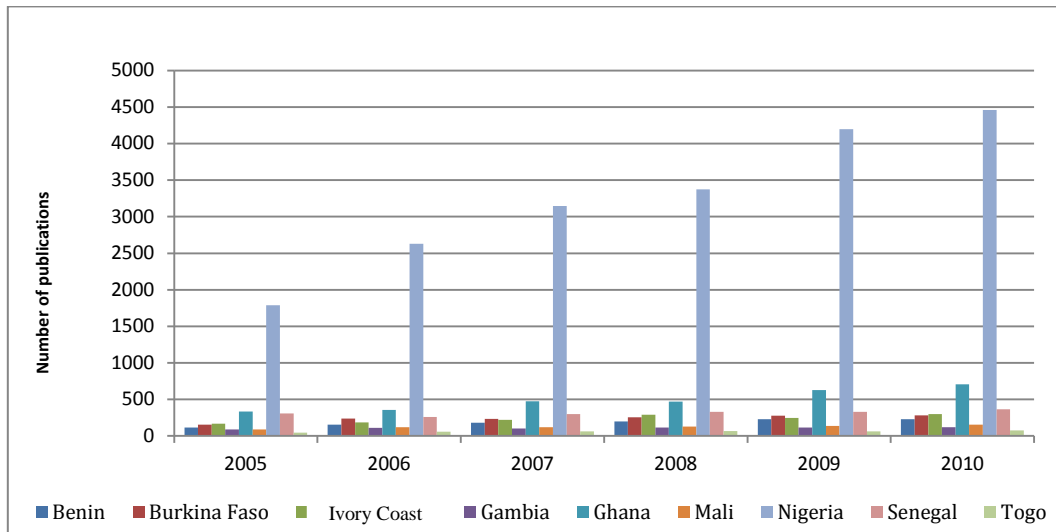
Table IV: Staff Levels and Scientific Production in Senegalese Universities

University	Staff		Papers, Theses, Patents		
	Teaching Staff	Admin., Tech. & Service Staff	Papers	Theses	Doctorates
UCAD, Dakar	1227	1191	1346	118	462
UGB, St Louis	162	206	360	15	-
University of Thiès	97	109	15	-	-
University of Bambey	94	65	-	-	-
University of Ziguinchor	63	70	59	-	-
Thiès Polytechnic (EPT)	31	61	-	-	-

Source: Extracted from MESUCURRS, 2010

For the 2005-2010 period, this level of production placed Senegal in 3rd position by comparison with other West African countries, with Nigeria and Ghana taking first and second places (Figure 5).

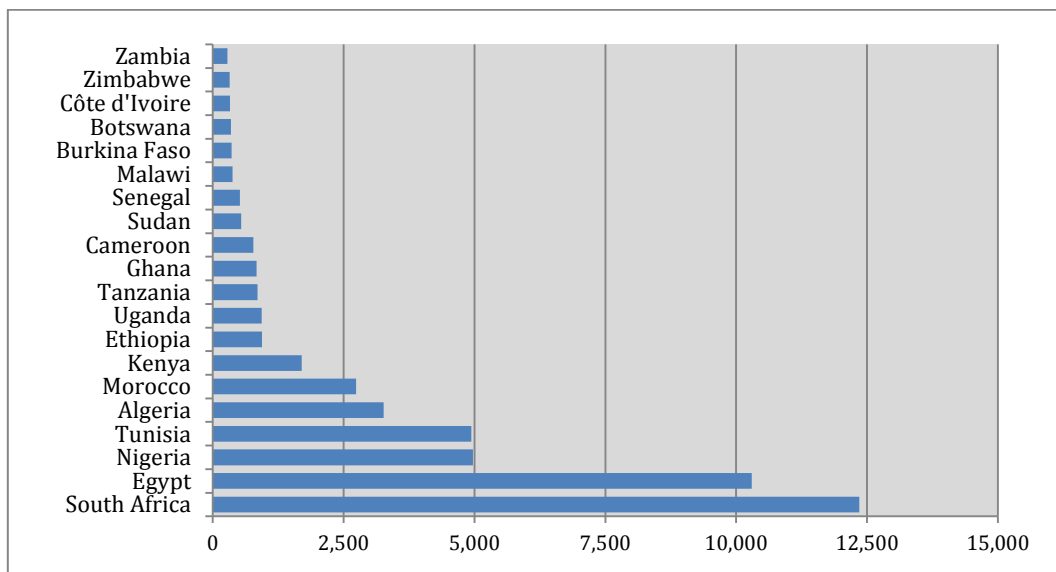
Figure 5: Scientific Production in West Africa



Source: SCImago Journal & Country Rank. Retrieved June 30, 2012, from www.scimagojr.com - Treatments F. Ndiaye (ANSD)

At the continental scale, Senegal ranks in an intermediate position but its relative position has deteriorated over the last twenty years. From 1970 until the late 1980s, the country has occupied the seventh or eighth place in Africa (Gaillard, 1997) and the 13th in 2006 and 2007 (Gaillard and Kane, 2009) and only the 14th, immediately after Sudan, Cameroon, Ethiopia, Ghana and front Malawi, Burkina Faso, Botswana and Côte d'Ivoire, as shown in Figure 6.

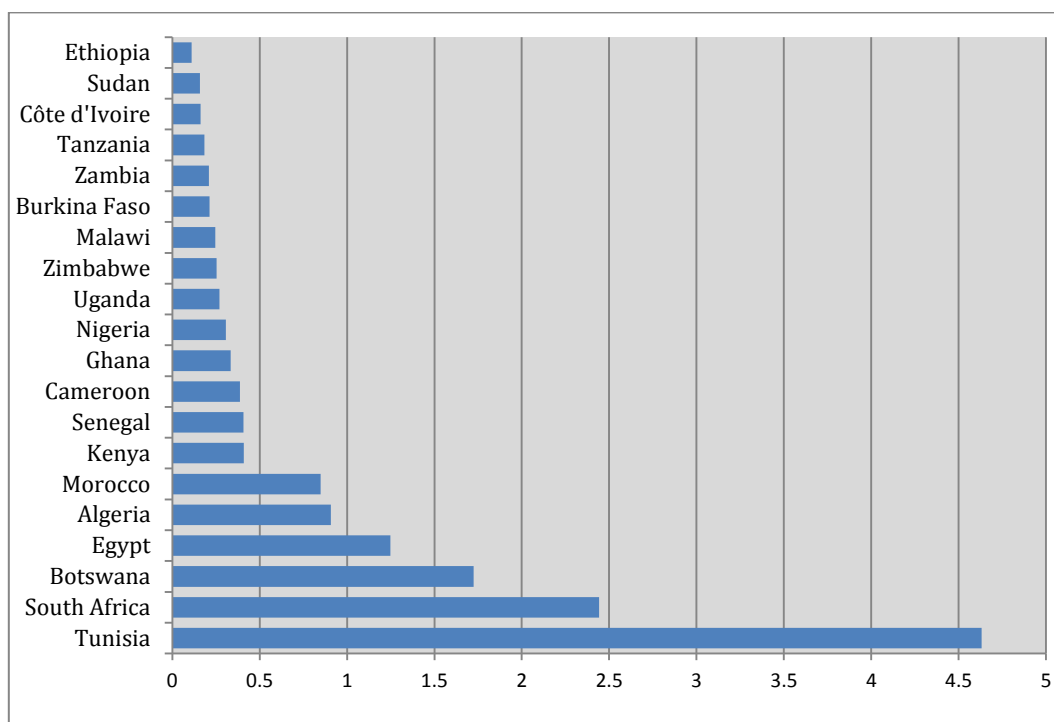
Figure 6: Top 20 Scientific Producers in Africa (2012)



Source: SCImago Journal & Country Rank. Retrieved June 30, 2012, from www.scimagojr.com - Treatments F. Ndiaye (ANSD)

However, relative to the population (per 10000 inhabitants), the Senegalese scientific production has a higher ranking in Africa and advanced to 8th place (Figure 7).

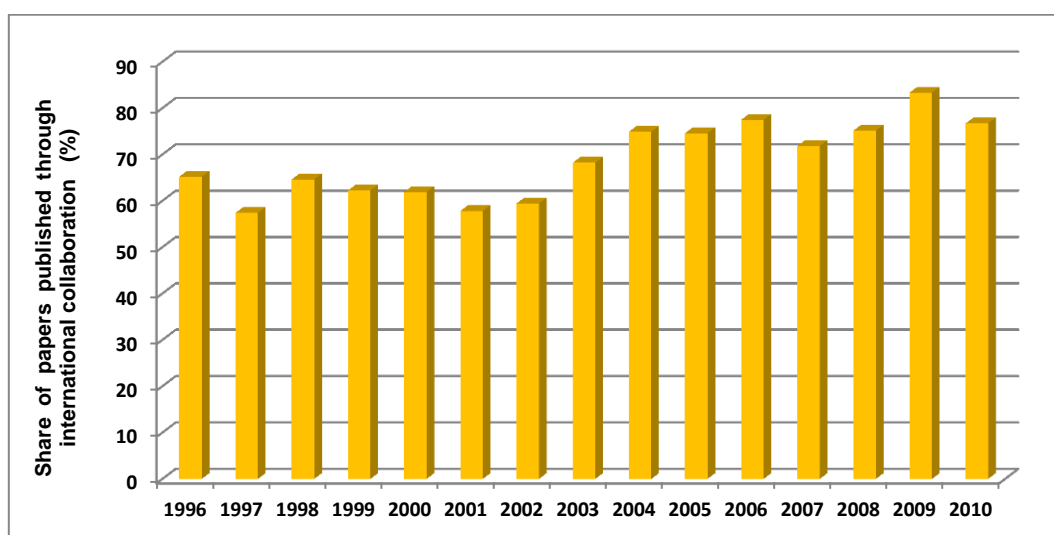
Figure 7: Top 20 Scientific Producers per capita (for 10000 inhabitants) in Africa (2012)



Source: SCImago Journal & Country Rank. Retrieved June 30, 2012, from <http://www.scimagojr.com>- Treatments F. Ndiaye (ANSD)

Furthermore, researchers in Senegal work in close collaboration with other researchers throughout the world. In fact, over the period from 2005 to 2010, over 70% of publications were produced through international collaboration (Figure 8).

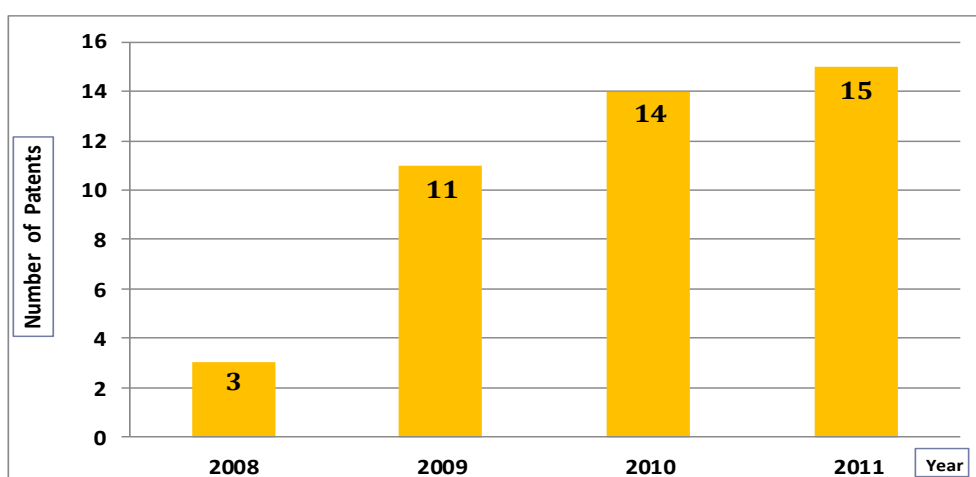
Figure 8: International Collaboration in Senegalese Research



Source: SCImago Journal & Country Rank. Retrieved June 30, 2012, from <http://www.scimagojr.com>- Treatments F. Ndiaye (ANSD)

As for productivity in terms of intellectual property, Figure 9 indicates the low but increasing number of patents filed with the African Intellectual Property Organisation (AIPO) from 2008 to 2011, and especially since 2009.

Figure 9: AIPO Patent Registration from 2008 to 2011



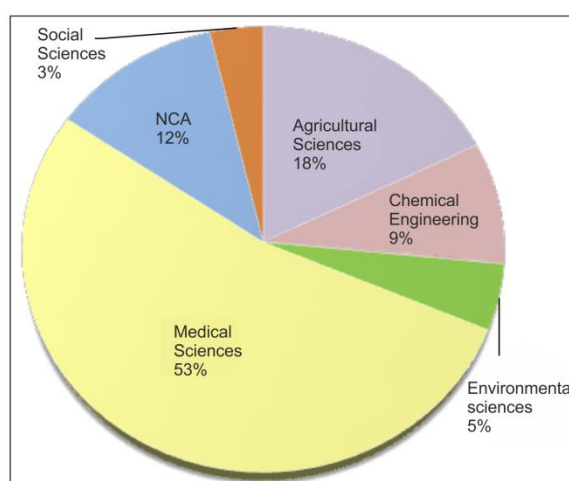
Source: ASPIT, 2012

Furthermore, it is important to emphasise that Senegalese research has achieved significant results in terms of knowledge, ready-to-use technologies and decision-making tools with applications in various fields (agriculture, livestock, environment, fishing, agribusiness, forestry, commerce, ICT, public health, etc.). The majority of these products, especially in agriculture and agro-food, have been transferred and used to boost production and generate significant added value. Thus, they have been decisive in the development of sectors of the domestic economy, even though no patent applications have been submitted or papers published.

2.1.4.2 Sectorial Productivity

Figure 10 shows the relative proportions of publications produced in the major research fields in 2012.

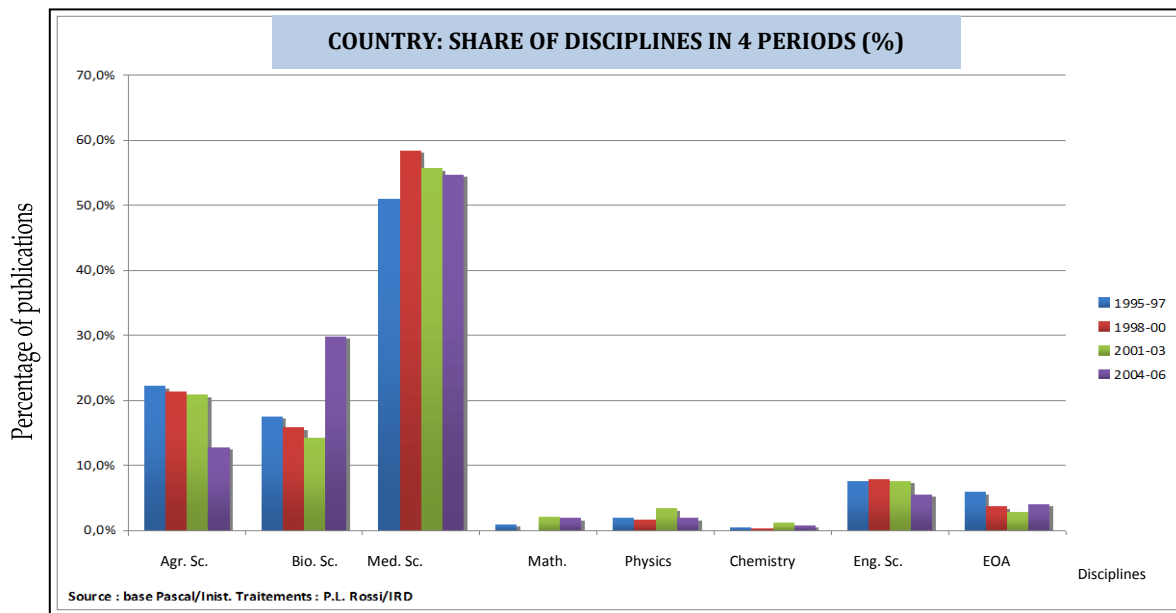
Figure 10: Distribution of Scientific Publications in Senegal over various fields



Source: SCImago Journal & Country Rank. Retrieved June 30, 2012, from <http://www.scimagojr.com>- Treatments F. Ndiaye (ANSD)

Figure 11 shows developments in 3-year steps from 1995 to 2006. The figures show the clear predominance of the medical sciences (over 50%), followed by the agronomic and biological sciences. Moreover, it can be seen that the field of biological sciences is the only field whose relative importance has increased significantly over the last 3-year period. One can also note the weakness in basic sciences (mathematics, physics and chemistry) and the relative decline of engineering or in Earth Ocean Atmosphere (EOA) sciences.

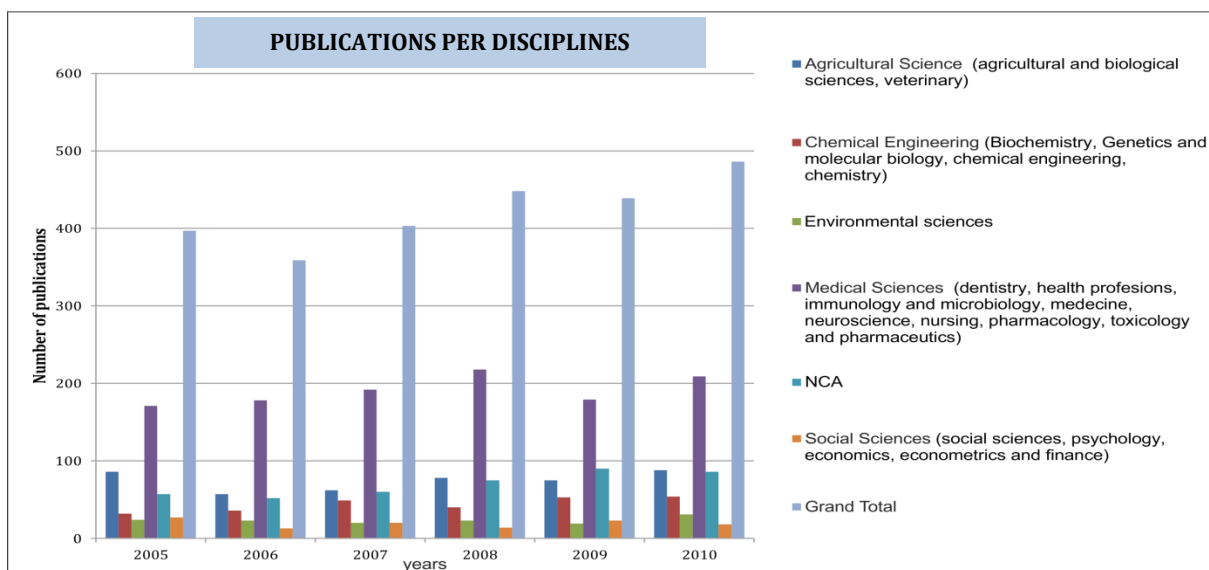
Figure 11: Relative Importance of the Major Research Fields over Four Periods of 3 Years



(In Gaillard and Kane, 2009)
Source: SCIE Thomson. Processing: P.L. Rossi/IRD

In the most productive fields over the period from 2005 to 2010, average annual scientific production (Figure 12) stood at between 400 and 500 publications for the medical sciences, followed by the agricultural sciences at around 200 publications.

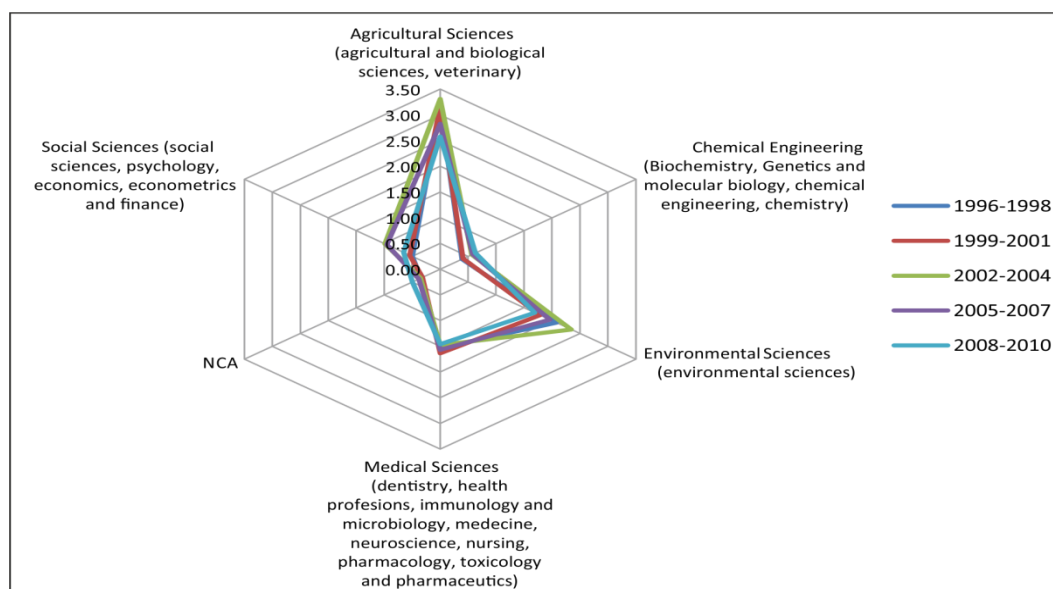
Figure 12: Dynamics of Disciplines in Senegal in Relation to World Variations



Source: SC Imago Journal & Country Rank. Retrieved August 02, 2012, from <http://www.scimagojr.com>; \$ - Treatments F. Ndiaye (2013, ANSD)

Furthermore, the evolution of the specialisation index reflected by Figure 13, indicates that Senegal has : i) a marked specialisation in the agricultural sciences which has fallen back in recent periods, ii) a relatively stable specialisation in the environmental and medical sciences; and iii) for other disciplines, there is under-specialisation, as illustrated by the significant drop in physics.

Figure13: Development of the Scientific Specialisation Index in Senegal



Source: SCImago Journal & Country Rank. Retrieved August 02, 2012, from <http://www.scimagojr.com>- Treatments F. Ndiaye (2013, ANSD)

2.1.4.3 Institutional Productivity

Standardising addresses and institutions has meant that the main institutions in the two databases between 1997 and 2008 can be identified. The data has been grouped in 3-year periods. As shown in Table V, four institutions (three if the production of the Dakar University Hospital centre is combined with that of UCAD) are predominant. These are Cheikh Anta Diop University of Dakar (UCAD), Institute of Research and development (IRD), Dakar University Hospital Centre (CHU) and the Dakar Pasteur Institute (IPD). Production increased significantly over the reference period, especially at UCAD which doubled production between 1997-1999 and 2006-2008. Over the last period, UCAD alone represented 42% and UCAD with the Dakar University Hospital centre nearly 60% of scientific publications indexed in the WoS. The four leading institutions (UCAD, IRD, Dakar CHU and IPD) are responsible for 90% of the indexed publications.

Table V: Published and Indexed Scientific Production from the most Visible Senegalese Institutions (1997-2008)

Institution	1997-1999	2000-2002	2003-2005	2006-2008
UCAD	174	123	244	329
IRD	138	148	196	173
Dakar University Hospital (CHU)	93	103	98	135
IPD	60	56	99	90
ISRA	35	40	40	49
Dakar Health Min.	15	32	40	37
EISMV	9	8	17	17
Dakar Polytechnic	2	11	11	17
UGB	2	6	9	17
WARDA (Africa Rice)	10	7	16	9
St Louis Health Min.	16	17	13	6
CIRAD	0	7	6	5
Thiès Polytechnic	3	5	4	4
Thiès Agricultural College	2	3	5	1

Source: SCIE Thomson. In Gaillard and Kane (2009). Processing: P.L. Rossi/IR

As noted by Gaillard and Kane (2009), the number of publications attributed to the Senegalese Agricultural Research Institute (ISRA) may seem relatively low, in view of the number of researchers it employs (around 100). However, a rapid scan of the list of publications from this institution for 2009 reveals that most of them are communications presented to seminars (mainly in Senegal), expert reports and papers not published in scientific journals, or publications that appeared in the institution's own journals (*Revue sénégalaise des recherches scientifiques* -Senegalese scientific research review-; ISRA Newsletter). But these are not indexed in international databases.

2.1.5 BRIGHT SPOTS

2.1.5.1 Economic and Sociocultural Achievements

Major achievements in terms of economic and sociocultural development, with the structuring effect they have in helping decongest the capital and strengthen the influence of Senegal, are the results of significant efforts devoted to economic and social infrastructure (Blaise Diagne airport at Diass, development of the Dakar West Corniche and the Dakar North Relief Road and toll motorway) and cultural infrastructure (Grand Theatre, African Renaissance Statue, Maison du Souvenir - still under construction).

Moreover, in terms of regionalised development, the entire reconstruction of the Faidherbe Bridge in Saint Louis (see Photo 1) is worthy of note.



Photograph 1: Faidherbe Bridge, Saint Louis

Source: www.google.sn/imgres?imgurl=http://imalbum.aufeminin.com/album/D20060301/170102_KIG5ERW4GWP8TR618FUCJ_AEVQDDE2Z_pont_faidherbe_5

This bridge has a positive impact on the development of the regional capital, St Louis, and the entire Senegal river valley. At scientific and cultural levels, it fully facilitates exchanges between secondary schools located in the Island (El Hadj Omar, former Lycée Faidherbe, Ameth Fall) and those of Sor (Charles De Gaulle, Andre Peytavin) and also the University Gaston Berger .

2.1.5.2 Agriculture and Agro-food

2.1.5.2.1 Legal aspects: LOASP: The Agro-Sylvo-Pastoral Orientation Law (LOASP), adopted in 2004, is a result of a long process of dialogues with farmers' organizations (OP) and reflects the government's choice to make agriculture the engine of economic growth and the fight against poverty (ANSD, 2011). It forms the basis for the agro-sylvo-pastoral development policy, as well as for medium-term operational programs, such as the National Agricultural Development Programme (PNDA), the National Livestock Development Program (PNDE) and the Forestry

Action Plan of Senegal (PAFS- Ndiaye and Gueye, 2012). Therefore, LOASP through the PNDA, has proposed a long-term vision that is based on principles such as economic efficiency, social equity, sustainable management of environment and competitiveness (ANSD, 2011).

2.1.5.2.2 Institutional Aspects: SNRASP and FNRAA: The National Agro-Sylvo-Pastoral Research System (SNRASP) was set up to implement the LOASP. It has a Steering and Management Committee (CPG), assisted by a Scientific and Technical Committee (CST). FNRAA is the institutional body responsible for the scientific and financial management of the system. This fund ensures optimised use of financial, human and physical resources, better market monitoring and economy of scale.

2.1.5.2.3 Research Results: Agricultural and agro-food R&D has helped transfer modern farming methods to increase yields and promote the exploitation and processing of local produce (groundnuts, maize, black-eyed peas, millet, sesame, tomato and rice). These achievements are mainly due to the work of the Senegalese Agricultural Research Institute (ISRA) and the Food Technology Institute (ITA).

In addition, ISRA produces and sells 25 types of vaccine in eleven African countries. Tillage and post-harvest technologies equipment as well as shelter-dryers for the conservation of onion, were also developed. In forestry, ISRA has selected salt-tolerant woody species adapted to acid sulphate soils for land reclamation and agro forestry development in saline soils. In 2012, these achievements earned the ISRA a science and technology award from the Islamic Development Bank (IDB).

As for ITA, it has achieved various results relating to the processing and storage of local food products (rosella or *bissap*, mango, millet, the traditional condiment known as *netétou*, etc.), allowing small and medium-sized businesses to gain important regional and international market share. ITA has also trained and supervised various economic interest groupings, mostly made up of women, especially at its Marie Thérèse Basse centre for training in food-related businesses. Furthermore, in collaboration with the NGO Oxfam-Gb, ITA has taken on the marketing of high-quality local produce through PANAL (Standardised Accessible African Products) which will be disseminated throughout the country. These successful initiatives earned ITA the Danone *Cereal Awards* prize in 2006 and a science and technology award from the Islamic Development Bank in 2007.

2.1.5.3 Health

Major achievements in health include the work of Professor Souleymane MBOUP and his team at the Aristide Le Dantec University Hospital, which has helped improve our knowledge on HIV2 and HIV/AIDS, in particular its geographic distribution and the modes and dynamics of its transmission. The team showed that HIV2 is less virulent than HIV. The discovery of HIV2 has allowed Senegal to respond early on to the disease. This, in conjunction with the efforts and leadership of the scientific, political and religious authorities, has meant that Senegal has one of the lowest HIV prevalence rates in Africa.

This work has provided a basis for the development of the ONUSIDA benchmark laboratory, one of the centres collaborating in biomedical sciences for the African Programme in the search of a vaccine against AIDS, and is currently one of the best equipped laboratories in Africa. The knowledge contributed on HIV and HIV2 was an influential factor in the nomination of Professor Souleymane MBOUP as one of the *Africans of the Century* by the magazine *Jeune Afrique (Sciences et Spiritualité)*, and earned him in Senegal the 2010 President of Republic *Grand Prix* for Sciences.

2.1.5.4 Other Achievements

2.1.5.4.1 President of Republic Grand Prix for Sciences (GPPRS): The President's *Grand Prix* for Science, created in 1990, is an annual award organised by the Ministry in charge of Scientific Research and, since 2010, has been administered in collaboration with the National Academy of Sciences and Techniques of Senegal (ANSTS). This award helps promote research and develop science and technology in Senegal and is intended to acknowledge creativity, erudition and merit of scientists and researchers, both Senegalese and expatriates resident in Senegal. Furthermore, this prize should be an essential lever for the construction of a scientific, technological and entrepreneurial capacity, able to provide positive responses to social demands. Therefore, it is intended to revitalize the Conference of Laureates, to ensure better monitoring of works awarded at the end of each edition (Niane, 2013).

The award is open to all scientific disciplines in both applied and basic research, with particular emphasis on the following types of research: medical and pharmaceutical; agricultural and agro-industrial; technological and industrial; exact sciences; and social and human sciences.

2.1.5.4.2 President's Grand Prix for the Promotion of Technological Inventiveness and Innovation (GPPRPIIT): The President's *Grand Prix* for the Promotion of Technological Inventiveness and Innovation in Senegal was also created in 1990 and is awarded every two years. It is open to any individual, Senegalese legal entity or group of individuals (Senegalese or resident expatriate). The award is organised by the Ministry of Industry and subject to a rigorous selection procedure based on technical, economic, social and environmental criteria. Award winners are nominated by a national jury organised by the Senegalese Agency for Industrial Property and Technological Innovation (ASPIT). This jury adjudicates the entries submitted by regional juries constituted by order of the Governor of each region.

2.1.5.4.3 AIMS-Senegal: The "**African Institute for Mathematical Sciences**" in Senegal (AIMS-Senegal) is an independent pan-African non-profit institute that aims to contribute to the development of Africa through training, research, and public engagement in mathematics and its applications. Established in Mbour, Senegal in September 2011, the Institute is recognized as an Institution of public utility. AIMS-Senegal is part of the Pan African network of AIMS Next Einstein Initiative (AIMS-NEI), consisting of centers of excellence to identify and train the best African scientists, as a means of contributing to the development of the continent.

In addition to the Government of Senegal and all public universities (UCAD, UGB, UB, UT, UZ), AIMS-Senegal enjoys the partnership of Universities of Ottawa and British Columbia (Canada), Pierre and Marie Curie and Paris-Sud (France), as well as of several institutions.

2.2 POPULATION

2.2.1 DISPARITY, YOUTH AND ETHNIC DIVERSITY

Populations and land areas of the fourteen (14) administrative regions of Senegal, as reflected by table VI, show a great disparity among them.

Table VI: Regional Distribution of Population, Area and Density of Senegal

Region	Population 2010	Population (%)	Area (km ²)	Superficie (%)	Density (in hbt/km ²)
Dakar	2 592 191	20.7	546	0,3	4 748
Diourbel	1 356 796	10.8	4 862	2.5	279
Fatick	724 345	5.8	7 049	3.6	103
Kaffrine	558 041	4.5	11 041	5.6	51
Kaolack	795 906	6.4	5 265	2.7	151
Kédougou	129 908	1.0	16 825	8.6	8
Kolda	603 961	4.8	13 721	7.0	44
Louga	857 944	6.9	25 644	13.0	33
Matam	542 201	4.3	28 852	14.7	19
Saint louis	894 000	7.1	18 981	9.6	47
Sédhiou	431 238	3.4	7 346	3.7	59
Tambacounda	651 018	5.2	42 638	21.7	15
Thiès	1 658 445	13.3	6 597	3.4	251
Ziguinchor	713 440	5.7	7 355	3.7	97
SENEGAL	12 509 434	100	196 722	100.0	64

Source: ANSD, 2011-c

Thus, the Dakar region, although territorially the smallest (0.3% of the land area) is the most populous, with 20.7% of the population (ANSD, 2011-c). On the contrary, the region of Tambacounda, the largest in the country (21.7% of the land area), located about 700 km from Dakar, is one of the least populated, with only 5.2% of the population (ANSD, 2011-c).

Estimated at 12,855,153 (ANSD Projections, 2011), Senegal's population is essentially young (55% under 20 years old). It is also varied, with a median age of 19 and an inter-census growth rate of 2.5%. Its elderly population, known as aînées (elders over 65), is stable at around 4%.

The capital, Dakar, has the largest population at some 2.5 million inhabitants, followed by the cities of Thiès, Kaolack, Touba, Saint-Louis, Rufisque, Ziguinchor and Diourbel. National population density in 2009 was 61.9 inhabitants per km².

The population of Senegal is made up of some twenty ethnic groups, each with its own language. The largest group is Wolof.

2.2.2 GENDER

The population of Senegal is 52% female (MEF, 2012) and women play an important role in the economy, responsible for a large part of agricultural production in rural areas and the main domestic tasks. They also constitute an important workforce in the informal sector, working mainly in commerce, textiles and agro-food business.

From 1978 to the present, various legal and political initiatives have been taken and considerable progress made toward gender equality. Senegal has adopted and ratified a raft of legal instruments drafted by the International Community, such as the Protocol on the African Charter of Human and Peoples' Rights. Law N° 2010-11 of 28 May 2010 has been enacted to institute absolute equality between men and women in all fully- or partially-elected institutions (e.g., National Assembly, etc.).

In addition, the Gender Fairness and Equality Directorate has been set up in the Ministry for Woman, Child and Women entrepreneurship.

In science and technology, considerable progress has been made in Senegal, with improved access to training and education for women. However, there is a lot to do, since the proportion of women involved in research is only 24%, compared to 32.6% for all OIC members (SESRIC, 2011).

Moreover, one has to recall that for the valorization of research results in many sectors such as the agro-food one, women are by far the most active. Therefore, gender issues should be considered in terms of woman's role both in research and the process of utilization of research achievements, with regard to her expectations, as well as to her direct or indirect involvement.

2.2.3 EDUCATION AND TRAINING

Since its independence, Senegal has made great efforts to implement an educational system, both coherent and responding to the global needs of the National Education sector. Over the years, initiatives and government interventions, scientific and technological activities and practices that took shape in 1995 were modified and, from 2000, impressed new trends to the innovation system. In this regard, the new Government STI policy direction is to translate research results into products, goods and services, as well as into intellectual property assets. This should drive strategic sectors (agriculture, fisheries, education and training, energy, industry, etc.) and lay the ground for an endogenous development based on appropriate scientific knowledge and adapted technologies (Dia *et al.*, 2012).

Education and training policy for 2000-2015 is enacted in the framework of the orientation law 91-22 of 16 February 1991.

While learning from development process lessons followed until then, this law takes into account mutations that occurred in both internal and external environment of the educative system. It also faces different challenges towards the objective of making Senegal an emerging country, with regard to industry, technology and democracy (MEF, 2011).

In the field of education, according to UNESCO/BREDA (<www.dakar.unesco.org>) the indicators are low, especially in terms of the gross schooling rate (69%), which is below average for sub-Saharan Africa (75%). The schooling rate is 73% for boys and 58% for girls. Education subsector are thought to suffer from the decrease of teaching quality, the lower level of teachers, demotivation of staff and lack of strictness in inspections, among other things. In addition, adult illiteracy (age 15+) is estimated at 41.9%. However, there are significant disparities between regions. Thus, adult illiteracy is more widespread among women (62%) and in rural areas (68.2%). According to UNDP (2015), quoting the National Education Ministry (NEM), the gross enrolment rate (GER) at primary school reached 93.9% in 2011, whereas it stood at 67.2% in

2000 and 79.7% in 2005. According to the latest official data³, the Net Enrolment Rate (NER) at primary school, which was 72% in 2002, reached nearly 83% in 2009. Nonetheless, among the enrolled children, only 2/3 completed the primary cycle in 2011. Indeed, the Completion Rate in primary cycle (CRP) went up from 38.6% in 2000 to 53.4% in 2005 and 66.5% in 2011.

Furthermore, the study made by the National Academy of Sciences and Techniques of Senegal on "*Science Education and Technology in Senegal, from preschool to high school*" (ANSTS, 2003), revealed a "disaffection of scientific series" by young people, especially girls. This led ANSTS, in its "**Dakar Declaration**", to pull the communication and thus advocating for an assessment of actual situation of the teaching of Science and technology in our country (Samb, 2013).

Taking into account these recommendations, the then Minister of Education appointed in 2004, by ministerial notice, a "*National Steering Committee of the Development of Science and Technology Education Project (CNPDEST)* ", under the auspices of the ANSTS.

By way of examples related to STI, we will only consider higher education, technical education and vocational training subsectors.

2.2.3.1 Higher Education

The network of public university map is densified since 2000, with the opening of universities of Thies, Ziguinchor and Bambey, together with the one of the Virtual University of Senegal (UVS). This, with the opening in 2016 of the second university of Dakar and the University of Sine Saloum in Kaolack (USSK), will help relieve UCAD and diversify the supply of higher education. But efforts still remain to be done to improve the internal efficiency of the sub-sector, marked by important rates of repetition and dropout (MEF, 2012).

Higher education is faced with the limits of its access capacities, the high cost of care, the low success rate in faculties, deteriorating educational supervision and repeated crises. Scientific and technological subjects, despite efforts, remain underdeveloped and welcome few of girls (MEF, 2012).

In an important "*Report on the Situation of Higher Education and Quality Requirements*", the National Academy of Sciences and Techniques of Senegal (ANSTS, 2010) analyses this sector without complacency and proposes many "*actions and prospective tracks*". Through the case of the University Cheikh Anta Diop (UCAD), Professor Abdou Salam Sall, its former Rector, devoted also a very interesting book to *the analysis of changes in higher education in Africa* (Sall A.S., 2012).

Thus, in the case of UCAD, as an example, following the National Consultation on Higher Education (CNES) in 1992, the implementation in 1994, of the Project for Improving Higher Education (PAES), supported by the World Bank, has allowed to: **i)** modernize the Central Library, create new infrastructure and provide modern equipment materials; and **ii)** improve the general climate of the University, by various accomplishments at the social campus.

However, very little progress has been made in terms of the quality of education and research because there is still work to build a strong National System of Scientific Research and Technological Innovation, organized around themes glued to development priorities and consensual (Dia *et al.* 2012).

³ <http://www.sn.undp.org/content/senegal/fr/home/mdgoverview/overview/mdg2.html>

In the meantime, we should welcome: i) the advent of strategic plans and performance contracts of public universities; ii) the future creation of Higher Institutes of Vocational Education (ISEP); iii) the contribution of the WAEMU and CAMES in quality assurance and enhancement capacity of teachers- researchers; and iv) progressive involvement of financial institutions (African Development Bank, World Bank, etc.). This should end up with a better monitoring and greater legibility of academic performances, while helping to further diversify the training offer, especially in the field of technology (Dia et al., 2012).

2.2.3.1.1 Human Resources at Public Research Centres and Universities

- **Human Resources at Universities:** Of those who pass the baccalauréat in Senegal, 80% go on to higher education, posing a serious overcrowding problem in educational institutions. Projections point to a population of 150,000 students in 2015. Senegal is therefore implementing reforms, principally concerning governance, staff vocational capacity-building and improving the suitability of higher education for the labour market. In terms of human resources, the five public universities and the Thiès Polytechnic School are staffed by 1,728 research lecturers of different grades, backed by administrative and technical personnel, as well as by doctoral students. Table VII shows the general organisation of human resources at Senegal's public universities.

Table VII: General Data on Human Resources at Public Universities and Thiès Polytechnic (EPT) in 2011

University	TRS	ATSS	Students	Sites	DS	Teaching staff/ student ratio
UCAD	1,281	1,299	68,777	37	07	1/54
UGB	162	206	4,687	10	02	1/29
UTH	97	109	1,579	07	01	1/16
UDZ	63	70	2,706	03	-	1/43
UADB	94	78	1,796	04	-	1/19
EPT (Thiès Polytechnic)	31	61	244	-	-	1/8

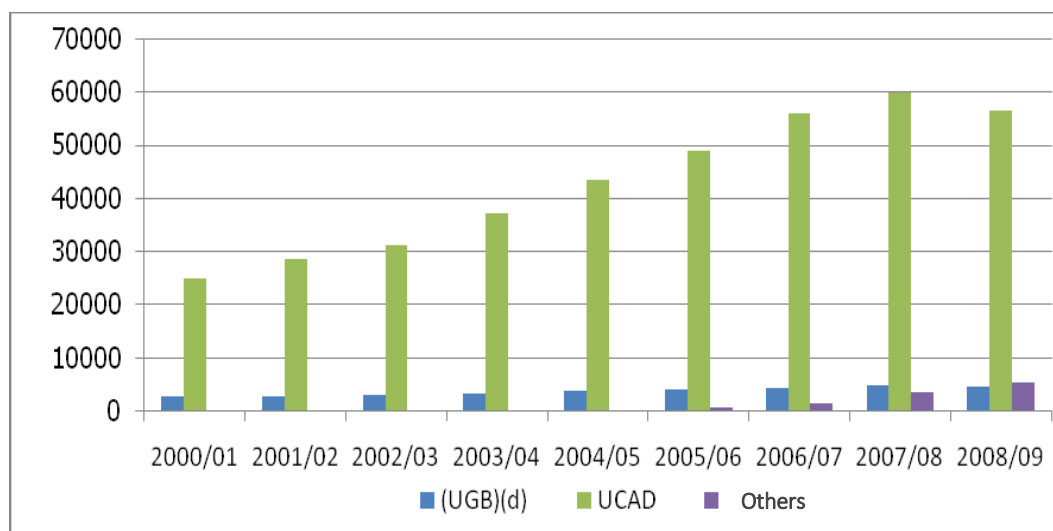
Source: Dia et al., (2012).

Key: TRS: Teaching and Research Staff
 ATSS: Administrative, Technical and Service Staff
 Sites: Colleges, Training and Research Units (UFR), Schools and Institutes
 DS: Doctoral School

This table reflects the efforts that have been made to recruit research lecturers forming the teaching staff, and administrative, technical and service staff (1,823 ATSS). However, the number of students (79,789) is such that previous efforts have had little impact on the quality of teaching staff and research.

Besides, Figure 14 (ANSD, 2011) shows the growth in student numbers at national universities from 2000 to 2009 and Table VIII (MESUCURRS, 2010) gives information on some major indicators for this sector.

Figure 14: Students Attending National Universities from 2000 to 2009



Source: ANSD, 2011

It is worth noting that considerable progress was made between 2000 and 2010 on all these higher education indicators shown in the table.

Table VIII: Some Key Indicators in Higher Education between 2000 and 2010

Students		2000	2010	Difference (%)
Degrees		9,206	30,000	+ 226%
Students	Public	27,000	72,260	+ 168%
	Private	5,000	23,310	+ 366%
	Doctorates	2,911	6,605	+ 127%
	Total students	34,911	102,175	+ 193%
	Total students	34,911	102,175	+ 193%
Universities and Colleges	Public	2	5	+ 150%
	Private	31	140	+ 352%
Research Lecturers		1,023	1,502	+ 47%
PhDs		380	1,822	+ 379%

Source: MESUCURRS, 2010

In 2012, the number of students was 87,265 in public schools and 35,705 in private schools, respectively. This, with a population of 13.56 million people, gives a rate of 906 students per 100,000 inhabitants (MESR, 2013-c).

- **Human Resources at National Research Centres:** In 2008, the public agricultural and agribusiness research sector employed 141 full-time equivalent researchers (Stads and Sène, 2010). Table IX shows the distribution of research staff over the various fields, indicating that in 2008 almost half worked in agronomics.

Table IX: Researchers in Various Fields in 2008

Field	Full-time equivalent researchers				Proportion of research staff (%)			
	ISRA	ITA	Higher Education (7)	Total (9)	ISRA	ITA	Higher Education (7)	Total (9)
Agriculture	50.3	10.4	8.3	69.0	51.3	98.8	25.4	48.9
Fishing	13.1	-	1.2	14.3	13.3	-	3.7	10.1
Livestock	9.8	0.1	0.7	10.7	10.0	1.2	2.3	7.6
Forestry	7.8	-	0.5	8.3	8.0	-	1.6	5.9
Natural resources	-	-	7.5	7.5	-	-	22.9	5.3
Other	17.0	-	14.4	31.4	17.3	-	44.2	22.2
Total	98.0	10.5	32.6	141.1	100	100	100	100

Source: Stads and Sène, 2010

Note: The calculations made by the authors are based on the 2008/2009 figures of the Senegalese Agricultural Research Institute - International Food Policy Research Institute (IFPRI-ISRA). Figures in parentheses indicate the number of institutions in the category. Data relating to expatriate researchers seconded to the ISRA are not included. Stads and Sène (2004).

The 2008 distribution of researchers in agronomics and zootechnics (animal domestication and breeding) is shown in Table XI (Stads and Sène, 2010).

Table X: Product-based Distribution of Agronomics and Zootechnics Research Staff

Product	Full-time Equivalent Researchers				Proportion of Research Staff (%)			
	ISRA	ITA	Higher Education (7)	Total (9)	ISRA	ITA	Higher Education (7)	Total (9)
CROPS								
Rice	13.7	-	0.1	13.8	22.8	-	0.9	17.3
Millet	5.2	1.3	3.2	9.8	8.7	12.3	36.0	12.3
Vegetables	5.2	1.3	0.6	7.1	8.7	12.3	6.7	9.0
Banana and plantain	2.6	2.6	0.1	5.3	4.3	24.7	1.4	6.7
Cassava (Manioc)	2.6	1.9	0.1	4.7	4.3	18.5	1.4	5.9
Groundnuts	3.9	0.6	0.5	5.0	6.5	6.2	5.3	6.3
Maize	3.9	1.9	0.4	6.3	6.5	18.5	4.5	7.9
Sorghum	3.9	0.6	0.1	4.7	6.5	6.2	1.4	5.9
Other crops	9.1	-	3.1	12.3	15.2	-	34.4	15.4
LIVESTOCK								
Beef cattle	3.7	-	0.1	3.8	6.1	-	1.6	4.8
Dairy breeding	3.7	-	0.1	3.8	6.1	-	1.2	4.8
Poultry	2.0	0.1	0.2	2.3	3.3	1.2	2.0	2.9
Other animals	0.5	-	0.3	0.8	0.8	-	3.3	1.0
TOTAL, CROPS AND LIVESTOCK	60.1	10.5	9.0	79.6	100	100	100	100

Source: Stads and Sène, 2010

Note: The calculations made by the authors are based on the 2008/2009 figures of the Senegalese Agricultural Research Institute - International Food Policy Research Institute (IFPRI-ISRA). Figures in parentheses indicate the number of institutions in the category. Data relating to expatriate researchers seconded to the ISRA are not included.

The data in this table show that research work in 2008 was mainly related to rice and millet. Other important products include vegetables, maize, groundnut and sorghum. Zootechnics research is centred mainly on the production of meat and milk.

However, it should be noted that most researchers of national centers are close to the retirement age of 60 years (60% at ISRA). The Government's decision to increase the subsidy to ISRA to, according Macoumba Diouf, the Director General (cited by Kouadio, 2011), enable recruiting extra ten young researchers, is therefore highly commendable.

2.2.3.1.2 Human Resources at Private Research Centres and Universities

We were able to gather data only for private agricultural and agribusiness research. In terms of human resources, a few private companies employ a fairly limited number of research staff. Table XII gives the staffing levels for private agricultural research expressed in full-time equivalent researchers (Stads and Sène, 2010).

Table XI: Staff working on Agricultural R&D in the Private Sector

Category	2001	2002	2003	2004	2005	2006	2007	2008
	Staff (full-time equivalent researchers)							
Cash crops (3)	8.1	7.7	5.8	11.6	13.5	12.8	13.5	13.4
Horticulture (3)	3.7	2.3	2.3	2.3	2.5	3.6	4.6	5.0
Agrochemicals (2)	3.3	3.8	4.3	3.8	4.5	4.5	5.3	5.3
Livestock and forage (2)	1.6	3.8	3.8	5.1	6.6	7.3	7.3	8.1
Fisheries (4)	9.9	9.9	9.9	9.0	8.1	8.6	9.5	9.5
Agricultural machinery (1)	0.9	0.9	0.9	9.0	9.0	9.0	9.0	9.0
Total (15)	27.5	28.4	27.0	32.7	36.1	37.7	41.1	42.2

Source: Stads and Sène, 2011

Note: Figures in parentheses indicate the number of companies in each category.

This table shows that, in 2008, there were 42 researchers involved in private agricultural and agribusiness research, one third employed by companies developing cash crops: sugar cane (CSS), cotton (SODEFITEX) and groundnuts (SUNEOR), 10 in fisheries science and 8 livestock breeding researchers.

2.2.3.2 Technical and Vocational Training

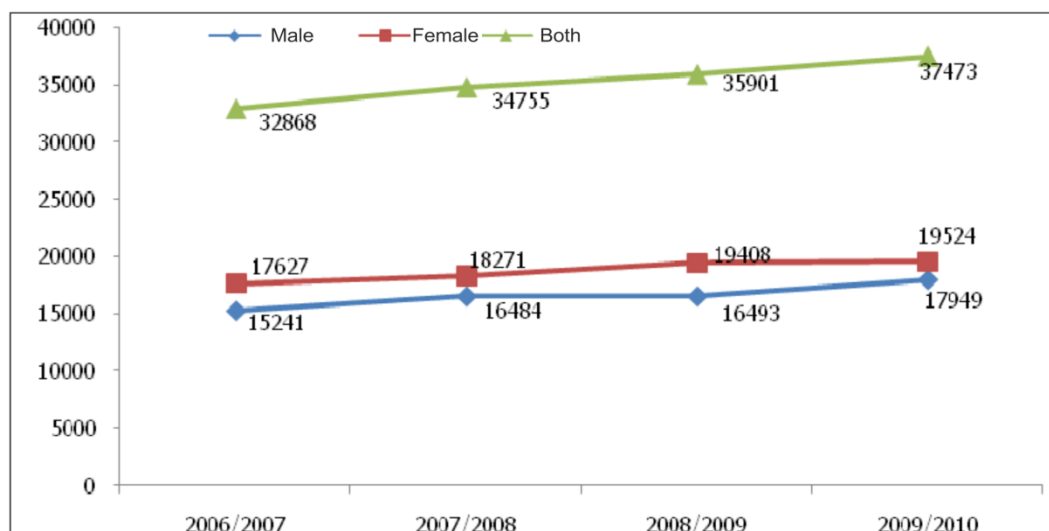
The technical and vocational training subsector (FPT) is certainly one of the most complex in the education and training sector (ANSD, 2011-c). Its facilities are the responsibility of the Technical Education and Vocational Training Ministry. In 2010, there were 213 professional training schools among which 70 public and 143 private.

The aim of the subsector is to provide technical and vocational training to meet the needs of the labour market. Therefore, the graduates of technical and vocational schools are operational and aimed at sectors of the economy.

The main categories of training at public facilities are informatics, and industrial and commercial technology. With the emergence of private facilities, the sector has seen renewed dynamism, diversifying the range of training courses available and adapting to market requirements. However, a look at the distribution of employees by sector shows that this provision of training for the primary sector is marginal compared to secondary and tertiary.

The growth in technical and vocational training is noted as indicated in Figure 15. Numbers of both male and female trainees have increased, with the majority being young girls. Moreover, the gender analysis shows a predominance of boys in the secondary sector, but an opposite trend for girls in the tertiary (ANSD, 2011-c).

Figure 15: Growth of Technical and Vocational Trainees between 2006 and 2010



Source: Statistical Directory of Technical and Vocational Training, 2010 (ANSD, 2011-c).

2.2.4 HEALTH

2.2.4.1 General Situation

Indicators for the Health sector are disappointing. Infant mortality (under one year old) was 58.94 per 1,000 in 2009, after falling between 2000 and 2006 (52.94 in 2006). Juvenile mortality of 98 per 1,000 is also increasing due to dysentery diseases, poor performance in the vaccination programme, malnutrition and malaria which is the number one cause of death, accounting for 25% of cases reported to the health service. According to the *Senegal Demographic and Health Survey (EDS 5)*, maternal mortality, at 392 deaths per 100,000 live births, is a reflection of the problems encountered in pregnancy monitoring and childbirth (ANSD, 2015). However, the implementation of the Universal health insurance policy (CMU) is expected to significantly reduce morbidity and mortality.

Malnutrition remains a public health problem and infant vaccination against the main childhood diseases remains insufficient.

Access to health services is still relatively difficult in Senegal, especially for emergency medical and obstetric services, even though the results of the *Senegal Poverty Monitoring Survey (ESPS)* show a clear increase in access rates. The mean access rate for attendance in under 15 minutes to a health service was 40% in 2002, increasing to 43% in 2005. In rural areas, this figure has increased by more than 5 points from 27.4% in 2002 to 33.5% in 2005 (MEF, 2012).

2.2.4.2 Health System Organisation

Senegal's National Health Development Programme (PNDS 2009-2018) provides the resources for getting to grips with health problems in all their dimensions, with an organisational system based on both public and private sectors.

- **Public Sector:** The health system is three-tier: operational (health district), intermediate (health region) and politico-strategic (directorates and national departments). However, it is still severely understaffed relative to health needs. To satisfy the recommendations of second National Health Development Programme (PNDS-II), Senegal has much work to do in providing health coverage, as shown in Table XII.

Table XII: Key Performance Indicators of 2010 Health Development National Programme (PNDS)

Performance indicator	PNDS Standard	Level reached in 2010	Coverage
Doctor/population ratio	1 / 15,000	1 / 15,320	98%
Nurse/population ratio	1 / 3,000	1 / 5,982	50%
SFE/FAR ratio	1 / 2,000	1 / 3,414	59%
TSS/population ratio	1 / 16,526	1 / 17,626	94%
Note: SFE: State Midwife FAR: Women of reproductive age (15-49) TSS: Senior health technician			

Source: MSP/DRH Health personnel census in Senegal – June 2009

- **Private Sector:** In addition to public health facilities, the health system in Senegal also comprises a number of private sector facilities (both profit and non-profit).

2.2.4.3 Epidemiological Profile

The epidemiological profile presents a wide spectrum, with various causes of mortality and morbidity, consisting mainly of infectious and parasitic diseases. However the number of non-transmissible diseases is rising. The predominant forms of transmissible disease are HIV/AIDS, malaria and tuberculosis.

- **HIV/AIDS:** This is a concentrated epidemic with estimated prevalence of 0.7% in the general population, one of the lowest figures in sub-Saharan Africa (Ba *et al.*, 2012).
- **Malaria:** Prevalence of malaria is falling (Ba *et al.*, 2012). :
 - Proportional malaria morbidity shows an overall downward trend, falling from 35.6% in 2001 to 22.7% in 2007.
 - Proportional mortality has fallen from 29.7% in 2001 to 18.1% in 2007.
 - The lethality rate in hospitals has fallen from 6.2% in 2006 to 3.3% in 2007.
- **Tuberculosis:** The incidence of tuberculosis is estimated at 110/1,000,000 inhabitants (WHO Report 2006, Global Tuberculosis Control). An increase in multiresistant cases, insufficient implementation of combined TB/HIV activities, low involvement of private medicine in the TB response and the poor contribution of operational research in the choice of intervention strategies in the National Anti-Tuberculosis Programme (PNT) are major problems in the fight against TB.
- **Other diseases:** There are numerous other diseases whose definitive elimination presents an enormous challenge, demanding an integrated approach. These include: i) diseases avoidable by vaccination (poliomyelitis, measles, etc.), diseases with epidemic potential (cholera, cerebrospinal meningitis, yellow fever) and neglected tropical diseases (onchocerciasis, lymphatic filariasis, trachoma, leprosy and Guinea worm), which are now being eliminated; ii) chronic non-transmissible diseases, which are increasing and costly to treat (diabetes, cancers, kidney failure, cardiovascular diseases, mental illness and dental hygiene); iii) infant and juvenile mortality which fell from 135 ‰ to 121 ‰ between 1997 and 2005 (Demographic and Health Surveys, EDS 3 and 4); however, neonatal mortality remains worryingly high (increasing from 31.4 ‰ in 1997 to 35 ‰ in 2005); and iv) maternal mortality which fell from 510/100,000 births in 1992 to 401/100,000 births in 2005.

2.2.5 HUMAN RESOURCES FROM THE DIASPORA

Valuable Senegalese scientists are at work in universities or research centers in many European, American (North and South) and Asian countries. They can and, very often, are willing to make a significant contribution to the development and conduct of specific scientific and technological training, research and popularization programs, particularly through several activities (reception of students or trainees, supervision of researchers, lectures, seminars, conferences, etc.). However, there are no specific mechanisms or strategies to identify and to involve them effectively in national STI / R&D programs of Senegal. Therefore, such arrangements should be conducted jointly between Ministries in charge of national education, higher education, vocational training, research, culture, etc., as well as with national teaching and research institutions. To that effect, among avenues to consider, are:

- Giving the Ministry of Foreign Affairs (MFA), through its diplomatic and consular missions, the special mandate to identify in their jurisdictions members of the national science and technology Diaspora, active in all steps of scientific and technological progress;
- Leveraging interagency or individual collaborative networks of National Teaching and Research Institutions (INER);
- Promoting specific collaborative programs INERs and those where there are members of the scientific and technological Senegalese Diaspora;
- Exploiting opportunities offered by UNDP TOKTEN (Transfer of Knowledge Through Expatriate Nationals) program;
- Organizing a statistical database on scientific and technological human potential of Senegal, with a special link dedicated to the Diaspora. This database should be managed by the MESR and articulated to National, regional and international research and teaching Institutions, to the Ministry of Foreign Affairs and to all diplomatic missions of Senegal abroad, as well as with those of foreign countries in Senegal; and
- Providing a multifaceted platform for interaction between the Diaspora and scientists and technologists staying in Senegal (sabbaticals, study tours, annual conference, e-mail exchanges, etc.).

2.3 PLACES

2.3.1 LOCATION OF SCIENTIFIC AND TECHNICAL POTENTIAL OF SENEGAL

The location of higher education and research institutions is mentioned in appendix 2 which shows that the disparity of the population observed in Table VII is also reflected in the distribution of Senegalese scientific and technical potential, since it is very disproportionate between these regions. Thus, the Dakar region, concentrates, by far, the largest number of institutions, mainly located in the city of Dakar. whereas the region of Tambacounda does not have any university or research institution.

Only cities of St Louis (UGB), Bambey (UADB), Thies (UT) and Ziguinchor (UZ) have public universities but, as shown in Table VII, their combined numbers, in terms of teaching-researcher staff (TRS) and administrative, technical and service staff (ATSS) are, all together, only about one third of those of UCAD, while the total number of their students is not even one sixth of the one of Dakar (Dia *et al.*,2012).

As for national research centers, their headquarters are all located in Dakar and only ISRA has some antennas inside the country, for example in Bambey, Djibelor, Kaolack, Kolda and St-Louis.

Finally, regarding public and private technical education and vocational training structures, the breakdown by regional academy shows that in 2010, there are 213 of them, including 70 public and 143 private, being respectively 33% and 67%. This situation also shows marked regional disparities, since the Dakar region alone, concentrates more than half (53%) of private facilities and more than 40% of the total, as shown in the table XIII (ANSD, 2011-c).

Table XIII : Distribution of Technical Education and Vocational Training Structures
(according to the status and region)

Region	Private	Public	Global
Dakar	76	16	92
Diourbel	4	4	8
Fatick	1	6	7
Kafrine	0	2	2
Kaolack	8	3	11
Kédougou	0	3	3
Kolda	1	3	4
Louga	3	3	6
Matam	0	3	3
Sédhiou	0	1	1
St-louis	7	7	14
Tamba	1	2	3
Thiès	32	7	39
Ziguinchor	10	10	20
SENEGAL	143	70	213

Source: Statistical Yearbook (School) National, 2010 (ANSD, 2011-c)

Furthermore, the vocational and technical training (VTT) structures are very unevenly distributed between rural and urban areas, with a high concentration in urban areas (208), at the expense of rural areas (5), of the 213 structures in the country, that is to say respectively 98% and only 2%(ANSD, 2011).

2.3.2 HIGHER EDUCATION AND RESEARCH INSTITUTIONS

2.3.2.1 Universities

The Higher Education subsector in Senegal has undergone marked changes over the last decade (2000-2009), with public universities increasing from 2 to 5 in 2009 and private universities from 31 to 112. The total number of universities in Senegal stood at 117 in 2009.

It is worth noting that the proportion of girls in secondary education is increasing (41.6% in 2009). Despite *baccalauréat* pass rates of 38.4% in 2010-2011, the annual flow of graduates is constantly increasing, with the number of candidates rising from some 9,000 in 2000 to nearly 30,000 in 2011.

2.3.2.1.1 Public Universities

The number of public universities has been increased and diversified with the implementation of the 10-Year Education and Training Programme (PDEF), covering the period from 2001-2010, to relieve congestion in UCAD whose capacity is more than saturated and to regionalize supply

and capacity of Higher Education in Senegal. In this regard, considerable efforts have been made, in particular to consolidate the achievements of the UCAD and UGB, as well as providing the new universities with their own infrastructure. However, there is still a deficit which means that some educational establishments hire furniture and relocate educational activities. Table XIV gives some idea of the configuration of this infrastructure within the various public universities (Dia *et al.*, 2012).

Table XIV: Educational Infrastructure

Universities	Lecture theatres	Practical/Theory Classrooms	Computer Rooms	Conference Rooms	Libraries	Media Libraries
UCAD	45	302	15	20	22	1
UGB	7	49	2		2	
UTH		45	7		3	
UDZ	1	35		1	1	
UADB	4	18	7			
Thiès Polytechnic	2	29	2		1	

In this respect, we must note the particular case of UCAD, initially planned to accommodate 15,000 students but currently is attended by over 70,000. Therefore, it is experiencing a series of deep crises since the 1980s. Since 2009, the majority of public universities have switched over to the D-M-Dr system (Degree- Master’s-Doctorate) and have integrated ICT into their teaching and research curricula.

In 2010, the Ministry responsible for Higher Education, supported by the World Bank, drafted a Higher Education Strategy Document placing emphasis on quality assurance, among other things. In 2011, the Ministry also set up a General Directorate for Higher Education (DGES) in order to achieve better governance of this subsector in Senegal.

Let us remind also the recent development by the MoHER of a higher education and research development strategy (2013-2022) and a higher education and research development plan (2013-2017). Besides, The National Quality Assurance Authority in Higher Education (ANAQ-Sup) was created by decree 2012-837 dated August 7, 2012, and placed under the administrative and technical supervision of the Higher Education and Research Ministry (MoHER). It is responsible for the control, guarantee and improvement of the quality of curricula and higher education institutions.

It is worth mentioning the creation in 2012 of Senegal Virtual University (SVU), already operational since the Academic Year 2013-2014 and of two other universities: the 2nd University of Dakar and the University of Sine Saloum in Kaolack (USSK) which will be operational in 2016. Finally, let us mention that the creation of an Arab-Islamic University is planned, as part of Higher Education reform, resulting from the National Consultation on the Future of Higher Education implemented by the MoHER.

2.3.2.1.2 Private Universities

Private Higher Education is increasingly developing and helping expand the network. The rationalisation of the inflow into the public universities has favoured the creation of several private higher education institutions, offering training programmes in a variety of specialised fields.

The private sector has therefore seen rapid growth over the last decade, but its facilities are almost all located in the capital and mainly specialized in areas leading to career openings such

as law, management, information technology, communications, marketing and trade. Some are mentioned below, for the record:

- Suffolk University, Dakar (www.suffolk.edu)
- AFI-UE Group, Business University (www.afi.sn)
- University of Dakar Bourguiba – UDB (www.refer.sn/isjapb)
- University of the SAHEL-UNIS (<http://unis.sn>)
- Amadou Hampâté Bâ University (UAHB)
- University Foundation and Management College (www.ufmcollege.sn)
- Catholic University of West Africa (UCAO)

2.3.2.1.3 Francophone University Agency

The Francophone University Agency (AUF) encourages university partnerships in order to promote Higher Education and Research in countries whose official language is also French. The AUF develops support programmes for the universities (particularly those in the southern hemisphere) based on three principles:

- Institutional consolidation;
- Scientific and university mobility; and
- Support for associative networks and structures.

Senegal is benefitting from numerous concrete AUF initiatives, including an important virtual campus (e-learning, teleconferencing,) and several mobility grants for students and research lecturers.

2.3.2.2 High Schools

2.3.2.2.1 Subregional and Public Colleges

- **Higher Polytechnic School (ESP):** One of the main missions of the Higher Polytechnic School (ESP < www.esp.sn >) is to train senior technicians (DUT degree), technology engineers (DIT degree), design engineers (DIC degree) and business managers.
- **Thiès Agricultural College (ENSA):** Since 2006, ENSA (< <http://www.ensa.sn> >) has been the agronomic hub of the University of Thiès, with the aim of training generalist engineers in the agricultural sciences and livestock breeding. Over a period of more than three decades, ENSA has trained over 500 engineer agronomists of various nationalities: Senegalese, Gabonese, Congolese, Chadian, Central African, Burundian, Malian, Moroccan, etc.
- **Other-High Schools:** There are nine (9) national colleges contributing to the public higher education services offered in Senegal:
 - National Administration School (ENA)
 - National School of Applied Economics (ENEA)
 - Thiès Polytechnic School (EPT)
 - National Police School)
 - Judicial Training Centre (CFJ)
 - National School of Social Workers and Specialist Workers (ENTSS)
 - National Maritime Training School College (ENFM)
 - National Health and Social Development College) (ENDSS)
 - National College of Arts (ENA).

These are complemented by three (3) regional high schools:

- Inter-State College of Science and Veterinary Medicine (*EISMV*)
- Advanced Multinational School of Telecommunications (*ESMT*)
- African Centre for Advanced Management Studies (*CESAG*).

One has also to note the recent creation in Senegal of the African Institute of Mathematical Sciences (AIMS), located in Mbour and which has a partnership agreement with the ANSTS.

2.3.2.2.2 Private Colleges

In Senegal, there are many approved private colleges providing advanced training. They fall into three categories: Higher Education Institutions, Major Colleges and Private Religious Colleges. The majority offer a very wide range of courses: Management, Commerce, Informatics, Law, Hotels & Catering and Tourism. We will focus only on the Dakar Advanced College of Commerce (Sup de Co), the African Institute of Management (IAM) and the Higher Institute of Management (ISM).

- **Dakar Advanced College of Commerce (Sup de Co):** The Dakar Advanced College of Commerce, founded in 1993, has as its main aim to train high-level managers with proven expertise in all aspects of management and ICT. Its reputation and influence mean that it receives students of over 25 different nationalities.
- **African Institute of Management (IAM):** Founded in 1996, the African Institute of Management (IAM <www.iam.sn>) is a regional college based in Dakar. It offers programmes for satisfying a wide variety of needs: regular students, qualified management personnel and business directors. Of the students attending the IAM, 35% are from abroad.
- **Higher Institute of Management (ISM):** Founded in 1992, the Higher Institute of Management (ISM <www.ism-dakar.com>) offers second cycle training in various specialities, leading to a specialised master's degree (e.g. Specialised Advanced Studies Degree - DESS). The ISM has trained over 5,000 African managers and is currently attended by some 2,000 students from 30 different countries in Africa and Europe.

2.3.2.3 Federative Structures: Doctoral Schools

Doctoral Schools are attended by research lecturers, researchers, research teams and research laboratory staff and conduct projects on training, research and expertise. The projects are multidisciplinary, supported by fairly broadly-based, high-quality teams and of an inter-institutional nature, based on a consistent scientific and teaching policy aimed at preparing future PhDs to take on their professional activities. UCAD has set up 7 Doctoral Schools, as follows:

- Water Quality and Uses;
- Life, Health and Environmental Sciences;
- Chemistry, Physics, Earth, Universe and Engineering Sciences;
- Mathematics and Informatics;
- Arts, Culture and Civilisations;
- Man and Society; and
- Legal, Political, Economic and Management sciences.

2.3.3 OTHER RESEARCH CENTRES

2.3.3.1 National Research Centres

We will report in particular on agricultural and agro-industrial research centres, health research centres, especially hospitals under the auspices of the Health Ministry, social and human sciences research centres and centres working in other disciplines.

2.3.3.1.1 Agricultural and Agro-industrial Research Centres

Agricultural and agro-industrial research benefits from a long-established network formed by the Senegalese Agricultural Research Institute (ISRA) and the Food Technology Institute (ITA), as well as the more recent National Soil Institute (INP).

- **Senegalese Institute for Agricultural Research (ISRA):** Research conducted by the ISRA is generally divided into major research fields based on the following themes: plant production, animal production, forestry production, fisheries production and rural socioeconomic issues. The ISRA is keeping pace with efforts to modernise agriculture, especially through its ISRA Production section, whose mission is to:
 - Add value to the results of research on products useful in the production process;
 - Help to provide rural areas with quality production factors (seeds, plants, vaccines, etc.); and
 - Help agricultural operators and investors by conducting studies and providing advice.
- **Institute of Food Technology (ITA):** The ITA implements an R&D strategy based on annual action plans, focused on identifying and satisfying the real needs of operators in the agribusiness sector. The strategy is based on a diagnosis involving the potential user before the research is begun. It is aimed at achieving the objective defined in the strategic plan, based on the broad guidelines of national policy on rural and industrial development. ITA research achievements are transferred through training or incubation. To that effect, the institute avails its premises, expertise and equipments, for a given period of time to any operator wishing to test his products and market, whilst helping in quality management.
- **National Soil Institute (INP):** Like the Senegalese Agricultural Research Institute and the Food Technology Institute, the National Soil Institute is a public scientific and technological institution set up as recently as 2004. Its research activities are centred on:
 - i) action research, considered as a variant of research & development for a sustainable land management (GDT), and
 - ii) strategic research to update and improve repositories on soil-resource designed on real laboratory conditions.

2.3.3.1.2 Health Research: Faculty of Medicine, Pharmacy and Dentistry

As the main national public institution conducting research on human health, the Faculty of Medicine and Pharmacy was founded in 1957 as the successor to the African School of Medicine (1915) and the African School of Medicine and Pharmacy. Its mission is to train doctors, pharmacists and dental surgeons and it is staffed by over 338 research lecturers, including 76 full professors and 56 associate professors. It incorporates the Life Sciences and Health Doctoral School and numerous institutes.

The Faculty publishes a 3-monthly scientific review (DAKAR MEDICAL) and a 3-monthly electronic newsletter, and annually produces over 150 doctoral theses in medicine, pharmacy and dental surgery. Its research lecturers publish significant numbers of papers in international journals every year.

The results of this research, especially on HIV, malaria, tuberculosis, malnutrition, the environment and health and plant-based medications, are also covered by patents and receive both national and international awards. The Faculty has received three Science *Grand Prix* Awards from the President of the Republic. Activities for disseminating research results are organised regularly through Health Days held every three years, Annual *Département* Days, conferences and forums open to the public.

The Faculty has a dense partnership network, collaborating nationwide with the Health Ministry, the Pasteur Institute, the Development Research Institute (IRD), the Senegalese Agricultural Research Institute (ISRA), regional Training and Research Units (UFR), hospitals, and health training colleges. On an international scale, collaborative projects have been undertaken with universities in Africa, Canada, USA, France, Switzerland and Belgium. The Faculty is a member of the International Conference of Deans of Francophone Medical Schools (CIDMEF), currently holding the presidency of this institution. At the African level, in addition to its prominent role in qualification juries of CAMES, the Faculty is a key participant in the Regional Committee for Specialised Training of the West African Health Organisation responsible for harmonising the training curricula for Specialist Degrees in Medicine and it was the first accredited Faculty for specialised training (neurology, ENT, and clinical biology).

For the future, the Faculty is developing strategies for establishing national degrees (to combat the brain drain), opening new regional Medical Training and Research Units (Thiès, Saint-Louis, Ziguinchor), boosting human resources at regional hospitals and opening regional health research institutes.

2.3.3.1.3 Social and Human Sciences Research Centres

- **Economic and Social Research Consortium (CRES):** CRES, founded in 2004, aims to satisfy African market needs in terms of national policies and programmes. It is chiefly concerned with poverty, inequality, economic growth, rural areas, education, health, regional integration, and the information and innovation economy. Its research programmes cover a number of themes, including the digital application of global banking to education; a study of the volume of investments necessary to achieve the 6% annual growth rate stipulated by the African Union in the PDDA (Detailed Programme for Agricultural Development in Africa); miscellaneous studies on the impact of the Return to Agriculture (REVA) plan; a review of public expenditures; evaluation of the PNDL (National Programme for Local Development); profitability of Higher Education over the 10 years of the PDEF (Education and Training Development Plan); taxation of tobacco; studies on poverty; etc. CRES is also conducting research of a regional nature on Economic Partnership Agreements (APE); support for ECOWAS in preparing a Community Development Programme; analysis of the macroeconomic framework of ECOWAS and the drafting of a regional research policy. CRES works in partnership with various agencies, research centres, universities, communities and specialised organisations, both nationally and internationally. Scientific production over the past five years has been very considerable.

- **Research Facilities of the Ministry of Economics and Finance:** To implement the country's global economic policy, the Ministry of Economics and Finance has set up a number of study and research bodies, including the ANSD, CEPOD, DGP, DPEE and UCSPE.

ANSD: Law ° 2004/21 of 21 July 2004, relating to the organisation of statistics activities, set up the National Statistics and Demographics Agency (ANSD) with the National Statistics Council (CNS) and the Technical Committee on Statistics Programmes (CTPS). It is responsible for the technical coordination of the activities of the national statistics system, regularly and continuously producing and disseminating quality statistical data in compliance with international standards to meet the needs of the government, public administrations, the private sector, development partnerships and the general public. ANSD statistics are circulated mainly in regular publications (monthly, 3-monthly and annual), survey reports, censuses and studies, and stored in dedicated databases. In addition, ANSD has a vast collaboration network and numerous agreements with various national and international bodies.

- **CEPOD:** The Development Policy Studies Centre was set up by order of the Ministry of Economics and Finance and its missions are to conduct research and implement initiatives to improve public policy and to boost capacity in both public and private sectors through training and technical assistance. Recognized by an honorary award from the World Bank Institute, CEPOD's staff is hired on renewable contractual basis and composed of socio-economist experts and sociologists. Recruitment of geographers is also envisaged. In terms of scientific production, apart from short technical communications and the three-monthly newsletter, CEPOD has produced numerous studies to provide a basis for decisions and legislation, such as the small and medium-sized business framework law, the public/private partnership law and the accelerated growth strategy. Furthermore, the Investment Promotion Agency (APIX), the Small and Medium-Sized Business Development Agency (ADPME) and the Senegalese Agency for the Promotion of Exports (ASEPEX) were all created following a CEPOD study on development in the private sector. Similarly, the setting up of the Senegalese Standards Institute (ISN) was implemented after a study in order to encourage the involvement of professionals. CEPOD has varied partnerships with CREA, UGB, the private sector, ECOWAS and the World Bank Institute.
- **DGP:** The General Directorate for the Plan is involved in government decision-making and drafted the Prospective Study and Economic and Social Development Framework Plan (PODES). It also framed sectoral policy documents covering all sectors, including Science and Technology, detailing focal points, and prepared the frameworks for medium-term sectoral expenditure, with the support of planning departments. It is good to see that the STI sector has now achieved priority status and as such is among the strategic fundamentals of the 11th Plan, based on development prospects and priorities. Furthermore, the national thematic commissions responsible for making planning proposals (diagnosis and strategy definitions) now include a commission dedicated to STI.
- **DPEE:** The objectives of the Forecasting and Economic Studies Directorate (www.dpee.sn) are to conduct research and implement initiatives for advising decision-makers based on an essentially quantitative approach involving econometric modelling; to provide information on situational developments and structural changes underway in

the economy; and to organise forums for presenting research results, involving users in the process of defining research parameters.

It has signed a number of partnership agreements with economics research centres in Senegal (CREA, CRES), international bodies for disseminating research and the IMF.

- **UCSPE:** The Economic Policy Coordination and Monitoring Unit is a department of the Ministry of Economics and Finance. It has replaced the Monitoring and Coordination Unit for Programmes to Combat Poverty, which drafted poverty reduction strategy documents (DSRP I and II), superseded by the Economic and Social Policy Document (DPES).

2.3.3.1.4 Research in Other Sectors

Research in other sectors, such as energy, water, mines and the environment, is also being carried out by specialised institutions.

- **Energy Sector Research:** The specialised institution for the energy sector is the Renewable Energy Study and Research Centre (CERER), set up in 1980 as an institute of the UCAD. In addition to studying meteorological phenomena (atmospheric radiation and rainfall monitoring), its research activities relate to the development of processes for using solar power and all other energy sources derived from weather phenomena. Taking into account national realities and priorities in energy and environment, CERER has mainly focused its activities on: i) photothermal and thermodynamic; ii) photovoltaic conversion; iii) wind power, iv) biomass recycling and v) natural ways of treating wastewater.
- **Water Sector Research:** In 2005, the government of Senegal implemented the **Millennium Drinking Water and Sanitation Programme (PEPAM)** (www.pepam.gouv.sn/index.php) whose Coordination Unit is in charge of coordinating activities of other implementing agencies, interventions of PEPAM fund backers and ensuring that the monitoring and evaluation system runs smoothly. PEPAM is a unified framework of interventions for achieving Millennium Development Goals in the area of drinking water and sanitation in urban and rural areas by 2015.
- **Mining Sector Research:** Until recently, mining was restricted to phosphates, industrial limestone and attapulgite. However, mining activities are being diversified to encompass the exploration and exploitation of gold, iron ore and uranium in the southeast of Senegal, and the development of zircon and titanium on the slope of Senegal's Great Sedimentary Basin. The government of Senegal has been implementing the Mining Sector Development Programme (PASMI) since 2007 within the framework of a technical cooperation agreement with the European Union (9th EDF), with the aim of conducting an aerial topographical survey of the southeast of Senegal, building a national mineral database, geologically mapping the sedimentary basin and eastern Senegal, and supporting traditional gold panning. Geological research and mining teams from Dakar UCAD are conducting field and laboratory work within an educational framework for qualifying PhDs, geological engineers and senior technicians based on a multiform partnership. Research work currently under way has identified new reserves of copper, chromium, nickel and platinum.

- **Environment Sector Research:** The Ecological Monitoring Centre (CSE) is a privately-funded public utility under the auspices of the Minister of the Environment and Nature Conservation. It is a centre of excellence using geomatics in the service of the environment for sustainable management of natural resources, and in particular for gathering, acquiring, processing, analysing and disseminating data and information concerning natural resources in Senegal using geospatial technologies. CSE monitors crop production and changes in pastoral ecosystems, and forecasts yields using satellite images or radar. It actively participates in studies designed to implement United Nations conventions on the environment (desertification, biodiversity, climate change, humid zones).

2.3.3.2 Regional and International Research Centres

Senegal is home to numerous research institutions that operate on a subregional, regional or international basis. They are usually covered by a *Headquarters Agreement* to ensure that their operations run smoothly.

2.3.3.2.1 Technological Research: Founded in 1977, the African Regional Centre for Technology (ARCT) has 31 member countries, located in all five sub regions of the continent. Its principal mandate is to promote technological development in Africa. To this end, it supports the interrelationships between Science, Technology and Innovation and actively participates, through its various programs, in the promotion of an effective partnerships and cooperation among African institutions and experts.

It also aims to strengthen communication between the public authorities, professional producers and the scientific and technological community. Within this framework, ARCT actively collaborates with Senegalese institutions. The ARCT's main training and equipment programmes relate for the most part to agro-food, new and renewable energy sources (biogas), environment and ICT sectors.

2.3.3.2.2 Agricultural and Agro-industrial Research

- **Africa Rice:** The **West Africa Rice Development Association (WARDA)**, founded in 1971, was replaced by the Africa Rice Centre in 2009. It is a research centre of the Consultative Group on International Agricultural Research (GCRAI/CGIAR). It is also an intergovernmental research association backed by African member countries. Its mission is to help reduce poverty and improve food security in Africa through activities involving research, development work and partnerships to increase productivity and profitability in the rice sector, whilst at the same time ensuring the sustainability of the production environment
- **International Food Policy Research Institute (IFPRI):** The IFPRI, founded in 1975, is one of 15 research centres funded mainly by governments, private foundations and international and regional organisations, the majority of which belong to the GCRAI/CGIAR. The IFPRI is headquartered in Washington DC and has just opened, in 2012, a West Africa subregional office in Dakar. Its job is to identify and examine policies to satisfy food needs in developing countries in order to advise and support decision-makers, NGOs and civil society.
- **Inter-State School of Veterinary Science and Medicine (EISMV):** The EISMV was founded in Ndjaména (Chad) in January 1971 by the Conference of the Heads of State and Government of OCAM (African and Malagasy Union), and has an office in Dakar. Over

the forty years of its existence, it has trained more than 1000 Veterinary Surgeons from West Africa, Central Africa, Madagascar and France. The EISMV promotes international cooperation and currently has 14 member countries: Benin, Burkina Faso, Cameroon, Central African Republic, Congo, Côte d'Ivoire, Gabon, Mali, Mauritania, Niger, Rwanda, Senegal, Chad and Togo. The EISMV has a dual vocation: veterinary higher education (animal health and productivity, animal conservation and exploitation, zootechnics, hygiene, surgery, fisheries products, etc.) and research (helping promote economic growth, poverty reduction and food security in towns and villages). Research projects are related to aviculture, dairy stock breeding and production, and food quality and security. The EISMV is equipped with a Livestock Skills Observatory (OME) and a very dense partnership and cooperation network with a wide range of partners.

- **Centre for International Cooperation on Agronomic Research for Development (CIRAD):** CIRAD is a French institute for agronomics research and training (agronomic and veterinary sciences, forestry and agribusiness) and sustainable development, serving countries in the southern hemisphere and overseas French territories. Its activities cover the long-term ecological, economic and social impacts and the transformation processes taking place in the societies and nations of the southern hemisphere. CIRAD conducts mainly collaborative, multidisciplinary and multi-institutional research. In Senegal, its activities are governed by the cooperation agreements of 14 January 1974 between France and Senegal. CIRAD researchers are active in Senegal's national research institutions (ISRA, ITA, CERAAS), Universities and Colleges (UCAD, UGB, ENEA, ESP, ENSA,), vocational organisations (ASPRODEB, CNCR), local communities and NGOs (ANCAR, etc.).
- **Development Research Institute (IRD):** The IRD is also a French organisation, unique in the European development research community. Its research, training and innovation activities are aimed at contributing to social, economic and cultural development in southern hemisphere countries. The IRD's representation in Senegal is currently its largest undertaking abroad in terms of programmes, staffing and budget. Its skills are used in five West African regions: Cape Verde, Gambia, Guinea-Bissau, Guinea and Mauritania. IRD personnel are welcomed as expatriates in Senegal and on short-duration missions in other countries in which they work.

2.3.3.2.3 Health Research

- **IRD (continuation):** As in agriculture, the IRD has a strong presence in food security and health policy. In partnership with their counterparts in the southern hemisphere, the IRD works on monitoring, designing high-performance diagnostic tools, and treating/eradicating certain pathologies. There are currently six IRD research units working in Senegal: Population and development centre (CEPED), Emerging infectious and tropical diseases research unit (URMITE), Malnutrition and associated pathology prevention unit (NUTRIPASS), Local heritage (PaLoc), Mother and child tropical infections unit, Epidemiological transitions, and translational research on HIV and infectious diseases (Trans VIHMI).
- **Dakar Pasteur Institute (IPD):** The IPD, founded in 1924 as an affiliate of the Paris Pasteur Institution, became a foundation under Senegalese law in September 2009. It is a part of the International Network of Pasteur Institutes, with 32 institutes throughout the world, united in carrying out the same mission (to help prevent and fight against

infectious diseases through research, public health initiatives and training), based on a common culture and shared values (www.pasteur-international.org). Its aim is to help promote public health in Africa, especially in Senegal, through research, teaching, training and medical, epidemiological and biological expertise, as well as working on the production of an anti-malaria vaccine. Research is the fulcrum of IPD activities and its current research programmes relate to malaria, arboviral infections and viral haemorrhagic fevers, respiratory, enteric and neurological viral infections and bacterial enteric infections. Research topics include pathogen maintenance and emergence mechanisms, pathogen resistance to anti-infection agents, and strategies for monitoring and preventing infections based on a multidisciplinary approach integrating microbiology, entomology, epidemiology, immunology and genomics. These activities are conducted in units, laboratories and field stations equipped for basic, operational and public health research. In terms of scientific production, between 2007 and 2011 the IPD published over 100 papers in reputable journals such as *Lancet Infect Dis*, *Clin Microbiol Infect*, *PLoS One*, *J Vec Ecology*, *Microbiology Research*, *Ann Trop Med Parasitol*, *J Immunol Methods*, *Epidemiology*, *Emerg Infect Dis*, *J Virol*, *Malaria J*, *European Journal of scientific research*, *Trop Med in Health, Science*, *Am J Trop Med Hyg*, *Nature*, *Ann Biol Clin*, *Virology*, etc.

- **Promotion of Traditional Medicines (PROMETRA):** PROMETRA is an international NGO based in Dakar under a headquarters agreement. Its overall objective is to promote traditional medicines and establish links between cultures throughout the world. Research is centre stage at PROMETRA which specifically aims to lay down the factual foundation of a little known science, so that African practices can be better rationalized. Thus, PROMETRA endeavors to develop endogenous sciences as well as close collaboration between traditional and modern medicines. PROMETRA has facilities in 26 countries throughout the world, with 16 in Africa, and has a Traditional Medicine Experimental Centre in Fatick, with six healer treatment units, a well-equipped analysis laboratory, a medicinal plant pharmacy, radiography room, ten hospitalisation units and sixty hectares of botanical gardens. PROMETRA has also set up the MALANGO Association with over 550 healers. Its staff have multiform, multidisciplinary skills in various fields: administration, research, human relations, agronomics, health, management, marketing, etc. Research priorities include HIV (research on an African solution to the pandemic), family planning, malaria, hepatitis, dysentery diseases, malnutrition and sociological and anthropological studies on healers. Research results are available at www.prometra.org. PROMETRA holds 17 research patents on products to combat diabetes, HIV-AIDS, haemorrhoids, etc. It has also conducted a number of surveys targeting healers, health personnel and populations to assess the place of traditional medicines and the involvement of healers. In future, PROMETRA envisages developing its various patents.

2.3.3.2.4 Environmental Research: CERES/LOCUSTOX

The Ecotoxicological and Environmental Safety Research Centre for Sahel (CERES-LOCUSTOX) was born out of the “LOCUSTOX Project” run under the auspices of the FAO from 1990 to 2003 with funding from the Netherlands and Senegal’s Government and relating to “A Study of the environmental effects of using chemicals to combat locusts”.

Other founder members of CERES/LOCUSTOX, apart from the Senegalese government, include the Council of NGOs in Support of Development (CONGAD) and ENDA Third World. CERES-LOCUSTOX is a centre of expertise with experienced staff working for the environment in compliance with the benchmark practices of the OECD laboratory and ISO/IEC 17025.

2.3.3.2.5 Social and Human Sciences Research

- **Council for African Social Sciences Research Development (CODESRIA):** CODESRIA is a pan-African research institution based in Dakar and set up in 1973 by African researchers. It is an international scientific NGO with the objectives of: i) creating a forum for ideas and interchanges among African intellectuals of various disciplines, also open to other researchers working in Africa with a view to conducting comparative studies in the Third World; ii) creating an independent scientific community capable of interpreting African social realities; iii) contributing to the debate on global issues; and iv) working for progress in African societies. CODESRIA has published 12 scientific reviews and nearly 70 books, as well as policy notes (abstracts of books and research results), and also organises seminars. The scope of its work covers climate change, environment and natural resources management, conflicts, young people, children, gender, economic policy, poverty, culture, regional integration, cooperation with emerging countries, etc.
- **African Institute for Economic Development and Planning (IDEP):** IDEP (www.unidep.org) was founded in 1962 by the United Nations General Assembly within the United Nations Economic Commission for Africa (UNECA), and is charged with working on economic and development planning. It has 54 African member countries. Its main objectives are to monitor and assist African countries in strengthening capacity in human resources, initiating dialogue and policy research, and advising governments on request. IDEP works on institutional and cooperative research programmes. It also handles some individual research conducted by IDEP staff and visiting or associate researchers. Priority research fields are, among others, as follows: development planning (challenges and opportunities); regional cooperation and integration; science, technology and intellectual property; public sector reform, governance and development; macroeconomic and sectoral modelling; and human resources development and use.
- **West African Research Centre (WARC):** WARC was founded on the initiative of African and American university professors. It specialises mainly in the social and human sciences. Its programmes cover travel grants (3 to 4 grants per semester) to doctoral students conducting research in Africa, a project on museums with the University of Michigan, a project on peace initiatives in West Africa and incentives for young entrepreneurs. WARC publishes a newsletter and has a library open to students, as well as research facilities (for instance, WARC is the umbrella for the Social Policy Research Centre - CREPOS).

2.3.4 OTHER TECHNICAL INSTITUTIONS FOR INNOVATION AND ADDING VALUE TO RESEARCH

Senegal does not have a national innovation system as such, coordinated and run on a synergistic basis. However, a number of specialised technical institutions are in a position to

contribute to such a system. In addition to ANRSA and ADIE (see above), this is the case with the Senegal National Science and Technology Academy (ANSTS), Posts and Telecommunications Regulatory Agency (ARTP), Senegalese Standards Association (ASN) and the Senegalese Industrial Property and Technological Innovation Agency (ASPIT).

In addition, the National Applied Scientific Research Agency (ANRSA) and the Senegalese Agency for Technological Innovation (ASIT), are two Senegalese institutions for promoting applied research, adding value to research results and promoting technological innovation.

2.3.4.1 Post and Telecommunications Regulatory Agency (ARTP)

The ARTP is an independent regulatory body set up under law No 2006-15 of 4 January 2006, with responsibility for the postal sector and the powers of the Telecommunications Regulation Agency (ART) set up under law No 2001-15 of 27 December 2001, relating to the telecommunications code.

The overall mission of the ARTP in regulating posts and telecommunications is to ensure healthy and fair competition to the benefit of consumers, sector operators and the economy in general. It has a general, legal and regulatory brief, covering administrative, technical and economic issues, and has investigative, monitoring and sanctioning powers.

2.3.4.2 Senegalese Standards Association (ASN)

The ASN took its present form on 19 July 2002. Its mission consists of preparing national standards and providing information and raising awareness, as well as providing training in tools applicable to quality, methods and procedures for use in production industries with a view to helping define a quality policy for goods, services and life; ensuring that quality is promoted by economic agents for customers on the domestic and international markets by putting in place a communications system based on organised documentation/information and the creation of computerised databases, and allowing for promotional products; and setting up a system for certifying conformity (products and quality systems). To date, 246 standards have been drafted and adopted in numerous fields.

The ASN is a founder member of the African Regional Standards Organisation (ORAN) based in Nairobi (Kenya), and a member of the International Electrotechnical Commission (IEC) Affiliated Country Programme. It is also a corresponding member of the International Standards Organisation (ISO) and is therefore kept informed of all standardisation work of interest to Senegal.

2.3.4.3 Senegalese Agency for Industrial Property and Technological Innovation (ASPIT)

ASPIT was formed by merging the Industrial Property Department (SPI), responsible for liaising with the African Industrial Property Organisation (OAPI), and the Senegalese Agency for Technological Innovation (ASIT), set up in 2001. This merger satisfied the need for consistency and synergy between the two independent bodies in order to establish industrial property and technological innovation as driving forces in the development process.

As the national liaison office for the OAPI, ASPIT translates the major objectives of this organisation into national initiatives on intellectual property, especially for issuing certification safeguarding industrial property rights.

ASPIT organises the Senegal President's *Grand Prix* Award for the Promotion of Inventiveness and Technological Innovation (GPPRIIT), and its other missions include promoting inventiveness and technological innovation, protecting innovations and adding value to the products and results of research.

2.3.4.4 Senegalese Office for Copyright (BSDA)

The BSDA is a public body with a professional vocation. It protects legal rights to private intellectual property and supports authors and creators of literary and artistic works (dramatic, musical, audiovisual, visual, etc.) that are exploited economically.

It has therefore developed an important communications strategy aimed at raising awareness among users of the obligation to pay royalties, stimulating discussion and advertising on TV, organising seminars and promoting communication via its website. It also publishes various documents, such as a booklet giving a few useful definitions relating to copyright and the copyright process, details of the Private Investment Promotion Project (PIIP) and information on the Music Industry Support Programme (PAIM).

2.3.4.5 National Scientific and Technical Documentation Centre (CNDST)

The CNDST was set up in 1977 to coordinate national policy on scientific and technical information and satisfy research requirements (documentation is needed both upstream and downstream of the research process). The documentation centre reports to the Research Ministry and has the status of a national directorate.

Its programs aim to: **i)** diversify targets users of scientific and technical information (STI); and **ii)** manage the interface between producers and consumers of STI, with four targets: scientific community, state, population and industry.

2.3.5 STRUCTURES FOR THE PROMOTION OF SCIENCE TECHNOLOGY AND INNOVATION (STI)

2.3.5.1 National Academy of Sciences and Techniques of Senegal (ANSTS)

Senegal National Science and Technology Academy (ANSTS), founded in November 1999 to promote scientific excellence, is designed as a company whose mission is to provide consultancy, assistance, advice and scientific expertise. It runs programmes based on its strategic plan, with major themes related to Science, Technology and Society; Innovation and Scientific and Technological Development; Scientific and Technological Cooperation and Integration; Teaching Science and Technology; and Information and Communications Technologies.

Through its numerous publications and the organisation of a number of activities (day sessions, seminars, conferences, forums, etc.), ANSTS has invested heavily in researching scientific and technical solutions to various economic and social, national and subregional problems, such as flooding in Saint-Louis and the threat of locust infestation. It has also carried out a lot of work on expanding, intensifying and diversifying its institutional cooperation framework, especially with sister academies, and in particular within the ASADI (African Science Academy Development Initiative), NASAC (Network of African Science Academies), NASIC (Network of Science Academies in Islamic Countries-OIC), IAP (InterAcademy Panel), etc.

ANSTS has therefore established its reputation and has been entrusted with the organisation of important government activities, such as the *Grand Prix* Science Award of the President of the Republic (GPPRS) and Africa's Scientific Renaissance Day (JRSA).

2.3.4.2 Senegalese Association for the Promotion of Inventions and Innovations (ASPI)

The Senegalese Association for the Promotion of Inventions and Innovations (ASPI) is created, Feb. 8, 1986. It has forty members and aims to encourage and promote inventions and technological innovations, while ensuring the interests of inventors and innovators of the country. The ASPI is a member of the International Federation of Inventors' Associations and is responsible for driving the creation of the African Federation of inventors Associations.

2.4 BUSINESS

Scientific knowledge and its proper use are essential for economic performance and competitiveness (Kane, 2009). Therefore, having opted for the new technology policy set forth in the Industrial Deployment Policy document (PRI) and embraced scientific and technological education and training, Senegal has made economic development the ultimate objective of R&D activities. Accordingly, the government places business at the centre of its strategic applied research. It is, therefore, to promote technology transfer and partnership among universities / other research centers / business through the process of generation / dissemination / exploitation of knowledge and know-how.

In addition, the interaction with the regional authorities, like those of governorates representing the Government and coordinating the work of ministries regional offices, can help to identify specific research needs. However, this is not so much the case today.

2.4.1 ADDING VALUE TO RESEARCH RESULTS

2.4.1.1 Nature and Modes of Expression

Adding value to an outcome of a research can be expressed in many forms: publication, patents, trademarks, industrial design, copyright, communication, teaching material, posters, etc. It must be integrated into the overall framework of the technology innovation process which, together with the role of public power and funding agencies, is highly dependent on:

- technological opportunity, associated with the capability of R&D systems to generate "Technological Packages";
- structure of the industrial and manufacturing sector, that has to take hold of these packages and transform them into goods or services; and
- scale and structure of demand on the markets (national, regional or international) that have to absorb these goods and services.

Among the proponents of these different levels must be built real "bridges", establishing a permanent flow of information exchange, strategic and constructive dialogues and interactions, in order to stimulate a real dynamics of partnership and synergy, to ensure optimal use of research results (Kane, 2009).

2.4.1.2 Stakes and Challenges

Beyond the difficulty in defining the concept, given the great diversity of its nature, its forms of expression and its beneficiaries, the exploitation of research results in Africa, particularly in the university context, offers no shortage of issues or challenges and faces many obstacles to overcome. In this regard and for Senegal, recent government initiatives have brought significant changes in the practices of university research. However, it should be noted that obstacles related to the current way of running public universities, resulting from the peer review and a relatively high degree of autonomy of lecturers-researchers, make research topics obey more to career concerns than to those of the collaboration between universities and businesses (Dia *et al.*, 2012). Among these obstacles are:

- lack of research performance and relevance, in terms of its outputs and capacity to generate useable results, through social or commercial exploitation
- lack of strategy and adequate resources, regulatory provisions and an organisational structure guaranteeing flexibility of action and good responsiveness, both from research teams and those responsible for adding value;
- weak support and commitment of the institution managers, who must have a clear understanding of adding value challenges and entities' ~~their~~ position and role in the overall machinery of the institution;
- lack of implementing a specific mechanism to increase production of intellectual property assets, especially within the framework of the African Intellectual Property Organization (OAPI) provisions to which Senegal has conferred authority in this field;
- lack of an appropriate mechanism within the research institution, fully dedicated to adding value to research results and managed by competent professionals;
- lack of synergies and effective flow of dialogue, collaboration and partnership, firstly among the various research teams and units, and secondly among those and the outsiders, both upstream and downstream of the research process, especially sponsors, potential users or beneficiaries of the results; and
- lack of pooling resources and rationalizing research teams, grouping them into poles of competence.

2.4.2 TECHNOLOGICAL INNOVATION PROBLEMS IN SENEGAL

The main constraints impeding technological innovation in Senegal include, as stated by a previous study (Gaillard and Kane, 2009), following elements:

- **The absence of a distinct national innovation strategy:** within a voluntaristic Science and Technology policy, harmoniously integrated into the overall economic and social development policy of the country, through its sectoral components, such as agriculture, industry, handicrafts, livestock, fishery, etc. This should give to the Central Governing Body of this sector significant resource, stability free from ministerial reshuffles, a higher hierarchical level in the government exchequer and a large trans-ministerial primacy. This body could then play a genuine role in the process of sustainable economic and social development of the country, in particular by an effective support, an improved coordination, harmonization and evaluation of Research activities and programs. Similarly, at the institutional level, universities and R & D centers generally do not have

effective strategies for demonstration, marketing, communications or feasibility studies for economic operators or potential developers;

- **Weaknesses in scientific, technological and innovation potential:** It is well known that the efficiency and productivity of research require timely availability of relevant resources (properly equipped laboratories, skilled and sufficient researchers and technicians and well endowed operating budgets, etc.). However, in Senegal, consented efforts, even if they are important, have not yet met the expectations and raising the level of public funding of national research should improve the situation.
- **Diversity or disparity in the legislation** governing researchers as well as research centers, with the absence of a suitable "researcher status" which allows interinstitutional gateways;
- **Heavy constraints on companies** using "technological packages" to generate goods or services. They experience several difficulties significantly affecting their innovative capacity and competitiveness. Among those are: 1) funding (ex. access to bank credit); 2) structural, legal and administrative factors (administrative slowness and clumsiness) ; 3) human factors (lack of senior technical manpower: Engineers, Supervisors) ; 4) technical factors (excessive cost and irregularity of production inputs or of services); 5) the narrowness of domestic markets (rigidity of customs barriers)); weak purchasing power of populations ; and 6) the constraints specific to the operation of certain sectors, such as those of agriculture and agri-food (lack of mechanization for harvesting, handling or conditioning operations, as well as for those of processing, distribution, etc.)
- **Shortages of R&D** structures, entities and activities within, companies, especially those in the private sector. Most of these are, in fact, subsidiaries of parent companies located elsewhere and merely exploit the "technological packages" sent by the latter.
- **Lack of cooperation** between business and R&D centres, especially university centres, because, most often, of a lack of information and communication on the results of endogenous research; and
- The extraversion of local people's consumption habits which are not always in line with local raw materials production, particularly in the agro-food sector

The scientific and technical research sector in Senegal should therefore play a stronger role in driving the economic and social development of the country than it has done in the past.

2.4.3 BUSINESS OPPORTUNITIES

2.4.3.1 Science and Technology Parks

Under the auspices of the National Applied Scientific Research Agency (ANRSA), the Science and Technology Park project is to be implemented on the 35-hectare site of the former Dakar *Technopole*. It will provide a platform for links between research and the fabric of the economy. Its overall objectives are: i) to develop a permanent partnership between the private sector and research bodies to commercialise innovative ideas; ii) to create technology transfer units to heighten the visibility of products and services; iii) to encourage the setting up of small, more dynamic businesses around the leading research centres; iv) to make it easier for public sector research results to be taken up and commercialised; and v) to monitor technological

developments by offering innovative products and services to boost business performance and increase added value for natural product exports (ANRSA, 2009).

2.4.3.2 Incubators and Business Nurseries

2.4.3.2.1 INNODEV Incubator: The Cheikh Anta Diop University (UCAD) in Dakar has launched the INNODEV innovation and development incubator. Its chief mission is to “allow business start-up projects of an innovative nature to mature and to boost their chances of success”. The first projects focused on Biotechnology, Agribusiness, Aquaculture, ICT, Civil Engineering and Renewable Energy.

2.4.3.2.2 ARESA BIPOLE: Launched by ANRSA, the “ARES A BIPOLE” laboratory is a facility for disseminating knowledge and adding value to research results, with the aim of promoting the transfer of appropriate technologies. It is active in the following major fields: i) biotechnology (production of plants in vitro, biofuels, biofertilisers and biopesticides); ii) food processing (vacuum dehydration, fortification, cold extraction of fatty acids from forest grain, etc.); and iii) CO₂ laser technology to improve arts and crafts production.

2.4.3.2.3 D2IE: Set up in 2007 by the Gaston Berger University of St-Louis (UGB), the *Domaine d’Initiative et d’Innovation Economique* (D2IE) (Economic Initiative and Innovation Project) has a 20-hectare business incubation site for innovative research-based projects, aimed at fostering businesses dedicated to services, production and training.

2.4.3.3 Prospects for Sharing Experiences

For all above mentioned sectors, Senegal has a wealth of experience that can be shared with the countries of the sub region and/or the *Ummah*. To this end, specific partnership agreements, to open up good prospects for technology transfer, can be developed, in particular for agriculture, agro-food and health sectors.

2.5 CULTURE

2.5.1 CULTURAL AND RELIGIOUS HERITAGE

2.5.1.1 Cultural Diversity

Senegal's policy on culture is embodied in article 8 of the Senegalese Constitution, within the framework of the *Universal Declaration of Cultural Diversity*. It is built around the following strategic objectives: i) to encourage cultural entrepreneurs, actors and agents; and ii) to promote diversity in cultural expression.

It is therefore essential, as stated by Professor Amadou Mahtar Mbow, former Director General of UNESCO, to "*Give everyone an education likely to be an agent of culture renewal, to facilitate the insertion of science and technology in the life of societies*" (MBOW, 1987).

In general terms, Senegal's cultural heritage is very rich and varied. Like the cultural centers, such as Blaise Senghor, Daniel Brothier and the French cultural center Leopold Sedar Senghor, it is embodied in numerous cultural institutions, museums, artists, scientific and literary writers, musicians and film-makers. In addition, several other sectors such as theatre, dance, fashion design and photography are widely represented and numerous cultural events are organised on a regular basis. These include Africa's Scientific Renaissance Day (JRSA, 30 June) and African Technology and Intellectual Property Day (JATPI, 13 September).

Furthermore, Senegal has a wealth of media expression, both public and private (press, radio, audiovisual, etc.). According to the 2011-2015 Economic and Social Policy Document (DPES), "*the diagnosis indicates that this subsector faces, among other things, a lack of visibility in cultural activities, the informal nature of the activity, deterioration of cultural production, the absence of any coordination structure, insufficient resources and administrative sluggishness in mobilising resources. The overall objective of the policy to be implemented is to lay emphasis on the expression of cultural diversity to highlight the economic and social importance of cultural activities to the country's development.*" (MEF, 2011).

2.5.1.2 Religions and Beliefs

Interactions between Science and Religion have always prevailed and, as stated by Albert Einstein (1941), "*Science without Religion is lame*". In the Islamic world, a number of scholar-scientists, such as Nasir al-Din al-Tusi, Ibn al-Nafis and Ibn al-Shatir "*belong in the pantheon of thinkers whose work has shaped the direction of modern science*" (Saliba, 2007).

In this regard, eminent Muslim scholars and scientists, have widely contributed to human knowledge during the period from the 8th to the 15th century, such as Abu Abdullah Al Battani (astronomy), Al Zahraoui (surgery), Ibn Al-Baitar (botanics), Ibn Khaldun (sociology, history), Jabir Bin Haiyan (chemistry), Omar Al-Khayyam (mathematics, physics), etc. (IDB, 2006) but also Ibn Sina (medicine), Ibn El Haytham (physics), Al Khawrizmi (mathematicss), etc. (Wade, 2010).

In Senegal, also having renowned scientists like Cheikh Anta Diop (1923-1986: physics, anthropology), the public and politicians pay due attention to the faith, while formulating policies. In addition, religious leaders have great influence on politicians, as well as on public opinion. Known for its religious tolerance which opposes no obstacle to the development of

science, Senegal embraces three main religions: Islam, Christianity and traditional religions which occupy an important place in the culture and daily life of the country.

2.5.1.2.1 Islam

For a long time, as noted by El Hadj Rawane Mbaye (Mbaye, 2003), Senegal has had illustrious Sufis and Moukaddam, including El Hadj Sheikh Umar Foutiyou TALL (1793-1864), El Hadj Malick SY (1851 - 1922), El Hadj Abdoulaye NIASS (1848-1922), Cheikh Amadou Bamba Mbacke (1853-1927), etc. Their heirs and prominent disciples have contributed to make Senegal as a real land of Islam in Black Africa. With more than 95%, Senegalese population is mostly muslim. Beyond belief, these scholars have always advocated the pursuit of knowledge and sanctifying work. This means the importance given to the development of Science in Senegal.

Senegal's Muslims are present over the entire national territory and are Sunni Muslims, some practicing Sufi Islam, represented by various orders: Tijanism, Mouridism, Quadiiriyya and Layenism. Photos 2 and 3 show the diversity of mosque architecture.



Photograph 2: Mosque of the Divinity at Ouakam, Daka
(Source : Dakar<http://www.beautifulmosque.com/divinite-mosque-in-ouakam-senegal/>)



Photograph 3: Great Mosque of Touba
(Source : www.le-senegal.net/s_villages/s_touba1.php)

2.5.1.2.2 Christianity and Other Belief Systems

Some 4% of the population are Christian, the majority Catholics spread over seven dioceses in Casamance, in the *Petite Côte* region (Serer country) and in the main cities such as Dakar and Saint-Louis.

Traditional beliefs are embraced by some 1% of the population, but members of other religions also embrace traditional practices. Thus, Islam and Christianity are often mixed with Animism, with its traditional rites and beliefs, and it still has a strong presence. Animists continue to conserve very strong ancestral knowledge.

2.5.2 POLITICAL AND ADMINISTRATIVE CULTURE

Cultural tradition of the political system and the organization of the Administration of Senegal comes from colonization and closely look like the situation in France. Institutions of the Republic include the three powers: Legislative, Executive and Judiciary, with the Economic, Social and Environmental Council.

2.5.2.1 Legislative Power

The Senegalese parliament used to be bicameral, consisting of a National Assembly and Senate. However, the Senate was abolished by a vote in both houses on 19 September 2012.

2.5.2.2 Executive Power

The executive power is embodied in the President of the Republic, elected by direct universal suffrage and a majority vote in one or two rounds. He is the guardian of the Constitution and guarantees the legitimate operation of government institutions, sovereign independence and the integrity of the territory. He determines the policies of the Nation, appoints the Prime Minister to lead the government and presides over the Council of Ministers.

2.5.2.3 Economic, Social and Environmental Council

The Economic, Social and Environmental Council (CESE) constitutes a consultative assembly for the public authorities and its members are experts in the economic, social, cultural and environmental fields.

2.5.2.4 Judicial Authority

The judicial authority is independent of the legislative and executive powers. It is exercised by the Constitutional Council, the Council of State (Conseil d'Etat), the Court of Cassation (Cour de Cassation), Court of Auditors (Cour des Comptes) and other courts and tribunals. The law also allows for a Conseil Supérieur de la Magistrature (state body that appoints members of the judiciary) and a Haute Cour de Justice (High Court of Justice) before which members of the executive answer for their acts.

2.6 SUSTAINABILITY

2.6.1 KEY SECTORS

2.6.1.1 Economy

2.6.1.1.1 General Considerations

The Senegalese economy consists predominantly of service activities and its main exports are fisheries products, mining products (gold, phosphates, etc.), petroleum products, chemicals (phosphoric acid), cement, hotel and restaurant services and telecommunications services. For the year 2012, some key indicators are given in table XV (ANSD, 2013, Traitements F. Ndiaye (ANSD)).

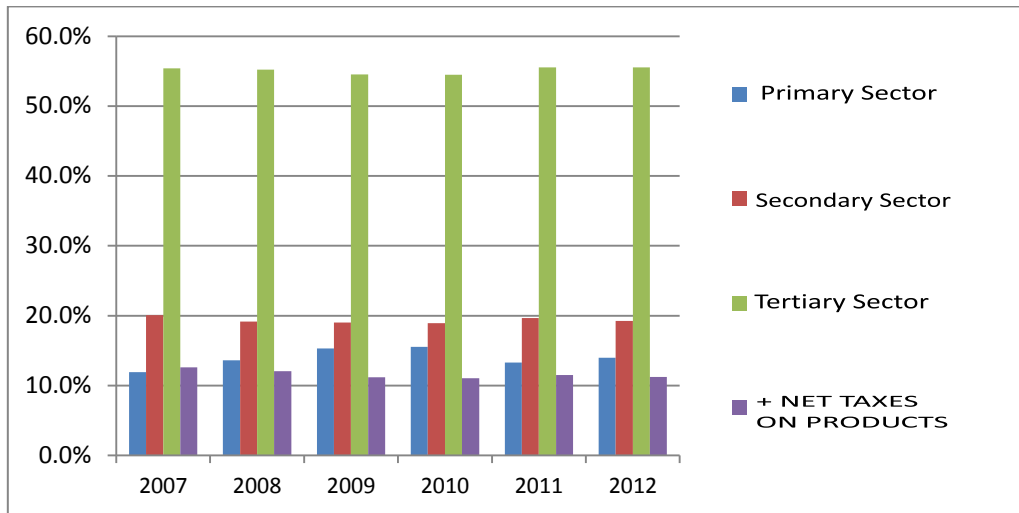
Table XV: Key Economic Indicators (2012)

GDP	CFA 7 172 milliards
GDP per capita	CFA 542 984
Growth Rate	3,4%
Inflation Rate	1.4%

Source : (Traitements Ndiaye F. ; ANSD, 2013)

Figure 16 shows structural changes in GDP: an economy dominated by the tertiary (service) sector (transport and telecommunications, commerce and administration) which account for around 60% of GDP, whereas the primary sector (agriculture, livestock, fishing) accounts for just under 20% of GDP but employs some 54% of the population. The secondary sector, consisting of around 50% public companies, represents approximately 20% of GDP and is dominated by agro-food and mining, textiles and chemicals sectors (Ndiaye F.; ANSD, 2013.).

Figure 16: Changes in GDP Structure in Senegal

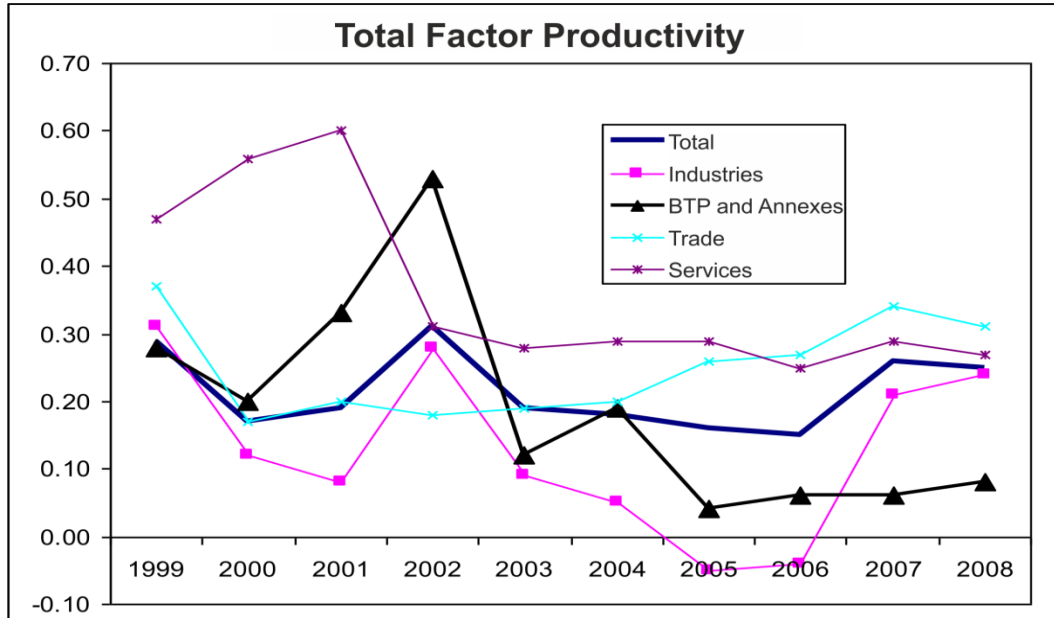


Source: ANSD; our calculations

Breaking GDP down into sectors shows that the trade balance (exports less imports of goods and services) remains structurally deficient due to food and energy imports, as well as imported plant and equipment.

Changes in total factor productivity for the main sectors of the economy are shown in Figure 17, indicating that the Senegalese economy overall is characterised by an absence of productivity gains, with an average figure of -3.4% between 2001 and 2005 (MEF, 2012).

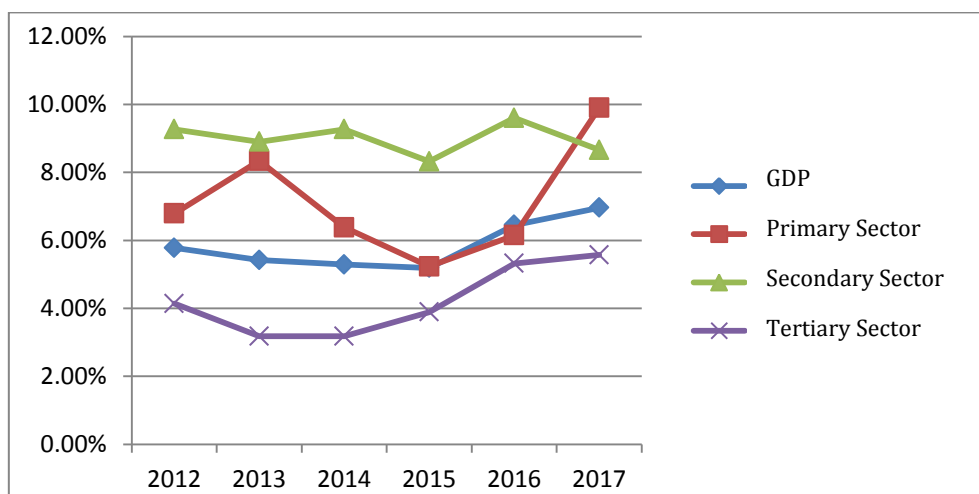
Figure 17: Changes in Total Factor Productivity



Source: ANSD and DPEE data, calculations by the authors, 2010

According to the 2012-2017 Economic and Social Development Framework Plan (PODES), growth will continue to depend on the tertiary sector and, to a lesser extent, the secondary sector. As shown in Figure 18, the contribution of the tertiary sector is projected at 51.5% as against 26.3% for the secondary sector and 16.2% for the primary sector.

Figure 18: Projected Growth Rate (MEF, 2012)



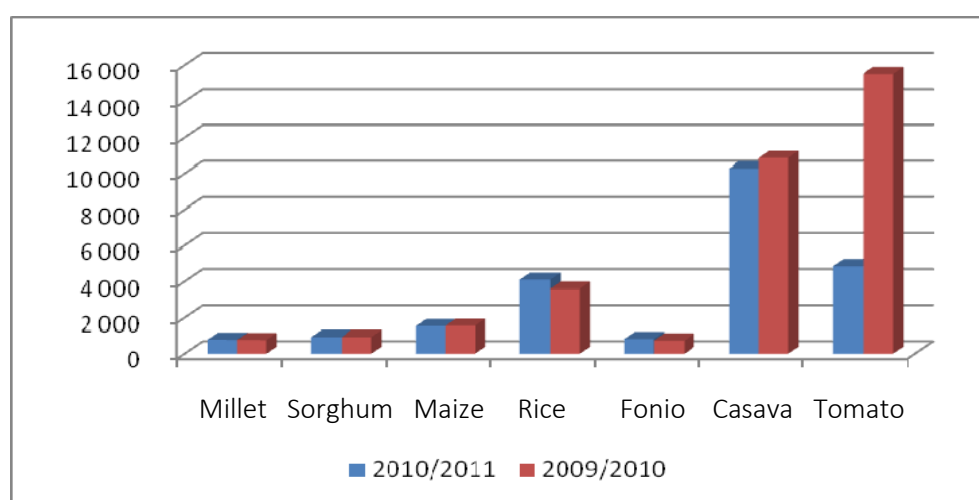
To this situation and the challenges it imposes, It is important to remember what Prof. Amadou Mahtar Mbow, Former Director-General of UNESCO said: *“the only rational attitude, the only possible way is mastery by Africans themselves and on the land of Africa, Science and Technology, in particular in all areas vital to its livelihood and its progress” (MBOW, 1987).*

2.6.1.1.2 Sectoral Considerations

AGRICULTURE: The agricultural sector *sensu lato* (agriculture, livestock, forestry and fishing) contributes significantly to the increase of economic growth, thanks to its great potential. Indeed, occupying around 12% of the national territory and about 54% of the labor force (MEF, 2011-c), it plays a leading role in improving the people’s diet as well as its food security and contributes up to 17% to the formation of the Gross Domestic Product (Thiam et al. 2009).

The extent of potential cultivable land is estimated at 3.9 millions hectares, although the average area cultivated annually is around 2.5 millions hectares and represents 65% of arable land. Rainy season crops total 96% of crops grown, compared to only 4% for irrigated land. Rainy season agriculture is particularly extensive. It is practiced by the majority of rural households and consists of family farms with an average of 4.30 hectares of land. By way of example, figures for food crop production are given in Figure 19 (ANSD, 2011-c).

Figure 19: Food Crop Production (metric tons)



Source: DAPS/EAA 2010

In addition, Senegalese agriculture, including the large-scale modern one, has an important margin for improvement to produce more because of the reserves of untapped arable and / or irrigable land, productivity gains still possible for the rural labor force, in particular for women. In this regard, as noted by the DPES (MEF, 2011-c), the National Program for Agricultural Investment (PNIA), we must welcome the many government initiatives to provide pragmatic solutions to the agricultural sub-sector constraints, through special programs such as **i)** “Back To Agriculture” plan (REVA: agricultural emerging poles and shared agricultural areas); **ii)** national program for self-sufficiency in rice (PNAR); and **iii)** Great Agricultural Offensive for Food and Abundance (GOANA).

Furthermore, agriculture as a whole In spite of everything, remains the major lever for developing the crafts and industrial sectors and can increase its exchange relations with all other sectors, through the development of value chains and processing activities (MEF, 2011-c).

However, despite these different initiatives, agricultural production only covers on average 52% of basic food needs, while the sector should make a more decisive contribution to improving food security, reducing poverty, in particular through the supply of raw materials for agro-industry, the absorption of various products, such as fertilizers, pesticides or agricultural equipment, generated by the industrial, semi-industrial and traditional sector (Ndiaye J.P. and Gueye, 2012).

The Senegalese agriculture remains indeed still very dependent on rainfall which decrease combined with the crisis of groundnut channels, the main cash crop of the country, have reduced the contribution of agriculture to less than 20% of GDP. Moreover, in addition to the natural poverty of soils (eg: salinisation, acidification or alkalization), the process of land degradation is,as mentioned by the DPES (MEF, 2011-c) caused and / or accelerated by some human activities (eg: deforestation, bush fires, poor drainage systems, improper use of pesticides and fertilizers, overgrazing, etc.).To this, other multiple constraints of various types should be added. These are: i) institutional (central and decentralized structures of government, national agencies, NGOs, Private Operators, platforms, etc.); ii) structural (small plots cultivated, number of people per farm, low financial capacity of family farms); iii) socio-economic (low use of inputs and the level of education of farmers, lack of rural infrastructures, etc.); or iv) technical (inappropriate technology, lack or insufficient support to producers, etc.).

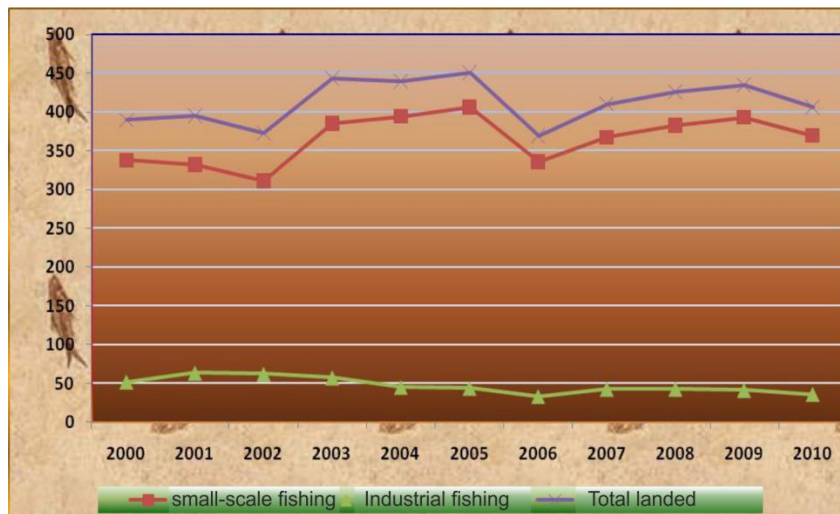
That is why, in general, for the modernization and growth of agriculture, as well as for the development of rural SMIs and SMEs, the levers that need action are: i) the hydraulic and energy (including renewable, solar, biofuels, etc.). ii) roads, transport, storage and processing infrastructures iii) ICTs, especially for real-time access to information on agricultural products markets; iv) rural and Agricultural Credit; and v) mechanization (MEF, 2011-c),

Improving productivity, renewal of farm equipment, seed capital reconstituting, food security and the promotion of agro-industry are also areas in which Senegal must progress, to achieve food sovereignty (ANSD, 2011-c).

FISHING: In overall terms, fishing remains a small-scale activity accounting for 600,000 direct or indirect jobs and contributing significantly to the economic and social development of Senegal with 10.9% of the primary sector GDP (around 2% of total GDP) and accounting for 32% of Senegal’s exports. Fishing products also play a fundamental role in feeding the population, accounting for 70 of its animal protein and nutritional intake (FAO, 2007). Fishing is still a key sector of the Senegalese family economy but has suffered the consequences of degraded fish stocks (due to overfishing, in particular by pirate vessels) and the recent increase in energy

costs. By way of example, Figure 20 shows the development of landed weights from 2000 to 2010 (ANSD, 2011-c).

Figure 20: Change in Maritime Fishing Landed Weight Figures (thousands of metric tons)



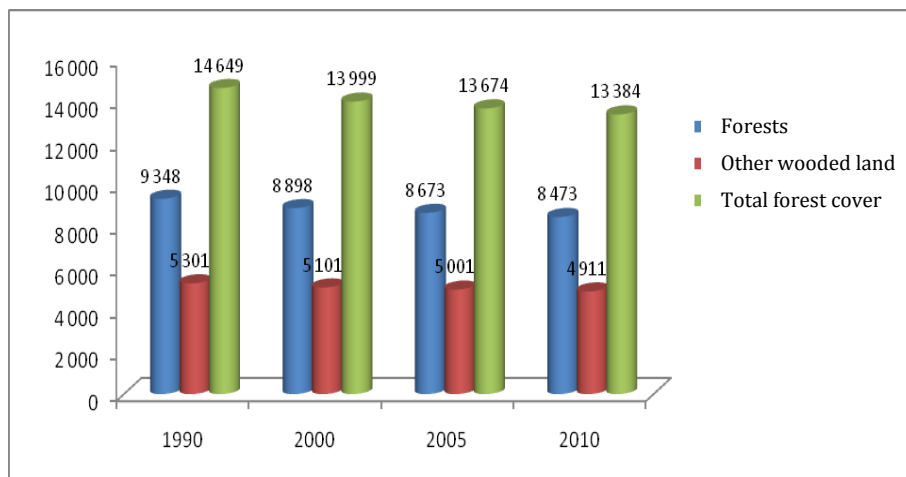
Source: DPM / Ministry of Maritime Economics (2010: provisional data, quoted by ANSD (2011-c).

With slightly over 90% of landed weights, annual turnover for small-scale fishing was FCFA 106 billion in 2010.

LIVESTOCK: The livestock sector is essential to the Senegalese economy for creating jobs and satisfying food needs. Local controlled meat production in 2008 amounted to a total of 40,645 metric tons, consisting of bovine meat (75%), ovine meat (18%) and caprine meat (7%), excluding poultry (ANSD, 2011-c). The National Livestock Development Programme (PNDE) introduced a number of procedures, such as artificial insemination, dairy cow selection and certain measures referred to as 'livestock safeguard measures'.

INDUSTRY: Bearing in mind its geographical location and political stability, Senegal is one of the more industrialised West African countries, home to some multinational companies, the majority of which are French. With the industrial sector's contribution to GDP standing at 19%, added value in terms of secondary sector volume grew to 5.6% in 2010, after falling 1.2% in 2008 and rising 1.3% in 2009, attributable to a rise in production for almost all sectors, excluding timber and engineering. Figure 21 shows how forestry potential has changed (ANSD, 2011-c).

Figure 21: Change in Forestry Potential over the period 1990-2010 (thousand hectares)



Source ANSD, 2012

However, the absence of innovation, difficulty in obtaining finance and the deterioration of industrial plant pushing up production costs have all prevented Senegalese industry from being able to compete on the local and international markets.

CRAFT INDUSTRIES: Providing jobs for 1,200,000 people, craft industries employ 18% of the active population. A quarter of craft workers live in Dakar. The subsector's contribution to GDP is approximately 12%. It absorbs 30 to 60% of urban labour and has 120 trade associations.

TOURISM: Senegal offers a vast range of tourist products associated with its natural and cultural richness. However, the most direct effects of tourism are felt in the most representative sectors: accommodation, restaurants, transport (air and land), parks and leisure sites, retail (souvenirs), etc. As shown in photos 4 and 5, tourism potential varies from one geographic area to another.



Photograph 4: Tourist Resort

Source: <http://www.tripadvisor.fr/SmartDeals-g293830-Senegal-Hotel-Deals.html>



Photograph 5: Senegal Museum of History at Gorée

Source: https://fr.wikipedia.org/wiki/Musée_historique_du_Sénégal_à_Gorée

According to a study of the impact of tourism on the Senegalese economy (NDP/UNWTO) conducted in 2003, the direct contribution of tourism is estimated at 4.6% of GDP, rising to 6.8% if indirect effects on the economy are taken into account (MEF, 2012).

SERVICES: Since 2000, the contribution made by the tertiary sector has stopped rising and amounts to over 54% of GDP. It consists predominantly of commerce, transport, posts and telecommunications, administration and social services.

- Transport and especially telecommunications are the most productive in the Senegalese economy. Employing only 4.6% of the active population, they have added 26.5% to the growth of total production. These sectors are responsible for the productivity gains achieved, with an annual average of 9.7% over the 2001-2005 period (ANSD, 2011).
- The building sectors are also relatively productive. Public works building is the economic subsector that has shown the strongest growth. Its dynamism has resulted in an increased contribution to GDP from 4.2% in 2005 to 4.7% in 2006.
- As for water and other commercial services, household services, private administration, etc., productivity gains here have been relatively low, at between 0.2% and 1.4%.

2.6.1.2 Energy and the Environment

2.6.1.2.1 Energy

Considered an essential factor in taking on the challenges of the Accelerated Growth Strategy (SCA) and achieving the Millennium Development Goals, the energy sector is currently facing

enormous problems. One of the major priority concerns of the government is being able to meet the country's energy needs, especially in electricity (industrial production, household and business consumption). Despite restructuring the energy subsector and boosting electricity generating capacity over the past ten years, demand still outstrips supply, leading to numerous power cuts. Senegal depends exclusively on imported oil, and the use of renewable energy is extremely low (MEF, 2012-a).

The rise in oil prices since 2007, has amplified the crisis of energy supply system, marked by periods of scarcity in the distribution of fuels, as well as butane gas and electricity (MEF, 2012-a). That is why the Government of Senegal has opted to accelerate the rural electrification policy by diversifying sources of electricity generation, with the goal of increasing to 15% the share of renewable energy and biofuels in the national energy balance (MEF, 2012-a).

To guarantee investors an attractive legislative and regulatory framework, promoting the development of renewable energy sources (RES) in Senegal, a framework law on the RES was developed and adopted by the Council of Ministers, in February 2010 (MEF, 2012-a).

2.6.1.2.2 Environment

In Senegal, the environment sector is still facing problems, despite legislation by the public authorities to ensure that impact on the environment is both positive and sustainable.

Forestry faces several constraints mainly related to the decrease in rainfall and population growth, causing irrational exploitation of natural resources (deforestation, overgrazing). Thus, between 1960 and 2007, the area of available natural forest decreased from 11 to 6.3 million hectares, meaning nearly 5 million hectares lost in the space of four decades (MEF, 2012-a).

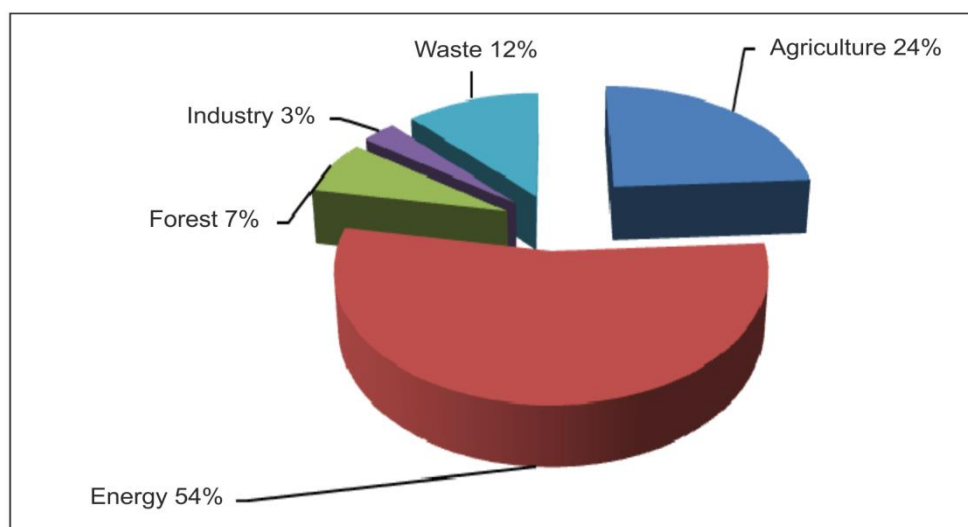
Moreover, the ecological consequences related to the degradation of fisheries resources can be seen through the low resilience capability of marine medium and stressing of environmental fluctuations MEF (2012-a).

With coastal erosion, overuse of pesticides and the increasing pollution of air and water in cities, other constraints, of legal and financial nature, are also identified by the PODES (MEF, 2012-a). These, in particular, are:

- Low knowledge and application of legal instruments of environmental management;
- Inadequate synergy between some conventions on climate change and biodiversity;
- Inadequate funding programs in the environmental sector;
- Difficulties in implementing the polluter pays tax;
- Weak coordination of technical and financial partners;
- Inadequate enforcement of the transfer of skills in natural resource and environment management to local communities with substantial financial resources and;
- Difficulties in financing structuring measures.

Pollution as a factor in climate change constitutes a serious environmental problem, contributing to greenhouse gas emissions. Senegal's national emissions amounted to 14,540 gigagrams equivalent of CO₂ in 2010, according to estimates published by the Intergovernmental Panel on Climate Change (IPCC). As illustrated by figure 22, these emissions are mainly from the energy, agriculture and waste sectors, amounting to 90% of total emissions, as against only 3% for industrial processes (ANSD, 2011-c).

Figure 22: Greenhouse Gas Emissions per Sector



Source: ANSD, 2011

An Environment Code was enacted in 2001 but enforcement leaves a lot to be desired. It is currently under review and this should tighten up the legislation considerably. Also, to be noted is the creation of the National Agency for Eco-Villages (ANEV) which, according to its Director, Colonel M. Demba BA, is on the way to set up a hundred of them in 2013 (Le Soleil, of 06 February 2013).

2.6.1.3 Hydraulic Engineering and Sanitation

In addition to the land potential, water resources are of a very appreciable level. They are estimated at over 35 billion renewable cubic meters of which 31 billion in surface water (Senegal River, River Gambia, Casamance and Kayanga) and 4 billion in groundwater. This assessment does not take into account uncontrolled runoff. However, the level of mobilization of groundwater resources (hitherto used mainly to meet the demand for potable water) is of the order of 5.5%. For better visibility in the diagnosis and strategy planning, challenges to face in the field of rural water supply are to relate to the low valuation of water resources for agricultural production (MEF, 2011-c).

As stated in the 11th Economic and Social Development Framework Plan (PODES - MEF, 2012), the government has drafted three hydraulic engineering and sanitation sectoral policy documents (1995, 2005 and 2010), clarifying the nation's vision in terms of strategic guidelines, combating poverty and integrated management of water resources. With this in mind, the Senegalese government has begun reforming the urban hydraulic engineering and sanitation sector, implementing an investment programme through the Sectoral Water Project (PSE) and the Long-Term Water Project (PELT). This reform entailed splitting the national water company (*Société Nationale d'Exploitation des Eaux du Sénégal* - SONEES) into three separate entities:

- Société nationale des Eaux du Sénégal (SONES) (Senegal National Water Company)
- Sénégalaise des Eaux (SDE) (Senegal Water)
- Office nationale d'Assainissement du Sénégal (ONAS) (Senegal National Sanitation Office).

To develop the urban hydraulic engineering and sanitation sector, the government is continuing to implement the sectoral policy document published in 2005, which is pivotal to its implementation of the Millennium Drinking Water and Sanitation Programme (PEPAM).

2.6.1.4 Mining and Quarrying

The mining sector is experiencing a recent revival with the start of gold production, in addition to phosphates, and prospects associated with the mining of iron. For the rehabilitation of mining activities, we must act on many levers, namely: **i)** infrastructures to reach mining sites and markets; **ii)** access to water, electricity and foreign markets; and **iii)** strengthening of processing capacity before exports (MEF, 2011-c).

Significant achievements have been made. But the industry has been marked by constraints related to the lack of human and material resources in the mining administration and complexity of requirements formalization miners, following their ignorance of the regulations (MEF, 2011 -c).

2.6.2 POLICIES, PROGRAMMES AND NATIONAL PROJECTS

As stated in the 2010-2015 Economic and Social Policy Document (DPES), since it became eligible under the Heavily Indebted Poor Countries (HIPC) Initiative in 2000, Senegal has used its overall poverty reduction strategy (DSRP document) to implement integrated policies and programmes on the basis of wider and wider inclusion, with the aim of creating conditions for sustained and sustainable growth to significantly reduce poverty and achieve the Millennium Development Goals (MEF, 2011).

In his speech at the Solemn Back of the National Academy of Science and Technology of Senegal (ANSTS), on the theme *"teaching Science and Technology in Senegal, from preschool to high school"*, the President of the Republic, HE Macky Sall, reaffirmed the strong political will of the Government to the advent of sciences, stating: *"If we really want to propel our country into the group of emerging countries, towards a better future, it is precisely timely, more than ever, to build a policy for teaching sciences and technology from a new vision "* (Sall, 2013).

Therefore, it is important to create optimal conditions for the best use of the creativity spirit and know-how of those involved in R&D, identify their respective expectations and take them into account in the new industrial policy. *"Therefore, the definition of clear scientific policy-oriented towards the enhancement of African labor and Africa's resources and towards the improvement of living conditions of its people is essential"* (MBOW, 1987).

Through some examples, we will mention some of the policies that have a close correlation with national research.

2.6.2.1 National Policies

2.6.2.1.1 Scientific Research and Innovation Policy

To place R&D at the strategic core of the country's overall development policy, the MESR's ambition is to establish a synergistic relationship between research institutions and companies through a productive partnership, in close collaboration with the relevant ministerial departments. The research policy should therefore: **i)** boost scientific and technological potential, while developing national efforts towards research; **ii)** render research objectives consistent with development aims; **iii)** promote the application of research results and adding value to them; and **iv)** ensure a permanent monitoring and assessment of research programmes and projects (Dia *et al.*, 2012).

There is still no real and comprehensive national research and innovation policy in Senegal, in which the government's priorities are clearly defined and sufficient resources provided.

However, the National Scientific and Technical Research Incentive Fund (FIRST), identifies, on an annual basis, research themes related to vital development sectors and to the life of the nation, *i.e.*: agriculture, health, education, economics, food sciences, environment and social sciences, etc. Despite the many efforts made, there is still much to do in research policy, defining objectives, establishing priorities and providing necessary funding.

However, we should welcome the entering of Senegalese government authorities in a process of consolidation, rationalization and redeployment of the Higher Education and Research system with, in particular:

- The creation of two new universities planned in Dakar and Kaolack. For the latter, the Rector has already been appointed and the option will essentially be put in agriculture and agribusiness, with antennas in the Fatick, Kaffrine and Diourbel regions;
- Signing of Performance Contracts between MoR and all public universities, to improve their governance, the quality of their teaching and research as well as their intellectual productivity and relationships with professionals;
- The adoption of a Decree establishing the National Authority for Quality Assurance of Higher Education (ANAQ-Sup);
- The desire to revisit the overall vision of human resources training, from Preschool to high school, giving more importance to Science and Technology, Research and Innovation;
- Redefining the university map, with a new impetus for short courses, vocational training, science and technology; and
- The creation, by Order of the Minister for National Education, dated 16 February 2004, of a National Steering Committee of the project on Science and Technology Teaching Development (CNPDEST), under the auspices of the ANSTS.
- The setting up of the steering committee of the National Dialogue for the Future of Higher Education (CNAES). This dialogue will start very soon and the results of its work will be examined by a special presidential council.

2.6.2.1.2 Agricultural and Agro-Food Policy

To implement an agricultural and Agro food policy, the Senegalese authorities have chosen to make agriculture the country's driving force behind economic growth. To achieve this, it is necessary to increase agricultural production and establish the conditions required for: i) ensuring food security in the face of a growing population; ii) optimising opportunities for accessing international markets with export-driven agricultural activities; iii) promoting agriculture on the basis of intensive, diversified, sustainable systems that do not impair our natural resources; iv) encouraging the emergence of an agricultural and rural entrepreneurial community; and v) developing agricultural exports to meet international demand.

These guidelines are consistent with subregional WAEMU Agricultural Policy (WAP) and the ECOWAS Common Agricultural Policy.

Development of the fishing and aquaculture subsector is based on an action plan that is already being implemented and has the following strategic objectives: i) to ensure sustainable management and restore fishing stocks; ii) to satisfy domestic demand for fish products; iii) to add value to fishing stocks and modernise small-scale fishing; iv) to encourage a professional approach and promote qualification of those involved in the fishing subsector; and v) to improve systems for financing fishing and aquaculture activities.

Senegal's agribusiness and agro-industrial policy is more or less defined in the agro-industrial part of the Accelerated Growth Strategy (SCA). The strategic objectives set forth are: i) to make horticulture the link between Senegal and high added value globalised supply chains and achieve significant growth of market share; ii) to make processed products a springboard for Senegal's entrepreneurial community, with diversity of growth niches to form a nationwide network of small and medium-sized businesses, the foundation of a new, modern and profitable agricultural sector; iii) to capitalise on our agro-industrial achievements and ensure sustained growth over the medium and long term; iv) to add value to existing products by introducing and adapting modern conservation and processing technologies; v) to set a quality benchmark suited to Senegalese producers and exporters, adapted to the rural context, and establish standards compliant with market requirements; and vi) to promote research and development for introducing new products and competitive technologies.

However, a number of ministries are involved in the organisation and administration of Senegalese agriculture in the broader sense, both upstream and downstream of primary production, which poses real problems in terms of overall coordination and consistency. In fact, a real agricultural policy taking account of the various subsectors, including production inputs (seeds, phytosanitary products, fertiliser, etc) and the post-harvest system for adding value (storage, conservation, processing, commercialisation, etc.) still remains to be built and implemented.

2.6.2.1.3 Health Policy

Research priorities were established at consultative meetings and at a national sharing workshop culminating in the drafting of a 2009-2012 National Health Research Strategic Plan. There are seven priorities: i) combating disease and implementing epidemiological monitoring, ii) reproductive health, iii) management of health programmes and services, iv) education for health, v) medications and traditional medicine, vi) improving the lives of underprivileged families and vii) combating poverty and a plan for capitalising on research results.

2.6.2.1.4 Environmental Policy

Senegal's environmental policy was defined within the context of decentralisation and combating poverty over a twenty-year period (2005-2025). The overall objective of this policy is to ensure rational management of natural resources and the environment to help reduce poverty with a view to sustainable development. To achieve this, a Senegalese Forestry Action Plan has been drafted with the following strategic objectives: i) to improve the natural resources and environmental knowledge database; ii) to reverse the current trend in respect of natural resources and the environment, in compliance with the relevant international conventions; and iii) to strengthen the participation of the private sector, populations and local communities in the concerted management of natural resources and the environment within the context of climate change with its diverse impacts on different subsectors (agriculture, livestock, forests, health, fishing, etc.).

2.6.2.2 Mobilizing National Programmes and Projects

Numerous programmes and projects of a scientific and technological nature have been launched and implemented under the auspices of a number of government departments and various national institutions. By way of example, here are some of the current programmes and projects launched by the Higher Education and Research Ministry (MESR): the Palmeraie project (research and development on an improved variety of high-yield oil palm - Tenera); Research

and Test Centres (CRE): units for adding value to research, structured into a delocalised and decentralised network; Programmed Thematic Groups (GTP): fund set up for interdisciplinary research and R&D in government-defined priority fields; Scientific and Technical Publication Fund (FPST): support for publishing STI journals; Survey on the innovation process in the informal sector: to better understand the innovation process in Senegal's informal sector; Endogenous knowledge documentation project: to promote and safeguard traditional knowledge; ASTII 2 (African Initiative on Science, Technology and Innovation Indicators); CAAST-Net (Network for the Coordination and Advancement of Scientific and Technological Cooperation between Sub-Saharan Africa and the European Union); IST Africa ("Regional Impact of Information Society Technologies in Africa").

2.6.3 OVERAL ANALYSIS BY SECTOR

2.6.3.1 Higher Education and Technical and Vocational Training

Despite a context of limited financial resources and thanks to technical and financial partnerships, universities, schools of higher, technical and vocational education (ESTP), as well as public centers and institutes have got more means for research or training. Thus, they have formed more and more researchers, engineers, senior technicians but still not enough to support the innovation effort of business. Moreover, the large increase of the students number, with its corollary of regular operation disturbances, the politicization of the university space and the lack of absorption of graduates are all elements to consider (Dia et al., 2012).

As for the technical education and vocational training, as stated by PODES (MEF, 2012-a) they suffer a lot, among others, of technological backwardness, outdated and obsolete equipment, inadequacy between training and employment, lack of resources allocated to the sub-sector, etc. In fact, although technical and vocational training is the second on the list of priorities in the 10-Year Education and Training Development Programme (PDEF), it was allocated only 9.1% of the resources in 2010 (MEF, 2012; see Figure 3).

In this regard, in his address at the 2013 ANSTS Solemn, the President of Republic recognizes that *"Our educational system, in its current form and operation, is a weighing legacy"* and that *"the evolution of science education is marked by this paradox, showing that the performances of students in these disciplines are still far short of what our country is entitled to expect"*. Hence, the urgent need to revisit the system to improve its performance, both internally and externally" (Sall, M.; 2013).

Thus, training of high level scientists and engineers must be developed and career opportunities in research professions made more attractive and interesting. That is why, according to the President of Republic, *" Any attempt to develop the teaching of science and technology should be based on solid levers, in particular the installation of an evaluation culture, as well as the establishment of a coherent and performing policy for teaching sciences and technology "*(Sall, M., 2013). Therefore, among the major prospects of this sector, we will consider, together with the DPES (MEF, 2011-c):

- Improving governance, devolution and decentralization of the management of the sub-sector, notably with the creation of an information system, building and equipment of academy inspections in new regions and promotion of women teachers in decision-making;

- The strengthening of operational capacity of the National Agency for Quality Assurance in Higher Education (ANAQ) and the extension of its powers to the technical education and vocational training;
- The promotion of vocational training oriented towards employment market, through the development of continued training, study on training needs, analysis of work situations, as well as support for the integration of new graduates;
- Integration of learning in the vocational and technical training system, by a training of workshop masters, and
- The development of partnership governance, with a strengthening of public-private partnership.

2.6.3.2 Agriculture and Food Sciences

In Senegal, science and technological innovation have, undoubtedly, allowed improvement and increase of agricultural productivity, in terms of both quantity and quality, while ensuring its durability. These technological innovations were developed mainly by public agricultural and agro-food research, although in recent years the private agricultural and agro-food research has made significant progress (Ndiaye and Gueye, 2012).

Moreover, among all areas of the country's research, agricultural and agro-food research appears to be the most advanced, with the presence of a specialised and operational institutional framework (ENSA, INP, ISRA, ITA), special funding provisions (FNRAA) and an appropriate coordination system (SNRASAP), also including all universities (UCAD, UADB, UGB, UT and UZ). Thus, collaboration between the universities and other institutes is gradually improving thanks to the FNRAA fund, whose eligibility criteria include inter-institutional partnership.

However, this operational partnership between research centres and universities should be extended to other actors, such as the agricultural and rural Council, organizations or inter professions of agricultural producers, industrial processors and distributors.

Indeed, strong fluctuations and the downward trend in yields of almost all crops call for more emphasis on irrigation, research (both upstream and downstream of the primary production) and extension, in order to durably reverse this trend (MEF, 2011-c).

The issue of renewal of seed capital is another source of constraints to productivity due to lack of certified seeds and confidence in those distributed. To that effect, it is necessary, to fill this gap, to maintain traceability of the varieties in circulation in the country and limit the use of seeds from all and sundry, which are of poor quality and poorly adapted to different agro-systems. A certification system, together with a good seed multiplication policy, involving professional multipliers and research centers, will avail certified seeds, in sufficient quantities and reliable quality (MEF, 2011-c). In this regard, it has to be noted the establishment of a National Committee for Varieties Approval and a Division of Seeds within the Directorate of Agriculture, for seed certification.

In addition, the agricultural sector still faces a number of constraints such as land degradation and its impacts on food insecurity and declining farm incomes (CSE, 2010), the production instability which is dependent from climatic hazards, inadequate policy and institutional framework, lack of access to basic services and local, regional and international markets as well as imbalances in investment (Ndiaye et Guèye, 2012).

Otherwise, this research sector should help to increase the competitiveness of SMEs and agro food industries, in particular by: i) improving hygienic conditions and quality of processed

products, based on international standards, ii) diversification of products ranges delivered in local and international markets, and iii) technical and managerial capacity building of food processing professionals. In this respect and like ISRA, Regional deployment of ITA would be very useful, by creating specialized antennas, according to dominant crops in each region.

Generally speaking, a greater emphasis should be put on research in the following strategic areas:

- *For agricultural hydraulics:* to value surface water and groundwater by developing infrastructures for collecting and distribution of water for agricultural production, structuring hydro-agricultural infrastructures and fighting against aquatic plants, as well as the development of an hydro geological information system shared by all stakeholders;
- *On the agronomic level:* to develop high-yielding varieties, farming and water management techniques for the development of cropping systems adapted to different agro-ecological zones of the country;
- *For breeding:* to improve animal production by promoting modern production units, enhancing the genetic potential of local breeds through, among others, artificial insemination and improvement of animal health;
- *For fishing:* to value fisheries and aquaculture production by restructuring products processing industry, complying with health standards of channels (especially upstream), modernizing traditional processing of fishery products and diversifying products; and
- *For food processing:* to develop appropriate conservation, storage and processing methods of agricultural, forestry, fisheries and pastoral products, while determining their biological and nutritional value; and
- *For the environment:* to encourage the development of: i) measuring instruments of climate change and the environmental impact of public policy; and ii) protected areas for biodiversity, transboundary resource management and the fight against pollutions and nuisances (MEF, 2011-c).

Therefore, to allow the agricultural and agro food research to fully play its role in this context, it is particularly urgent: i) to strengthen the institutional framework for piloting the sub-sector, by institutional anchorage of different actors and strengthening of sectoral research, extension and adding value centers of agricultural and agro food products; and ii) to take over the aging staff and the motivation to curb the massive departures of researchers from research institutes to other horizons, including universities or ministerial departments (MEF, 2011-c).

2.6.3.3 Health Sciences

Senegal's health situation resembles that of most sub-Saharan countries, analyzed by a major symposium organized by the German National Academy of Sciences Leopoldina, together with the Ghana Academy of Arts and Sciences (GAAS) and the Network of African Science Academies (NASAC) and held in November 2012 at the Bernhard Nocht Institute in Hamburg, Germany (BNI 2012).

The country is, in fact, facing the double burden of communicable and non-communicable expensive care diseases. Despite significant progress in the fight against major endemic diseases, there is still much to do (Ba et al, 2012). Social facilities and health human or infrastructural resources have a very uneven distribution and remain concentrated in the west of the country, in big urban centers, particularly in Dakar (MEF, 2011-c).

As explained by the PODES (MEF, 2012-a), one of the main causes is the mobility of health workers due to lack of real staff motivation policy, but also and especially in the absence of an appropriate living environment. In addition, there is no succession plan for staff that stayed a number of years in these difficult areas. It should also be noted the lack of a plan for renewal of equipment acquired at the beginning of programs and which become outdated or obsolete without being replaced.

The Health and Social National Development Plan 2009-2018 is moving towards resolving this important gap, to realize the ambitions of the Millennium Development Goals (MDGs). This plan is in the perspective of accelerating the implementation of various prevention programs and offerings of curative quality service. In this regard, efforts of densification of regional hospitals and health centers human resources, as well as the opening of Regional Institutes of Health Research, with new medical schools in the regions, particularly in Thies, Saint Louis and Ziguinchor are welcome (Ba et al, 2012).

However, defining an order of priorities to underpin specific research is a critical need, to strengthen research infrastructure and human resources, and establish an enabling regulatory environment in which R&D can advance and innovation can be implemented. Among those priorities are:

- Mastering the flow of students in the Faculties of Medicine, Pharmacy and Dental, in establishing a *numerus clausus* (quota);
- Work to densify and to pool resources, by creating laboratories of excellence and a National Fund to Boost Medical Research;
- Set up institutional ethics committees and a National Research Council in Human Health, to strengthen the links between research institutions and doctoral schools in health with Division of Studies and Research (DER) of the Ministry of Health, to allow it to monitor research programs and direct them to the priorities defined in the National Health Research Plan;
- Promote a policy of disseminating research achievements, with the systematization of results sharing workshops, the creation of websites for dissemination of those achievements;
- Develop a health researcher status, to ensure a career plan; and
- Involve the Private Sector in Research, by associating it to the process of project development.

Also, meeting the challenges of the changing health problems requires the mobilization of vigorous partnership efforts, in a multidisciplinary approach, among all stakeholders and across various sectors. In this regard, among urgent partnership needs of Senegalese health research, we will mention:

- The development of skills in clinical research trial to develop powerful diagnostic tools, adapted to treatments and means of struggle, or the eradication of some diseases;
- Research in social sciences, humanities and economics, with an ecosystemic approach to health, offering viable steps, applicable in the local context, to respectively understand: i) the social determinants of diseases ii) cultural differences; iii) the costs and benefits of disease prevention and improvement in health status, in order to better formulate a sound health sector policy;

- The synergy between national policies and programs and those of various international institutions (eg IRD, IPD, etc.), to form a sustainable critical mass, catalyze new initiatives and share best practices;
- Involvement of Senegalese scientific Diaspora, working in major health research centres in North America and Europe, to also reverse the scientific brain-drain.
- Develop public and private sectors partnerships, e.g. between academia and the pharmaceutical industry to increase access to medicines, address risk factors, support and implement innovation, develop new models for collaboration in R&D and use of intellectual property, , while ensuring academic independence.

2.6.3.4 Social Sciences and Humanities

Generally, Senegalese societies, their culture and the country's economy give rise to important knowledge, produced by a network of well-established research institutions: faculties, faculty and university institutes, research centers depending from ministerial departments, the existence of the National Agency for statistics and demography and of other public structures producing sectoral statistics (agriculture, health, water, etc.) or technical documentation from planning activities.

Visited Institutions are of pure basic research, like CODESRIA striving to interpret the social and economic realities in Africa and contribute to the debate on global issues, or on applied and action-oriented research. This research is done either by regional and international organizations (BREDA, IDEP, WARC) or by national structures attached to ministries departments (eg. ANSD, CEPOD, DCEF, DGP, DPEE and UCSPE, under the Ministry of Economy and Finance).

Completed programs are marked by their diversity. Topics discussed relate, broadly, to the economy or poverty but also to social issues (including gender), climate change, environment and natural resource management "water, forests, », the regional integration, as well as to global and sectoral development planning. Quantitative Surveys and censuses produce general and sectoral data that are as much as possible disaggregated by sex. Qualitative aspects are both taken into account in research and development and basic research in social sciences and humanities.

The above topics respond to various issues of the day and give rise to quality publications carried by various medium (journals, books, articles, notes, and dialogue with policy makers, civil society and the general public). Scientific links and partnerships are developed by research organizations, among themselves, in the sub-region, as well as across Africa and the world.

Research staff, although insufficient in government structures, is everywhere of high quality. It is composed of academics (grades of professors, lecturers, assistant lecturers) and highly educated (PhD, DEA, Engineers, etc.). Some sub-regional structures such as CODESRIA and IDEP rely on skills selected in their databases and organized in networks.

Bodies belonging to multilateral or panafrican agencies (IDEP, CODESRIA, WARC) or with larger contracts studies on the African market or in the world, have a more comfortable research budget than national structures, rather supported by State subsidies. As an example, according to Sene(2012), CRES reached in 2011 a budget of 1,194,155,262 CFA francs (equivalent 2.4 USD millions). Also, WARC receives funding from the Government and U.S. agencies allowing it to diversify its activities (scholarship offers, organizing trainings, facilities offered in research, such as on library management open to students or the granting of premises to the Centre for

Research on Social Policies - CREPOS). Besides, the National Center for Scientific and Technical Documentation (CNDST) has no support from the state for its field activities and, therefore, suffers from a deep lethargy.

At the level of regional and international banks consulted (AfDB, IDB), there are departments dealing with STI at their headquarters. But, in their direct geographical sphere, STI is rather treated in country programs and may be included in the priorities agreed with the Member States.

2.6.3.5 Environment and Sustainable Development Sciences

Strategic options of the Government in the environmental sector are mainly inspired by the logic of sustainable development, to achieve the Millennium Development Goals (MDGs). They also rely on international conventions and commitments which Senegal has subscribed (MEF, 2012-a).

Thus, several plans have been developed since 1994 for the implementation of these conventions at national level: i) the national plan of action against desertification; ii) the National Action Plan for Biodiversity; iii) the decadal Actions Plan on sustainable modes of production and consumption, developed and validated in 2006; and iv) the national action plan for adaptation to climate changes (MEF, 2012-a).

In legal terms, the government has introduced several instruments that contribute to the sound management of the environment and natural resources. Among them, there are mainly: i) the agro-forestry-pastoral law (LOASP); ii) the legislation relating to land tenure; and iii) sector-based texts (water and sanitation codes, code of hunting and wildlife, mining Code, forest Code, environmental Code). As an example, the Environmental Code addresses, among other issues, inventory, management and regulation of hazardous waste: industrial and domestic wastewater, solid and similar waste, biomedical waste, radioactive residues, industrial waste, obsolete pesticides, plastics and rubber (including tires), used oils, etc. (MEF, 2012-a).

We must also acknowledge the harmonization efforts between these different instruments, but the lack of communication among the various actors explains, partly, the lack of synergy in the management of environmental problems.

2.7 COLLABORATION

Review of institutions showed that beyond those established in Senegal, with a regional or international orientation, national universities, research centres and private training institutions have a long tradition of cooperation, at national and both at regional and international levels. Moreover, a number of regional and international organisations have developed numerous initiatives in Africa aimed at promoting science, technology and innovation, especially for providing support in drafting and implementing science and technology policies, strengthening capacity and setting up or consolidating R&D initiatives and programmes, in particular those in the fields of agriculture, health and social science.

The initiatives discussed below are only those in which Senegal has been or is still a stakeholder.

2.7.1 NATIONAL COLLABORATION

With the emphasis on companies in the new innovation policy, much is expected from the collaboration of universities and schools with businesses, both for training and for research and technological innovation, with multidisciplinary programs best suited to the development of certain strategic technologies and needs of the latter.

In this respect, considerable progress can be seen in the agricultural and agro-food sector, thanks to funding from FNRAA and the setting up of the National Agricultural, Forestry and Livestock Research System (SNRASP).

For this sector, national (ISRA, ITA, universities and colleges) and regional (CORAF) institutions already develop national and sub-regional collaborative programmes. They even plan to pull their resources, with support of the French research institutes network in Senegal (IRD, CIRAD, Pasteur Institute).

Also to be mentioned is the establishment and development of doctoral schools of a trans-disciplinary, interfaculty and inter-institutional nature, and involving business world professionals, in order to help breaking down research barriers and add value to its results.

2.7.2 REGIONAL COLLABORATION

The collaboration of Senegalese institutions with the sub-region and the region, is implemented on bilateral basis as well as through WAEMU, ECOWAS or the African Union. Other initiatives, such as the Knowledge Management Africa (KMA), are also to be noted. Among sectors of concrete collaboration are agriculture, livestock, agro-food, renewable energy, water and sanitation, health, environment and science and technology, including social sciences, etc.

2.7.2.1 Collaboration with WAEMU

The recent collaboration with the West African Economic and Monetary Union is primarily embodied in the Higher Education Support Programme (PAES), run in all eight member countries to reform higher education and bring it into line with international quality standards.

In addition, Senegal has benefited from the support of CILSS and WAEMU which are respectively implementing at the member countries the Programme for the Promotion of Domestic and Alternate Energies in the Sahel (PREDAS) and Biomass Energy Program (PRBE), and both aiming at consolidating actions related to the development of domestic fuels (MEF, 2012-a).

2.7.2.2 Collaboration with ECOWAS

Following the First Conference of Ministers Responsible for Science and Technology in 2004 and the drafting of the framework for science and technology in 2005, the Economic Community of West African States (ECOWAS) has recently adopted a Science, Technology and Innovation Policy (CEDEAO, 2011-a) and a Strategic Action Plan (CEDEAO 2011-b). These documents were made available to all 15 member countries, including Senegal. The policy should provide incentives for scientists and technologists in the subregion and mechanisms for building an entrepreneurial community with production and service sectors, discussing their problems and creating solutions.

In this respect, there is also the active role played by Senegalese universities in the Network for Excellence in Higher Education in West Africa (REESAO) for which Professor Saliou Ndiaye,

Rector of UCAD, called on the adoption of concrete actions, to build an African space for opened up and harmonized Higher Education (Le Soleil of 04 February 2013).

Furthermore, with support from the African and Madagascan Higher Education Council (CAMES), ECOWAS has harmonised the Medical Sciences Specialised Study Degree Curricula. The Faculty of Pharmaceutical and Dental Medicine (FMPO) at UCAD also played an active role.

2.7.2.3 Collaboration with the OAU/AUC

The Organisation of African Unity (OAU), now African Union Commission (AUC)'s concern with science and technology is embodied in its statutes. At various summits the AU has continued to reaffirm its role as a driving force for economic and social growth and development (Lagos Action Plan -AU, 1980 and the ABUJA Treaty, 1991). In addition, with the aim of raising awareness in Africa, special days have been declared for annually commemorating Africa's Scientific Renaissance (30 June) and Technology and Intellectual Property (13 September). Senegal celebrates regularly these days, by organizing each time an event on different topics.

Similarly, the AUC has launched the ASTII and several other initiatives:

- **African Science, Technology and Innovation Indicators Initiative (ASTII):** The African Science Technology and Innovation Indicators (ASTII) Initiative is a programme within the Consolidated Plan of Action for Science and Technology in Africa (CPA), adopted in September 2005 in Dakar, by the African Ministers Conference on Science and Technology (AMCOST). Launched in 2007, ASTII initiative is managed by NEPAD office on Science and Technology and serves as a framework for science, technology and innovation (STI) to respond to the socio-economic challenges facing the continent.

In Senegal, one of the countries participating in the first (2010), as well as in the second (2012) phase of survey on STI indicators in Africa, it is the Ministry of Higher Education and Research (MESR) which coordinates the project.

- **Other AUC Initiatives:** Among those are: the Pan-African University (PAU), and the African Science, Technology and Innovation Observatory (AOSTI) in Malabo, Equatorial Guinea. In addition, the African Union Commission is setting up the Pan-African Intellectual Property Organisation (PAIPO), the African Virtual University (AVU) and the African Research and Innovation Council (ARIC). Senegal is a key stakeholder in all these initiatives.

2.7.2.4 Knowledge Management Africa (KMA)

With a vision that knowledge should be the driving engine of appropriate development solutions for Africa, "*Knowledge Management Africa*" (KMA) is an African initiative, launched in February 2005, by the Development Bank of Southern Africa (DBSA). The KMA objective is to facilitate the creating, harnessing, synthesis, sharing, dissemination and utilization of knowledge to improve governance, service delivery and development outcomes in Africa. KMA also aims at creating the requisite knowledge infrastructure and contributing to a culture of learning in the African continent. Dakar hosted its third international conference, in May 2009, on "*Knowledge to reposition Africa in the Global Economy*", in close collaboration with the National Academy of Sciences and Techniques of Senegal (ANSTS) and the African Regional Centre for Technology (ARCT). This conference thoroughly debated on the issues of Scientific and Technological Knowledge Management for Africa's sustainable development.

2.7.3 INTERNATIONAL COLLABORATION

To use science, technology and innovation as vectors for endogenous, self-sustained development in Africa, a number of initiatives benefitting Senegal have been developed by numerous international institutions such as UNESCO, UNECA, IDRC, European Union and various other organisations, such as the OIC and its affiliates, in particular the IDB, COMSTECH, and ISESCO. Other initiatives, such as the African Science Academy Development Initiative (ASADI), are also to be mentioned.

2.7.3.1 Collaboration with UNESCO

With the CASTAFRICA I (Dakar, 1974) and CASTAFRICA II (Arusha, 1987) ministerial conferences, UNESCO helped African states, including Senegal, to review and draft their science policies. UNESCO has also launched numerous other initiatives, such as the University-Industry-Science partnership programme (UNISPAR) inaugurated in 1993, as well as a programme for improving scientific education and the Virtual African Campus. Similarly, in response to the Addis Ababa Declaration on Science, Technology and Scientific Research, adopted in January 2007 by the Summit of the Heads of State and Government of the African Union, UNESCO launched an important initiative aimed at promoting the development of a national STI policy (ASTIPI). Finally, in its 2008-2013 medium-term strategy document, UNESCO placed particular emphasis on the roles of science, research, technology and innovation in ensuring peace and sustainable development. To that effect, after the Chair of Education Sciences with the Faculty of Education and Training Sciences and Technologies (FASTEF), UNESCO has just opened a new chair in UCAD entitled "Scientific and Technological Education and Teachers Training", at the Normal High School of Technical and Vocational Education (ENSETP), in co-responsibility with the IUFM of Aix-Marseille. The objective of the Chair is to promote an integrated system of research, training and ongoing development of teaching in the field of Science and Technology (Le Soleil, of 06 February 2013).

2.7.3.2 Collaboration with the OIC and its Organs

The Organisation of the Islamic Cooperation is the second largest intergovernmental organisation after the United Nations, with 57 member states on four continents. It safeguards and protects the interests of the Muslim world in the spirit of promoting international peace and harmony among the different world populations. The OIC has a number of institutions whose missions are to promote and support science and technology. These institutions include, in particular, COMSTECH, ISESCO and SESRIC, many of whose activities are funded with the help of the Islamic Development Bank.

These institutions actively support Senegal in its efforts to strengthen national scientific and technological capacity, in particular through training activities.

2.7.3.3 Collaboration with the International Atomic Energy Agency (IAEA)

The International Atomic Energy Agency (IAEA) is supporting Senegal in its work on peaceful nuclear applications. The fields of health, nutrition, agriculture, livestock breeding and nuclear safety are covered by this cooperation. The basic programme for the 2009-2011 project cycle, involving technical cooperation with the IAEA, funded eight (8) projects to a total amount of US\$ 1,169,080.

2.7.3.4 Collaboration with UNECA

Initiatives of the United Nations Economic Commission for Africa (UNECA) aimed at promoting STI as driving forces in Africa's development include i) studies on scientific and technological indicators; ii) studies on the contribution of science and technology, especially biotechnology, to the growth of agricultural yields in Africa; iii) the rationalisation of productive capabilities and revitalisation of the African industrial sector; iv) defining an action framework for building African infrastructure for information and communication (African Information Society Initiative) and v) the African Innovation Framework (AIF). Over the past few years, UNECA has also set up the Science and Technology Advisory Group (STAG) and organised a series of major high-level international conferences, including Science with Africa in 2008 and 2010, as well as those of the Committee on Development Information Science and Technology (CODIST 2009 and 2011).

2.7.3.5 Collaboration with European Union

The scientific and technical collaboration of Senegal with the European Union focused on CAAST-Net and IST- Africa projects:

- **CAAST-Net Project:** (Network for the Coordination and Advancement of Scientific and Technological Cooperation between the sub-Saharan Africa (SSA) and the European Union): CAAST-Net is a mechanism, the goal of which is the reinforcement of scientific and technological collaboration between Africa and Europe. The project was conceived against the background of a global consensus that capacity in scientific and technological R&D and Innovation is essential to economic competitiveness, sustainable development and ultimately to poverty reduction. It is supported by the European Union's seventh framework programme for research and technology development and aims to strengthen the coordination of research programs between the European Union and sub-Saharan Africa. Among the key countries within the SSA context, Senegal, 18th Member to integrate this network in 2008, at the General Assembly held in Rwanda, is co-leader of Work Package 4 (WP4), in collaboration with the AIRD (Inter-Institutions Agency of research for development). WP4 is responsible for identifying research priorities to include in the 7th Framework Programme of S&T cooperation.

CAAST-Net collaborated with the Ministry of Higher Education Research of Senegal to run the second stakeholder conference on innovation in Africa-Europe S&T cooperation in Dakar (24-25 April 2012). The overall purpose of the conference was to promote learning and understanding between Europe and Africa in areas of mutually beneficial Scientific and Technological policy and to enhance the S&T collaboration between the two continents. More information about CAAST-Net can be found on the project website (www.caast-net.org).

- **IST Africa Project (Regional Impact of Information Society Technologies in Africa project) 2010-2011:** IST-Africa is a multi-stakeholders collaborative initiative within a Consortium coordinated by Ireland and grouping 14 Countries (Botswana, Burundi, Cameroon, Egypt, Kenya, Lesotho, Mauritius, Mozambique, Namibia, Rwanda, Senegal, South Africa, Tanzania, Uganda), as of July 2011. This project aims at reducing the digital divide in Sub-Saharan Africa. It also aims to support the implementation activities of the 8th Africa-Europe Partnership, the transfer of skills for capacity building and development of STI in Africa, and the construction of a community to strengthen cooperation in research between Europe and Africa.

2.7.3.6 The African Science Academy Development Initiative (ASADI)

The African Science Academy Development Initiative (ASADI) is a 10 years effort, launched in 2004 to strengthen the capacity of African science academies to inform the public policy and public discourse with independent advice based on the scientific evidence. Supported by the Bill & Melinda Gates Foundation and administered by the U.S. National Academies of Sciences, the initiative is mostly focusing on efforts to improve human health. Its third international conference was held in Dakar, in November 2007 on "*Water and Health*", also in close collaboration with the National Academy of Sciences and Techniques of Senegal (ANSTS), an active stakeholder of ASADI, and the African Regional Centre for Technology (ARCT).

2.7.3.7 Other Collaborations

A number of other initiatives with specific programmes have also been launched by various specialised international institutions (FAO, OMM, WIPO, WHO, UNIDO, etc.) and development banks such as the African Development Bank (AfDB) and World Bank. They are benefitting a number of African countries and relate mainly to strengthening capacity for research, training (scholarships) and adding value to the results of national research projects.

2.8 PROGNOSIS

Despite the number of constraints (human capital, funding, infrastructure, equipment, etc.), Senegal seems committed moving in the direction of a technology-based future.

To consolidate this trend, it becomes urgent to foster a viable industrial development dynamics for a better economic growth with a view of sustainable emergence, on a competitive production basis, given the multiplier effects of the industry on other segments of the economy, especially agriculture which remains a key sector.

For this purpose, the information gathered during interviews allowed us to draw up a typical profile, including a situational inventory, strengths, weaknesses, recommendations and prospects.

2.8.1 STRENGTHS AND WEAKNESSES OF RESEARCH IN SENEGAL

The physiognomy of Senegalese research, in overall terms, presents a number of common characteristics in terms of both strengths/weaknesses and opportunities/threats. Therefore, prior to examining the specific features of each research sector, we will first outline general considerations.

2.8.1.1 General Considerations

2.8.1.1.1 Strengths

One of the major strengths is the commitment of the Senegalese government authorities in a process of consolidation, rationalization and redeployment of the Higher Education and Research system, in particular by: i) giving more importance to Science and Technology, to Research and Innovation; ii) establishing two new universities in Dakar and Kaolack; iii) signing Performance Contracts with all public universities, iv) adopting a decree establishing the National Authority for Quality Assurance in Higher Education; v) Setting up by, Ministerial Decree, of the National Steering Committee of the project on Science and Technology Teaching Development (CNPDEST); and vi) Conducting the National Dialogue for the Future of higher

Education (CNAES) which, among other crucial issues, considered the implementation of a policy for the development of science, technology, engineering and mathematics (STEM; MESR, 2013-a).

Senegal has several other strengths in the field of Science, Technology and Innovation (STI), in particular for R&D. Among these, are following elements:

- The human resources, in terms of both research lecturers and the number and diversity of its doctoral students. It is also worth noting the new boost to R&D provided by inter-institutional and interdisciplinary approaches, the first promoted by the National Agricultural and Agribusiness Fund (FNRAA) and the second by the doctoral schools;
- The existence of important research, training and R&D facilities at universities, R&D centers and some technical ministries. In addition, there is a diversified and high quality institutional framework, with regard to the number of national, regional and international R&D institutions and various STI promotion structures such as the ANRSA, ANSTS, ASN, ASPIT, CNDST, etc.;
- As first African country having adopted and submitted in 2011 a National Plan for the Development of Intellectual Property (NPDIP), Senegal is now in a process of setting up a National Council for Coordination and Development of Intellectual Property (NCDICIP) and a National Committee on Geographical Indications (NCGI);
- The vitality of scientific and technical cooperation of Senegal with many sub-regional, regional and international institutions. In this regard, the large number of these, represented in the country and frequent organization in Dakar, as well as in other cities, of several regional and international scientific events (seminars, conferences, workshops, etc.), constitute a perfect illustration.

2.8.1.1.2 Weaknesses

The weaknesses in STI relate mainly to:

- the absence of a vision and a clearly-defined scientific and technological policy embodied in a strong government agency with clearly-defined research priorities and substantial resources, in particular with structured and coherent activities, a sectoral Policy Statement and meaningful, harmonized and coordinated national research programmes;
- the lack of vitality and political visibility of the body governing scientific and technical policy: no inter-ministerial (or presidential) councils on research, absence of a policy for funding ongoing relevant research and lack of coordination due to the partitioning of ministerial supervisory bodies;
- little attention is paid to STI during budgetary discussions, hence the extremely small proportion of the overall budget earmarked for public investment in research, leading to a lack of human, financial and material resources (underequipped laboratories and workshops);
- lack of status to attract researchers and no harmonisation of the status of research personnel working in different public institutions, leading to a significant brain drain and an ageing generation of existing researchers and personnel;
- low perception of the research impact on the development of the country due to lack of dissemination and exploitation of R&D results resulting from the insufficiency of demand-driven research, in the absence of appropriate mechanisms and a rational and coordinated national research and innovation system;

- relatively low scientific production and inadequacy of scientific periodicals;
- inadequate operational training of human resources for research and imbalance in the technician/researcher ratio; and
- partitioning of Research leading to the existence of small poorly equipped and performing laboratories

2.8.1.1.3 Opportunities

The scientific community, decision-makers and funding institutions firmly believe in the importance of STI as a basis for social and economic development. Therefore, the government is concerning itself with making use of science, systematically commissioning studies to shed light on major decisions and action to be taken. Thus, "Senegal 2035" Prospective Study has identified "technological innovation" as a structuring key variable for the future. It is projected by 2035 to build an "Emergence in Solidarity" society i.e. a form of development that reconciles economic imperatives with intra and intergenerational solidarities.

Moreover, the strong messages delivered in the direction of the importance attached to the role and place of the STI in the development process of Senegal, both in the General Policy Statement of the Prime Minister and in the President of Republic address during the last award ceremony of his Great Prize for Sciences, are all good opportunities.

Furthermore, the eleventh Economic and Social Development Framework Plan (PODES) embraces STI in its strategic guidelines and as a decisive factor in action to be taken (MEF, 2012-a). This choice promises a favourable outlook for the essential reworking of Senegal's scientific and technological policy, since the plan's strategic orientations and the resulting lines of action will inspire sectoral Policy Statements as well as national programmes and projects eligible under the Three-Year Public Investment Programme (PTIP).

More recently, after the National Dialogue on the Future of Higher Education (CNAES, January 6 to April 9, 2013), a 2013/ 2017 Priority Reforms Programme for Higher Education and Research in Senegal and Development Plan for Higher Education and Research (PDES) were defined (MESR, 2013-a and MESR, 2013-b). Thereafter, the President of the Republic took major decisions concerning Higher Education and Research (MESR, 2013-c).

Finally, we should mention the election in the National Assembly of a number of scientists who are aware of the importance of building a national strategy and the need to settle the question of the status of researchers, so that STI serves as a driving force for development. Other noteworthy opportunities include the following:

- political and social stability;
- financial institutions such as the African Development Bank, World Bank and Islamic Development Bank are becoming more and more involved in funding STI and R&D projects;
- the introduction of information and communications technologies that are favourable to remote learning;
- the creation and dynamism of the Senegal National Science and Technology Academy (ANSTS) and the future establishment of a National Scientific and Technical Research Council (CNRST);

- the existence of the African and Madagascar Higher Education Council (CAMES), the Association of African Universities (AUA), the Francophone University Agency (AUF), and an international scientific community open to collaboration
- the advent of the new Industrial Redeployment Policy (PRI) in Senegal which aims since 2000 to build a competitive dense diversified and decentralized industrial base integrating small and medium-sized enterprises and small and medium-sized industries (SME-SMI) for processing agricultural, forestry, fisheries and mining resources.

2.8.1.1.4 Threats

The way in which research governance is spread over various ministries reflects the lack of a national scientific and technological policy, no longer based on unified planning and decision-making as it was from the 1970s to the 1980s. This lack of clear vision and consistency in research coordination is one of the reasons that research structures are partitioned and sound research priorities difficult to establish. Thus, due to a lack of harmonisation, the synergy between research conducted at institutes and that conducted in the universities is low, despite the significant progress seen in the agricultural and agribusiness sectors with the advent of the FNRAA and SNRASP. The following aspects are also worth considering:

- the National Budget document is submitted to the National Assembly, after discussion by the Executive, but there is no margin for manoeuvre on this budget. Furthermore, its structure does not allow for any commission dedicated to research or STI, limiting its powers of decision-making on this matter;
- the gearing down of training courses on offer, especially in the private sector, with the risk of a drop in teaching quality and the value of degree qualifications on the labour market; and
- the large number of strikes and other disruptions in public universities whose frequency is a serious threat to the peace, quality and time *quantum* lessons, often with real risks of “white”(lost) years.

2.8.1.2 Sectoral Considerations

We shall cover only those considerations specific to each sector.

2.8.1.2.1 Offer in Higher Education

➤ Strengths

- human potential within the universities forming a group of national experts in various STI fields;
- diversification of the range of educational courses within the Degree-Master’s-Doctorate system, with improvement in the quality and capabilities of research lecturers and the contribution of UEMOA/WAEMU and CAMES to quality assurance;
- development of national and international partnerships in Senegalese Higher Education.

➤ Weaknesses

- lack of control over inflow and outflow resulting in excessive numbers of students negatively affecting teaching quality with a low teacher/student ratio;
- poor promotion of university teaching and the precariousness of one category of teaching personnel, supply teachers, going hand in hand with falling standards of scientific and technological teaching;

- insufficient infrastructure and scientific equipment in laboratories and poor development of technological and vocational higher education;
- imbalance in the numbers of students reading science and those reading technology-related subjects, a key factor that needs to be addressed.

2.8.1.2.2 Agricultural, Food and Environmental Science Research

➤ Strengths

- funding from the FNRAA and the setting up of the SNRASP;
- quality and competence of research personnel;
- infrastructure (laboratories, research centres and stations) over the entire national territory.

➤ Weaknesses

- lack of coordination due to partitioning of supervisory ministerial agencies;
- multiplicity of agricultural policy documents difficult to fit into an overall plan;
- weaknesses in human, financial and material resources (underequipped laboratories, workshops and training centres);
- extraversion of the population food consumption habits;
- insufficient demand-driven research and development of results;
- insufficient specialised scientific journals and relatively low international scientific production.

2.8.1.2.3 Health Sciences Research

➤ Strengths

- existence of a special Research Division in the organization of the Ministry of Health;
- trust of partners and possibility of outside funding for research and innovation;
- possibility of establishing cooperation agreements with national and international institutions.

➤ Weaknesses

- weak human resources;
- too great a dependence on outside funding for research and innovation;
- the Health Ministry's Studies and Research Division has very little power over researchers at institutions, resulting in problems in coordinating and controlling research projects;
- low involvement of the private sector in health research;
- research lecturers devote less and less time to research as a result of excessive student numbers.

2.8.1.2.4 Economic, Social and Human Sciences Research

➤ Strengths

- A continuous flow of sound information on situational developments and structural changes in the economy from the Forecasting and Economic Studies Directorate (DPEE), and studies by the Development Policy Study Centre (CEPOD) mean that laws can be enacted and strategies implemented whose impact can be decisive on economic growth

(examples: Small and Medium-Sized Business Framework Law, Public/Private Partnership Law, Accelerated Growth Strategy);

- Gender issues are investigated, especially by the Gender and Scientific Research Laboratory of the Fundamental Institute of Black Africa (IFAN) and by the Equality Observatory, responsible for enforcing the Law on Equality;
- The academic expertise and that of the pan-African and multilateral research institutions (CODESRIA, WARC, etc.) are firmly involved in the analysis of development challenges facing policy makers, and take into account global and regional changing context;
- In general, Senegalese societies, their culture and the economy benefit from important knowledge produced by well-established research institutions: faculties and college/university institutes, research centres reporting to ministerial departments, the National Statistics and Demographics Agency (ANSD) and administration bodies that produce sectoral statistics (agriculture, health, water, etc.) and technical planning documentation.

➤ Weaknesses

The social and human sciences are generally 'poor relations', and in this respect we note the following:

- insufficient attention is paid to issues relating to the development of the social and human sciences in national research policies;
- lack of integration of social, economic and cultural dimensions in projects of a technological nature; and
- inconsistencies in the articulation of development frameworks: telescoping of PODES and DPES without a clear definition on how they are linked and what their boundaries are.

2.8.2 ADVENT OF THE NATIONAL POLICY FOR SCIENCE, TECHNOLOGY AND INNOVATION

In the new approach to economic and social development in Senegal, scientific research, ICT and technological innovation should be at the heart of government policies. The main challenges being the increase, the use and sharing of STI achievements and overall ownership by communities as a whole.

Thus, the approach of Industrial Redeployment Policy (PRI), combined with new policies for scientific and technological education and training backed by LMD system, initiates a technological turning point for Senegal. It also calls for the elaboration of an explicit strategy document (Dia *et al.*, 2012). The industrialization process must, in fact, be accompanied by a special strategy with an effective institutional framework based on an integrated system for the promotion of endogenous R&D in Universities, Research Centers or Institutions and driving an internal dynamics for the optimal results utilization.

2.8.2.1 General Considerations

2.8.2.1.1 Human Capital and the Issue of Gender: The ageing population of researchers should be a major concern and medium- and long-term training and recruitment plans are required to attract young people into research in Senegal. The promotion of fairness and gender equality is now integrated as a special dimension of public policy to combat any form of inequality and, in particular, to harmonise the opportunities of men and women so that they can participate on a

level playing field in the development process. However, a special effort should be made to attract and retain girls in scientific disciplines and offer them good career prospects in research (ANSTS, 2010).

2.8.2.1.2 Legal Framework and the issue of Brain Drain: Above all, this is a question of establishing an attractive status for researchers, offering a promising professional career path whilst establishing clear procedures for protecting and adding value to the results of their work. In addition, harmonising the status of research personnel should contribute significantly to retaining the most deserving researchers and slowing down the brain drain which presents a serious threat to the National Research System in Senegal, especially for the Agricultural, Forestry and Field Research System (SNRASP) and the two main research institutes (ISRA and ITA).

2.8.2.1.3 Funding: The setting up of the National Scientific and Technical Research Incentive Fund (FIRST) and the National Agricultural and Agribusiness Fund (FNRAA) as national mechanisms for the competitive funding of research is a very healthy sign. However, the amounts placed in the hands of these funds are insufficient to satisfy all research requirements. Accordingly, it is essential to intensify, diversify and secure ongoing funding, in particular by encouraging private sector participation. Furthermore, all possible efforts must be made to add value to the results of research, whose funding should be guaranteed, strengthened and generalised over all sectors.

2.8.2.1.4 Implementing Programmes and Projects: The efficiency of overall research activities demands strong and ongoing cooperation between the research institutions themselves and also between these institutions and all other stakeholders: public authorities (governing body and other ministries), economic operators, technical or financial partners and civil society, etc. Therefore, the big challenge is the sustainability of the mechanisms put in place, especially funding and the involvement of all partners in the implementation, monitoring and evaluation of research and innovation programs.

For all purposes, among research priorities, we can note programs on following topics:

- Emerging diseases (cancer, AIDS, diabetes, sickle cell anemia, etc.);
- Innovations in agriculture and processing of agricultural products;
- Global factors to boost the national economy competitiveness;
- Climate change, risk and disaster prevention;
- Complex and constantly changing social realities;
- Rediscovery of traditional scientific knowledge, to better situate Senegal in Africa and in the world;
- Intangible heritage and resources of medicine and traditional pharmacopoeia. and
- Decongesting Dakar and distribution of the population

2.8.2.2 Implementing the National Policy for Science, Technology and Innovation (NPSTI)

2.8.2.2.1 Major Elements of the NPSTI: The major elements in the implementation of a national policy for Science, Technology and Innovation (NPSTI) are subject to varying levels of emphasis and should, *mutatis mutandis*, take account of the levels of commitment and involvement of managers whose leadership is decisive. Furthermore, specific socioeconomic elements should be

considered, as well as the cultural realities specific to each country. In Senegal, the following elements are important:

- Identifying and evaluating needs and priorities;
- Defining a vision and a mission;
- Defining strategic objectives (overall and specific);
- Defining strategic pillars (basic and sector-based);
- Setting up an institutional framework and mechanisms for the NPSTI;
- Mobilizing resources and building capacity for the STI/R&D potential;
- Setting up a legislative and regulatory framework;
- Disseminating information and raising awareness;
- Encouraging cooperation and partnership in STI/R&D;
- Promoting a national scientific and technological culture;
- Monitoring and evaluation.

2.8.2.2.2 Resource Mobilization: The availability of consistent resources is essential for the application of any policy. Therefore, an effective strategy and special efforts to mobilize both internal and external, but also public and private resources, should be developed to meet all needs. In this regard, It is pleased to note that "*Strengthening national capacities in science, technology, information and innovation*" has now become a strategic objective (SO) of the Orientation Plan for Economic and Social Development (PODES- MEF, 2012-a).

2.8.3 GENERAL PROSPECTS AND RECOMMENDATIONS

2.8.3.1 Prospects for Research

Any policy, from conception to implementation, is a process involving major actors whose roles are different but complementary and synergistic. They must be part of a partnership dynamic, with a constant flow of information interchange and sustained collective action. For the advent of the Senegalese National Science, Technology and Innovation Policy (PNSTI), the Government, through the Higher Education and Research Ministry (MESR), remains in charge but needs the full support and involvement of all actors, in consensual thematic issues related to national development priorities. This means that all parties must agree on a precise schedule of activities to be conducted, with clear demarcation of respective responsibilities.

2.8.3.1.1 Central Coordination: The efficiency and sustainability of the national research and innovation system requires, under the leadership of MESR, the establishment of an effective orientation, coordination and funding mechanism of priority R&D programs provided with optimal human, material and financial resources and which enables results extension, development and utilization. This mechanism would also make attractive R&D / STI environment, with a strong involvement of young people and women and would value national expertise providing motivating status, protecting intellectual property and promoting brain turnover rather than brain drain, as well as consolidating information and communication system for research. This demands constant support from all stakeholders and coherent and continuous government action. The major opportunities for the MESR relate to the following:

- setting up a National Scientific and Technical Research Council;
- drafting and adopting a National Research Strategy document;
- setting up a National Research and Education Network (NREN);

- drafting and adopting a National Science, Technology and Innovation Policy document;
- consolidating national, regional and international cooperation on STI;
- promoting scientific and technological excellence (Great Prizes of the President of Republic) and motivating young people and women with scientific and technological aspirations;
- promoting scientific journalism to raise awareness on STI among the general public.

2.8.3.1.2 Scientific and Technological Research: The prospects for scientific and technological research would involve consolidating achievements and reorientation towards sustainable growth and development in various sectors (e.g. agriculture, mining, industry, etc.). This will, moreover, involve an effective commitment to partnership by first opening up university decision-making bodies to other research institutes and vice versa, with representation from the private sector and NGOs, and then taking advantage of mechanisms for mobilizing funding and scientific intellectual resources.

2.8.3.1.3 Social and Human Sciences Research: The specific prospects to be highlighted relate to research of an economic, cultural and social nature. In terms of research priorities, programmes should be set up to drive competitiveness in the economy, as well as focusing on other issues, such as climate change, risk and disaster prevention, introducing the unpaid work of women (caring, cooking, housework) into the national accounting, rehabilitation of traditional knowledge, exploitation of non-material heritage, medicinal resources and traditional pharmacopoeias, decongestion of Dakar, etc.

2.8.3.2 Recommendations

Recommendations that we believe are appropriate to formulate stand first in a national prospects, then in the context of the OIC, before that at regional and international levels. Obviously, further study should indicate an order of priority to these recommendations as well as deadlines and modalities for their implementation.

2.8.3.2.1 National Outlook: Strengthening and consolidating scientific and technical potential by creating an appropriate legal framework, and above all providing adequate resources for improving scientific and technical research and innovation present major challenges if Senegal is to be transformed into an emerging economy, based on knowledge. The following lines of action are recommended, the majority derived from the work of Commission No 5 on “Scientific Research, Information and Technology” as groundwork for the 11th Economic and Social Development Framework Plan (PODES) (MEF, 2011-a):

- **Stabilising the institutional framework of science and technology policy:** reworking the national scientific research policy and placing it in the hands of a strong, individualised, high-profile and stable ministry, outside Higher Education, with supervisory powers over the majority of research institutions;
- **Drafting and adopting an effective national science and technology policy,** with a clear vision, incorporating a specific strategy for technological innovation and closely linked to the National Economic and Social Development Policy (PNDES);
- **Defining a legal framework for science and technology policy and raising the status of researchers to improve their lives:** harmonised regulatory legislation attractive to researchers in all national research institutions; codification of procedures for adding

value to and commercialising the results of research; development of community living places;

- ***Strengthening the mechanisms for funding research and innovation:*** increasing research funding from its current level of 0.3% of GDP to a minimum of 1%, in line with the recommendations of the African Union and UNESCO as well as the OIC; putting in place mechanisms for funding innovation; boosting the technical and managerial capacities of small and medium-sized businesses and small-scale industries; creating former student (alumni) associations, parents associations and identifying sponsors whose donations and names can be associated with an auditorium, classroom, etc.;
- ***Improving the efficacy and competitiveness of the universities and other national research institutions:*** strengthening the capacities of research personnel, and consolidating STI infrastructure and equipment; allowing for at least 1,000 researchers or scientists per million inhabitants by 2025 and putting in place a department for science and technology communications and monitoring; Consolidate the National Higher Education Quality Assurance Agency (ANAQ-Sup) and drafting strategic plans and performance contracts for the universities and public research institutions; creating a Special Fund for promoting publications and protecting intellectual property rights;
- ***Encouraging inter-institutional collaboration in R&D and innovation, and strengthening the participation of young people and women in research and scientific careers:*** redefine the institutional anchoring of research and open up research institutions; create technical platforms for collective use, in order to encourage collaborative work, information sharing and integration of programs and projects; setting up, in all sectors, references that take into account youth and gender issues;
- ***Promote the involvement of Senegalese scientific and technological Diaspora in the development and implementation of national teaching, research and innovation programs,*** by establishing mechanisms and specific strategies for identifying and using the skills of expatriates;
- ***Strengthening national structures for adding value to scientific and technological research and promoting cooperation and public-private partnerships:*** building science parks and increasing the number of extension, transfer of research results and technological monitoring over the entire national territory; putting in place a true National Scientific Information and Innovation System (SNISI); developing technology platforms and private pilot plants for demonstration and production, with appropriate equipment and serving as incubators and nurseries for business start-ups, strengthening the ties between businesses and research institutions, in order to attract private investment;
- ***Encouraging close collaboration between businesses and universities/research centres:*** developing shared governance with strong public-private partnerships, taking account of intellectual property protection; welcoming doctoral students into businesses so that they can prepare their theses on subjects of interest to business; creating interfaces with the private sector for disseminating and transferring research results in a real time environment; creating Higher Institutes of Vocational Learning

(ISEP) at all universities to diversify the courses on offer, especially in the field of technology; putting in place tax, legal and financial incentives for businesses that invest in research, and making use of research results;

- **Encouraging collaboration between universities and research centres and the keepers of traditional or endogenous knowledge:** defining a strict regulatory framework governing occupations and commercial exploitation of this knowledge; rationalising, codifying and adding value to this knowledge by protecting its intellectual property;
- **Promoting information for developing and consolidating Senegal's position in Information and Communication Technologies (ITC):** putting in place i) a digital system for the economy with reliable information, and functional infrastructure for documentation for collecting, processing and adding value to information as a whole; and ii) a portal and database allowing all universities and R&D institutions access to information on funding opportunities (competitive funds, etc.);
- **Promoting a culture of science and citizenship:** undertaking vigorous campaigns in the educational system and media to promote and instil a veritable culture of science and innovation, targeting both children and adults; integrating a civic culture of “buy Senegalese” and reinforcing a scientific and technical approach among journalists in terms of both initial and ongoing training.

2.8.3.2.2 Prospects for the OIC Member Countries

- Strengthening cooperation and integration between Senegal and the OIC member countries especially on the following issues:
 - ✓ implementation of scientific and technological policies;
 - ✓ scientific and technological research and development of research results, especially in leading edge technologies (biotechnology, nanotechnology, biofuels, ICT, etc.);
 - ✓ exchange of strategic information and visits by experts, lecturers and researchers;
 - ✓ raising quality standards in Higher Education and research;
 - ✓ distance learning for scientific disciplines;
 - ✓ utilizing of national scientific and technological diaspora.

With a view to integration, solidarity and cooperation, it is therefore important that Senegal and the other countries of the Ummah are able to come together and adopt a concerted approach to STI. In this respect, the countries of the OIC, both bilaterally and within the framework of the community bodies set up (COMSTECH/STIO, ISESCO, SESRIC, etc.), could harmonise their national strategies, whilst accommodating the specific characteristics of each country.

- **Facilitating researcher mobility and co-qualification:** This is a question of creating mechanisms and frameworks for researchers to share experiences (networking) and harmonising the support facilities in different regional units (synergy).
- **Regional and subregional organisations** would also be invited to set up researcher directories and research/innovation databases, and use their facilities to promote women's participation in scientific activities (ex. UNECA – and its Gender Centre).

- Taking advantage of the proposal of the Islamic Development Bank (IDB) to its Member Countries on making 10% of their financing requests for STI projects: Important projects and programmes for strengthening capacity (equipment, infrastructure, training, etc.), cooperation and partnerships could be implemented thanks to this opportunity.

2.8.3.2.3 Regional and International Outlook

- ***Strengthening cooperation in and integration of regional and international scientific and technological research:*** This is a question of developing leverage for growth and a means of concerted action for defining innovative solutions to development issues. Furthermore, to stem the brain drain and guarantee a critical mass of highly-qualified science and technology experts, it is essential to support the creation of research institutions and centres of training excellence throughout the continent, especially in leading edge fields such as molecular biology, biotechnology, informatics, nanotechnology and new materials, and those related to crucial sectors such as food security, energy, treatment of tropical diseases, soil erosion, water quality, deforestation and desertification.
- ***Promoting the insertion and/or involvement of expatriates and the Senegalese scientific community abroad:*** The strategy to be put in place should involve the Senegalese diplomatic corps (embassies in countries with high scientific and technological potential) and be based on i) paying greater attention to migratory issues in bilateral cooperation programmes; ii) high performance monitoring system of internal and external migratory flows; iii) involvement of expatriates in research and/or development actions by promoting transfers of technology, knowledge and know-how and iv) promoting partnerships and cooperation with foreign institutions at which Senegalese scholars are working, at both regional and international levels.
- ***Promoting intellectual property at universities and other research institutions:*** The African Intellectual Property Organisation (AIPO), African Regional Intellectual Property Organization (ARIPO), European Patent Office (EPO) and World Intellectual Property Organisation (WIPO) should be encouraged to raise their profiles within universities and provide universities and research institutions with ample information on safeguarding intellectual property rights.

3. ADDENDUM

As specified in the *Disclaimer*, investigations and data collection that supported the general drafting of this report started shortly before the advent of the change of regime, which occurred in March 2012 and continued until April 2013. Thus, this chapter must be read in the light of the major developments that took place since then and that can be perceived through three parameters:

- *at first*, the updating of national socio-economic data, especially with the publication in 2013 of the results of the last general population, housing, agriculture and livestock census (RGPHAE: ANSD, 2013), along with the Demographic and Health Surveys (DHS continues 2012-2013 and 2014: ANSD, 2015);
- *secondly*, the major political reforms recently implemented, mainly the adoption of part of the Act III of decentralization, highlighted in a new code for local governments and, on another hand the reforms initiated by the Ministry of Higher Education and Research (MoHER) and
- *thirdly*, the changes made in the approach to the overall management of the national economy, with the adoption by the Executive Institution of the Plan for an Emerging Senegal called Plan Senegal Emergent (PSE), the new strategy for a national economic and social development.

3.1 THE UPDATING OF NATIONAL SOCIO-ECONOMIC DATA

The results of the RGPHAE (ANSD, 2013) show that the Senegalese demographic profile maintains its main specificities:

- Senegal has a population of 13,508,715, with a slight predominance of the female element. Indeed, women represent 50.1% of the total population versus 49.9% of men;
- The population is still very unevenly distributed, with a national average density of 69 people/square kilometer. The population remains concentrated in the western and central part of the country. The average density is 5735 people/km² in Dakar, against 9 p/ km² in the region of Kedougou in the East;
- The population growth rate remains high but stable (2.5% in the period between censuses from 1988 to 2002, the same figure between 2002 and 2013)
- The natural movements are characterized by a still high fertility rate and mortality indicators that are overall decreasing, except for maternal mortality;
- Fertility remains high but stable. The total fertility rate was 5.3 children per woman as per the 2002 General Census of Population and Housing (GSPH) and the 2012 continued Demographic and Health Surveys (DHS), it declined slightly in 2013, with 5.1 children per woman (ANSD, 2015).

Thanks to efforts in child health and against infectious diseases, the gross death rate evolved to 8% in 2013 and child mortality indicators have improved overall, but more in urban areas than in rural ones, as indicated by the figures in the Tables 1-5 below (ANSD, 2015).

Addendum Table 1: Mortality Indicators for Children- RGPHAE - 2013 (in %)

Indicators	Overall	Urban	Rural
IMR	53	41.1	62
JMR	27	15.5	34.2
IJMR	78.7	56	94.2

IMR: Infant Mortality Rate; JMR: Juvenile Mortality Rate; IJMR: Infant-Juvenile Mortality Rate

Addendum Table 2: Continued DHS: Child Mortality (in %) Overall

Indicators	Continued DHS 2012-2013	Continued DHS -2014
IMR	43	33
JMR	23	22
IJMR	65	54

IMR: Infant mortality rate; TMJ: Juvenile mortality rate; IJMR: Infant-juvenile mortality rate

As for maternal mortality, it seems worrying. It amounts to 434 deaths per 100,000 living births in 2013 (RGPHAE), against 409 during the 2010-2011 Health and Demographic Surveys - Multiple Indicator Cluster Surveys HDS-MICS. In 2013, the indicator reached 439 deaths in the rural areas and 921 deaths in Kedougou, a poor region with a very low technical platform.

Life expectancy was 64.8 years in 2013, with an advantage for women (66.5 years) and urban areas (67.4 years).

Addendum Table 3: Life Expectancy RGPHAE-2013 (year)

Total	Men	Women	Urban	Rural
64.8	63.2	66.5	67.4	62.7

The Senegalese population is still extremely young. The average age is 22.4 years and the medium age (half of the population) is 18.7 years.

Urbanisation remains rampant (see figures below). The urbanization rate increased steadily from one census to the other since 1976 (ANSD, 2015).

Addendum Table 4: Evolutions in the Urbanization Rate (%)

RGP 1976	RGPH 1988	RGPH 2002	RGPHAE 2013
34	39	41	45.2

The urban growth rate increased from 3% from the inter-censal period 1988-2002 to 3.5% between the RGPH of 2002 and the RGPHAE of 2013. Meanwhile, the growth rate of the rural population decreased from 2.3% between 1988 and 2002 to 1.7% between 2002 and 2013.

Addendum Table 5: Evolution of the Urban Growth Rate and the Growth Rate of Rural Population (%)

Indicators	1976-1988	1988-2002	2002-2013
Urban Growth Rate	3.7	3	3.5
Growth Rate of Rural Population	2.2	2.3	1.7

The intense demographic growth, rural migration and the erection of certain localities into municipalities explain, to a large extent, the high level of urban growth in Senegal. Moreover, it is a macrocephalic urbanization. Indeed, Dakar the capital alone accounts for 49.6% of the urban population (almost half of it) and displays an urbanization rate of 96.4% (almost 100%).

Regarding the status of the living conditions, the results of the 2013 RGPFAE show that efforts are still needed in access to basic social services.

The Gross Enrolment Rate (GER) in primary education which amounts to 80%, is below the MDG target. In the population aged 10 and over, only 45.4% are literate. The illiterate represent 54.6% of the population. The majority of illiterates are women (54%) and people living in rural areas (62.7%).

The population of working age (15 years and over) represents 58.2% of the total population. There is a registered unemployment rate of 25.7%, reflecting a low turnout of the active population in the production of goods and services.

Anthropogenic pressure on the environment remains high. The wood (50.4%) and gas to a lesser extent (32.7%) are the most used combustible materials in cooking by households.

Access to sanitation is still low. The main mode of drainage is the spillage in nature and involves more than one of two households (56.5%). A small proportion of households use a sewage system (28.7% in urban areas and 1.5% in rural ones).

As for access to safe drinking water, remarkable progress has been made. The tap is the main mode of water supply for households (73.8%). But overall, only 37.4% of these households have a tap in their homes, 16.3% use public taps or the water hydrant. In urban areas 79.2% of households have access to a private tap. In rural areas, 57.1% of households use a public tap.

3.2 THE VARIOUS POLITICAL REFORMS MADE

3.2.1 THE ACT III OF DECENTRALIZATION

The Reform called the *Act III of Decentralization* is highlighted in a new law, the 2013-10 of December 28, 2013 Law, establishing the general local governments code.

The major objective of the *Act III of Decentralization* is to ensure the rebuilding of territorial action through the decentralization reform. Its purpose is to organize Senegal into viable territories that are competitive and can foster sustainable development.

The main lines of the Act III are as follows:

- The elimination of the region as a local government;
- Transformation of departments into local governments (their current administrative boundaries are maintained);
- Complete communalisation, i.e. the erection of all rural communities and districts into municipalities;
- The creation of the City by joining towns that constitute it;
- The distribution of 9 areas of transferred competences between the two types of local governments now existing, the department and the municipality.

3.2.2 REFORMS OF THE HIGHER EDUCATION AND RESEARCH SECTOR

3.2.2.1 Initiated Reforms

The higher education and research sector has evolved significantly since 2013. Indeed, in the context of the implementation of the decisions of the *Presidential Council on Higher Education*

(MESR, 2013-d), consecutive to the *National Consultation on the future of higher education* (CNAES-MESR, 2013-a), the MoHER has taken many initiatives, made many reforms and adopted several documents, despite an often unsteady situation in universities. Among the highlights, one can note:

1. The 2013/2017 Senegalese Higher Education and Research Priority Reforms Agenda, adopted in August 2013, with the following focus areas:

- *Reforms to strengthen the steering of activities;*
- *Reforms for an effective institutional governance ;*
- *Reform to promote STEMS in all the components of the education system;*
- *Reforms for a diversified and quality training offer;*
- *Reforms for students' success;*
- *Reform of Cheikh Anta Diop University (UCAD);*
- *Reforms to boost national research;*
- *Reforms of funding mechanisms for higher education and research; and*
- *Reforms for the promotion of cooperation and the internationalization of the higher education and research system.*

2. Higher Education and Research Development Plan in Senegal. PDESR 2013-2017, adopted in August 2013 and that includes the following strategic areas:

- *Evolution of the number of high school graduates and new policy on access to higher education*
- *Improving the efficiency of the higher education system: greater internal efficiency and regulation of access to scholarships, grants and academic works;*
- *A controlled increase in Higher Education and Research expenses; and*
- *Funding Sources for Higher Education and Research expenditures.*

3. The achievement of the will to endow Universities and public research institutions with strategic plans and performance contracts (PC) that are funded by the Country and the World Bank (IDA). As Toguebaye emphasizes (2014), these contracts are part of a quality approach to training strategies, research and service delivery, especially when the following three requirements are addressed:

- *ensure the institution's performances;*
- *enhance the credibility of diplomas and research results; and*
- *continually improve the confidence of the society and the employment market vis-à-vis the institution.*

4. The appointment of a new Director and the revival of the activities of the *National Centre for Scientific and Technical Documentation (NCSTD)*, after years of lethargy;

5. The start up and consolidation of the activities of the ***National Agency for Quality Assurance in Higher Education (ANAQ-Sup)***, established by the Decree number 2012-837 - ANAQ SUP. ANAQ SUP is an autonomous state agency under the administrative and technical supervision of the Ministry of Higher Education and Research (MoHER) and the agency is responsible for ensuring, monitoring and improving the quality of curricula and institutions of higher education and Research. Among others, it provides technical advice to the Minister of Higher Education on accreditation of higher education institutions and periodically evaluates the teachings, tools and pedagogical methods in the institutions and education sectors;

6. The extension of the National University Card, along with the creation of the Senegal Virtual University (SVU) already operational since the Academic year 2013-2014 and two other universities: the 2nd University of Dakar named after Professor Amadou Mahtar Mbow, former Director General of UNESCO and the University of Sine Saloum in Kaolack (USSK), recently named University of Sine Saloum El Hadj Ibrahima Niassé (USSEIN), of the name of a great religious leader in Islam. Both universities will be operational in 2016. We need also to remember that the creation of an Arab-Islamic University is planned;

7. The **Support Project for Senegal Virtual University (SVU)**, was funded via a loan from the African Development Fund (ADF / AfDB), and was effective in January 2014 ; its completion is expected in December 2016. The already operational technological approach to the SVU, is based on an intensive use of ICT to promote equal access to young graduates from Senegal to training that ensure their employability. It comprises a first phase of five (5) Digital Open Spaces (DOS), to reach young people, even in suburbs, in Dakar, Saint Louis, Thies, Kaolack and Ziguinchor.

8. The establishment in each region, starting with Thies, Dakar, Matam and Bignona of **Higher Institutes for Professional Education (ISEP)**, with short technical courses. The ISEPs have primary duties:

- *To contribute to the diversification of the supply of higher professional education;*
- *To offer opportunities of continuing professional education for high school graduates or holders of a degree recognized as equivalent to that;*
- *To participate in the training of senior level technicians for a High School Diploma + 2 years;*
- *To conduct assessments and develop projects for private and public companies;*
- *To train operational agents in defined areas;*
- *To contribute to the implementation of conditions of permanent qualification for citizens;*
- *To promote and develop the existing advantages of the site and of the surrounding areas;*
and
- *To organize specific part-time or full-time training for working people*

9. The adoption of the Decree No. 2014-565 of May 6, 2014, that aims at organizing the Ministry of Higher Education and Scientific Research (MoHESR) and creating a *General Institute of Research* therein;

10. The adoption of the Law No. 31/2014 of the 26th of December 2014 on Senegalese public Universities which works on the status, tasks and organizational principles of universities. However, it states that the financial regime that is applicable to universities is set out by decree and does not govern the operation and organization of SVU and ISEP.

3.2.2.2 Planned Reforms

Among the short-term perspectives of MoHER we have four key initiatives :

- The creation of the **National Research and Innovation Fund (FNRI)** to be managed by the Ministry in charge of Research and that replaces the *Fund for Scientific and Technical Research drive (FIRST)*;
- The adoption of the draft **Law for the Orientation of Higher Education, Promotion of Research, Innovation, Technology and Science (ESPRITS)**. This law has a Strategic Framework (Mission, Ethical Values, Organizational Principles) and an Institutional Framework (Governance Mechanisms, Higher Private Education). However, there is a need to precise that this project is still quite controversial within the Higher Education unions;
- The construction of the **City of Knowledge** in the new urban hub of Diamniadio on 14 ha, with its different divisions: i) Administration; ii) Research, technology transfer and innovation; iii) Training; iv) Promotion of scientific culture; v) Conference Centres; and
- The creation of the National Centre for Scientific and Technical research (CNRS) that is responsible for:
 - ✓ *implementing research and technological development programs in the framework of set choices and priorities;*
 - ✓ *contributing to the dissemination of scientific and technical information, the publication of research and also conducting technological watch activities;*
 - ✓ *strengthening national research infrastructure;*
 - ✓ *performing services for the benefit of research operators and contributing to the valorisation and transfer of research findings;*
 - ✓ *establishing agreements or contracts of association, as part of research activities or services with institutions and public or private research organizations;*
 - ✓ *creating synergies between different research teams that work on priority themes (networks, hubs of excellence) and businesses.*

The CNRS includes very high level infrastructure / shared laboratories that provide a *Technical Support Platform for Research and Innovation for Economic Emergence (PATRIE)*. It will have sophisticated equipment covering the fields of Molecular and Elementary chemical analysis, materials characterization, molecular biology etc. The availability of these equipments is first in line with the huge resource pooling policy, often expensive to purchase and operate, but that offers the possibility of producing additional data needed for the development of research. That institution will generate knowledge in areas of research and promising technological development such as the environment, food, materials, energy, health, pharmaceuticals, biotechnology, etc. The project has started with the process of implementing an electronic microscopy laboratory and a facility with a planetarium and an aquarium.

3.2.3. THE NEW APPROACH TO THE NATIONAL ECONOMY STEERING STRATEGY

The Ministry of Planning has been put in place again for a brief period between 2013 and 2014 and was merged with the Ministry of Economy and Finance, which became the Ministry of Economy, Finance and Planning (MEFP) in 2014.

In this new department, all the services of the former Ministry of Planning and other ministries, dealing with activities consubstantial with development planning are gathered in a new structure called the Directorate General of Planning and Economic policies (DGPPE).

A new reference document which de facto serves as a national plan, was adopted in February 2014. This is the *Plan for an Emerging Senegal (PSE)*, which is defined as part of a federating and coherence creating tool for previous strategy documents in order to accelerate emergence. This is both a strategic and thematic vision that seeks to revise the prism of the development approach in Senegal. It is a long-term plan developed by the Senegalese government and which sets the year 2035 as its implementation bottom line. Its vision is to build "*an emerging Senegal in 2035 with a united society in a state of law.*" The strategic guidelines of the PSE are organized around three pillars which aims are:

- first pillar: to ensure macroeconomic stability and the launching of economic take-off programs. This pillar contains among its major axes, technology and know-how as determinant elements of the structural transformation of the economy and advocates supporting growth through the learning and the utilization of traditional knowledge and know-how in the implementation of activities.
- second pillar: increase access to basic social services and social security and to ensure the conditions for a sustainable development. This pillar aims at meeting social needs through the promotion of quality education and maternal and child health, the economic integration of human resources, the establishment of safety nets to prevent the vulnerability of certain segments of the society, social protection and the preservation of the environment;
- third pillar : to meet the requirements of good governance, with the establishment of the rule of law through the strengthening of institutions and local governments, the accountable management of public resources, and the promotion of social dialogue, peace, security and African integration.

Under the achievements accounted to the PSE, we can list: i) the launch of the construction of the highway Thies - Touba ("Ila Touba"); ii) the second Dakar University, named Amadou Mahtar Mbow, the University of Sine-Saloum in Kaolack, called El Hadj Ibrahima Niasse (USSEIN); iii) the effectiveness of family security grants destined to the very poor and the Law on the reduction of the cost of rent; iv) the introduction of universal health coverage (UHC); v) the implementation of the Acceleration Program for Senegalese Agriculture (PRACAS); and vi) the adoption of the social stability and economic emergence pact designed to build consensus of social actors around emergence.

The list of the 27 *flagship projects* of the PSE is attached as Appendix 3, for all practical purposes.

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5. APPENDIXES

APPENDIX 1: PROGRAM OF VISITS AND MEETINGS

APPENDIX 2: GEOGRAPHIC LOCATION OF PUBLIC & PRIVATE HIGHER EDUCATION AND RESEARCH INSTITUTIONS

APPENDIX 3: FLAGSHIP PROJECTS SENEGAL EMERGING PLAN (PSE)

APPENDIX 1: PROGRAM OF VISITS AND MEETINGS

Date	Visited Institutions	MEETING	
		Surname & Name	Contacts (Telephone, Email)
13/01/2012	MEF.DGP.DPN Rue René Ndiaye BP 4017	Sékhou Diakhaby	(+221) 77.651.33.69 (+221) 33.823.88.91 (+221) 33.823.14.37 diafa2000@hotmail.com
18/01/2012	MEF.ANSD Rue de St Louis x Rue de Diourbel - Point E, BP 116 Dakar RP - Senegal	Babakar Fall	(+221) 77.450.59.34 (+221) 33.869.21.40 (+221) 33.825.33.32 babakarfall@yahoo.fr babakar.fall@ansd.sn
17-19/01/ 2012	SAINT-LOUIS	Meeting with UGB, ISRA, SAED, GOVERNOR, MAYOR, FARM ORGANIZATIONS / NGOs, CHAMBER OF COMMERCE, INSPECTION, BREEDING, DRDR, WATER AND FORESTS	
	National Center for Livestock and Animal Industries Technicians CNTEIA	Papa Sher Diop	(+221) 77.633. 94.62. pisher59@yahoo.fr
	Chamber of Commerce of Industry and Agriculture of Saint Louis	Moussa Ndiaye	(+221) 77.537. 93.34. cciasainlouis@yahoo.fr
	Rural Community Fass Ngom	Alioune Sarr	(+221) 77.564. 51.70.
	Municipality of Saint Louis / Municipal Development Agency	Demba Niang	(+221) 33.961 .34.27 Demba_niang@yahoo.fr
	Regional Council of Saint Louis	Babacar Faye	fayebabacar@yahoo.fr
	Regional Directorate for Rural Development (DRDR) of Saint Louis	Besdaly Coulibaly	(+221) 77.565.12.59
	Regional Inspectorate of Water and Forests of Saint Louis	Colonel Babacar Faye	(+221) 77.641. 42.92.
	Regional Inspectorate of Water and Forests of Saint Louis	Cdt Abdourahmane Diagne	(+221) 77.918.76.80
	GREEN Saint Louis	Issa Thiaw	(+221) 77.244.79.49 youissa@yahoo.fr
	Regional Inspectorate of Water and Forests of Saint Louis	Capitaine Babacar Dione	(+221) 77.564.37.01
	Governance of Saint Louis	Mamadou Lamine Mané	(+221) 77.547.41.57 (+221) 70.745.18.76 diambaman@yahoo.fr
	GREEN Senegal	Woré Gana Seck	
	INP Hann Mariste, Route des Pères Maristes BP : 10,709.	Moustapha Dièye	(+221) 33.832.65.65(+221) 77.637.36.67
	Université Gaston Berger de Saint Louis	Omar Sougou	
		Abdou Sène	
SAED Ngalèlè, RN2 (Route de Rosso) BP 74 Saint-Louis	Seyni Ndao	(+221) 77.639.15.21 seynindao@hotmail.com	
	Amadou Thiam	(+221) 77.538.58.77 Amadou-thiam@saed.sn	
	Baye Salif Diack	(+221) 77.649.72.71 zalebilal@yahoo.fr	
20 -21 /01/ 2012	THIES	Meeting with UT (ENSA), GOVERNOR, MAYOR, CONGAD, DRDR, INSPECTION BREEDING, WATER AND FORESTS Returned to Dakar on Saturday 21 January 2012	

Date	Visited Institutions	MEETING	
		Surname & Name	Contacts (Telephone, Email)
	Chemical Industries of Senegal (ICS) Km 18, Route de Rufisque - BP 3835, Dakar	El Hadji Mansour Sambe	(+221) 33.939.50.75
23 /01/ 2012	THIES	Meeting with GREEN, CERAAS, CHAMBER OF COMMERCE Departure to Bambey	
24/01/2012	BAMBEY	Meeting with ISFAR, CNRA, PREFET, FARM ORGANIZATIONS	
	National Agricultural Research Center of Bambey	Samba Thiaw	(+221) 77.702.05.73
	Suneor Diourbel Dombe, Diourbel	Bamba Diouf	(+221) 77.450.32.46 (+221) 33.971.14.72
24/01/2012	Governance of Dakar Rue de Essarts	Mme Traoré	(+221) 33.821.88.32 (+221) 33.889.82.92 (+221) 33,822.15.86
24/01/2012	ICS TAIBA THIES		
24/01/2012	Université de Thiès	Ahmet Tidiane Diallo	(+221) 77.569.39.06 (+221) 33 952.21.21 (+221) 951.14.76
24/01/2012	Université de Thiès/ENSA	Ahmet Tidiane Diallo	(+221) 77.569.39.06 (+221) 33 952.21.21 (+221) 33.951.14.76
24 au 25/01/2012	CNRA BAMBEY	Samba Thiaw	(+221) 77.450.32.46 (+221) 33.973.60.50 cnra.bambey@isra.sn
24 au 25/01/2012	ISFAR (Bambey)	Abdoulaye Faye	(+221) 77.819.27.65
24 au 25/01/2012	ISFAR (Bambey)	Abdoulaye Dramé	(+221) 77.637.94.79 (+221) 33.973.61.95 (+221) 33.973.60.60
26/01/2012	Direction des Mines <i>104, rue Carnot - 7^{ème} étage</i>		(+221) 33.822.04.19
26/01/2012	Industry Directorate	Ibrahima Basse	basseibou@yahoo.fr
26/01/2012	MEF.UCSPE Immeuble Peytavin Dakar	Mr Mayacine Camara	(+221) 33.889.21.66
		Mme Fatou Diouf	
		Mr Bassirou Diop	
25- 26/01/2012	Université de Bambey	Matar Seck	(+221) 33.973.30.90 / 86 (+221) 77 536 1346 matarseck@ucad.sn
		Cheikh Mbacké Sène	(+221) 77.651.54.76 boromnaas@yahoo.fr
27/01/2012	PROMETRA Cité des Chercheurs, Bel Air, Immeuble Eva N° 93. Dakar	Mr Katy	(+221) 77.277.30.76 (+221) 33.832.28.50
30/01/2012	ITA Route des Pères Maristes - Dakar Hann - BP: 2765 Hann.	Ababacar Sadick Ndoye	(+221) 77.630.85.38 (+221) 33.859.07.07
31/01/2012	MEF.CEPOD Avenue Carde x Rue Calmette - BP : 4010 - Dakar	Mr Aliou Faye	(+221) 33.821.91.06
01/02/2012	BAD Boulevard Général De Gaulle - B.P 229 Dakar	Gilbert Galibaka	(+221) 77.507.02.26 (+221) 33.820.08.88

Date	Visited Institutions	MEETING	
		Surname & Name	Contacts (Telephone, Email)
02/02/2012	National Assembly Place SOWETO. Dakar. Dakar. BP 86	Balla Moussa Daffé	(+221) 33.849.63.71 (+221) 33.823.34.72
		Abdoulaye Séne	(+221) 77.638.24.62 (+221) 33.823.55.73 Seneabdou@hotmail.com
02/02/2012	MEF.DPEE Sacré Coeur 3 Pyrotechnie Villa n°78 bis derrière la BICIS VDN BP 116 Dakar RP	Mr Pierre Ndiaye	(+221) 33.824.03.01 (+221) 33 824 92 65 info@dpee.sn
		Mr Serigne Moustapha Séne	
03/02/2012	BID Immeuble A.Fayçal, Rue Amadou A.Ndoye angle rue Huart. BP : 3381 Dakar	Rudolphe Coodfried Missinhoun,	(+221) 33.889.11.44 rodck@isdb.org
		Sidi Mouhamed Ould Taleb	
03/02/2012	CORAF/WECARD 7 Avenue Bourguiba BP. 48 - Dakar	Paco Sérémé	(+221) 33.869.96.25 (+221) 33.869.96.18 secoraf@coraf.org
		Harold McCauly	(+221) 33.869.96.18
07-Feb-12	FNRAA Ouest-Foire Cité Air France - Villa n° 6 B.P. : 10 560	Pape Ndiengou Sall	(+221) 77.569.52.51
		Samba Sall	(+221) 77.261.36.57 (+221) 77.529.45.45 (+221) 33.820.77.45
09-Feb-12	CRES N° 1 et 2, Cité Iba Ndiaye Diadji, Pyrotechnie - Rue 10 prolongée près du collège Sacré cœur, Dakar	Boubacar Diaw	(+221) 77.657.42.40 (+221) 33.864.77.57 Papadia3@hotmail.com cres.ucad@yahoo.fr
		Pr Abdoulaye Diagne	
		Mr. Doudou Ndiaye	
09/02/2012	MEF. DCEF 8, rue Docteur Guillet Dakar	Massar Wagué	(+221) 77.549.19.35 (+221) 33.822.12.67 (+221) 33.822.35.62 mrwague@yahoo.fr
10/02/2012	DAPS- Ministère Agriculture Pyrotechnie N°137 - Sacré-Coeur 3 BP 4005	Gorgui Djibril Diallo	(+221) 77.638.99.10 Gorgui_diallo@yahoo.fr
		Ibrahima Sagna	(+221) 77.568.81.67 (+221) 33.864.64.13 (+221) 33.864.64.69 ibsagna@yahoo.fr
13/02/2012	IDEP Rue du 18 Juin, derrière "Assemblée Nationale"	Mr. Adebaye Olukoshi	(+221) 33.823.10.20 (+221) 33.823.32.38
		Thorcisse Ntilivamunda	
		Antonin Benoît Diouf	
13/02/2012	MCGCV - DIRECTION DU GENRE En face Centre de Transfusion Sanguine	Absa WADE	
14/02/2012	CSE Fann Résidence Rue Léon Gontran Damas - Dakar	Jacques André Ndione	(+221) 77.65.14.11 (+221) 33.825.80.66/67 jacques- andre.ndione@cse.sn

Date	Visited Institutions	MEETING	
		Surname & Name	Contacts (Telephone, Email)
16/02/2012	BREDA/UNESCO Unité des Sciences de l'UNESCO Immeuble Freyssline et Fils (4e étage) 34, avenue du Président Lamine Gueye	Abdoulaye Barry	(+221) 77.519.33.90 (+221) 33.822.76.18 (+221) 33.849.23.23
		Antoine Mbengue	antoine mbengue 5@yahoo.fr
		Marie Coly	(+221) 76.294.03.08 m.coly@unesco.org
20/02/2012	CCIAD 1 Place de l'Indépendance, BP 118, DAKAR.	Moustapha Ka	(+221) 77.558. 09.12 (+221) 33.823.71.89 taphasikael@yahoo.fr cciad@orange.sn
20/02/2012	CCIAD/ Observatoire Economique	Yaya Mbodji	(+221) 77.413 .66.59 yambodji@gmail.com
22/02/2012	Université Cheikh Anta Diop de Dakar Avenue Cheikh Anta Diop BP 5005	Mr Abdoukarim Ndoye	(+221) 77.659.23.29 (+221) 33.825.05.30
		Mr Toguébaye	(+221) 77.558.30.47 toguebaye@ucad.sn
		Mr. Pape Gueye	(+221) 77.634.83.47 (+221) 33.821.47.49 (+221) 33.821.47.59 ndiobagueye57@yahoo.fr
23/02/2012	MESUCURRS	Tahir Diop	(+221) 77.630.59.57 (+221) 33.849.71.43/41
24/02/2012	Renewable Energy Division 15, Bd Djily Mbaye, 3ème étage Immeuble ASCOMA Dakar	Lamine Diop	(+221) 33.889.52.02 (+221) 77.523.54.54 lamediodp1953@gmail.com
28/02/2012	CODESRIA Avenue Cheikh Anta Diop X Canal IV BP 3304, CP 18524, Dakar	Ebrima Sall	(+221) 33.824.03.74 executive.secretary@codesria.sn
05/03/2012	BSDA 7 rue Saint Michel x Ngalandou DIOUF	Ndéye Abibatou Youm Diaby Siby	(+221) 33.889.01.86
05/03/2012	BSDA	Aly Bathily	(+221) 77.539.84.42 (+221) 33.889.01.86
07/03/2012	CNDST 61 Boulevard Djily Mbaye	Emmanuel Kabou	(+221) 33.822.96.19
		Oulimata Diagne Mbénar	
08/03/2012	IPD 36, Avenue Pasteur B.P. 220 - Dakar	André Spiegel	(+221) 33.839.92. 02 pasteurdakar@pasteur.sn
12/03/2012	ENDA Av cheikh Anta Diop Immeuble en face Codesria - Bâtiment B 1 ^{er} étage	Mouhamadou Fatih Mbengue	(+221) 77.609.09.23 (+221) 33.869.99.61 (+221) 33-869-9948 fatih@enda.sn
13/03/2012	WARC Rue E x Leon G. Damas – Fann Residence- Dakar	Pr Ousmane Séne	(+221) 33.865.22.77
14/03/2012	IDRC Av cheikh Anta Diop	Mr. Alioune Camara	(+221) 33.859.77.43
14/03/2012	SPIDS Bourguiba x usine Ben Tally Dakar	Djibril BA	(+221) 77.639.05.10 (+221) 33 .824.44.65 @spids.snspsids
15/03/2012	CRAT 17ème étage Immeuble Fahd Ben Abdelaziz - BP 2435 – Dakar	Abderrahim Doumar	(+221) 33.823.77.12
		Mme Maikol Adou	
		Dr. Maach	
		Mr Moussa Sall	

Date	Visited Institutions	MEETING	
		Surname & Name	Contacts (Telephone, Email)
15/03/2012	TROPICASEM Km, 56 Boulevard de la commune de Dakar	Amadou Sarr	(+221) 77.644.72.43 (+221) 33.859.25.25 amadou.sarr@tropicasem.sn tropicasem@orange.sn
		Kéba Alioune Dramé	(+221) 77.647.05.72 aliounedrame@tropicasem.sn
16/03/2012	ENDA GRAF SAHEL BP 13069 Grand Yoff. Dakar	Cheikhou Touré	(+221) 77.547.70.18 tourecheikhou@gmail.com
		Babacar Touré	(+221) 77.639.61.30 babrioro@yahoo.fr
22/03/2012	CIRAD 37, avenue Jean XXIII, BP 6189, Dakar-Etoile	Denis Depommier	(+221) 77.637.18.78 (+221) 33.822.44.84 denis.depommier@cirad.fr
22/03/2012	Petrosen	Joseph Médou Director of Promotion	(+221) 77.529.73.23 (+221) 33.839.92.86 jmedou@petrosen.sn -
29/03/2012	ISRA Route des hydrocarbures Bel-air, BP 3120 Dakar	Dr. Macoumba Diouf	(+221) 33.859.17.19
05/07/2012	ANRSA Avenue Cheikh Anta Diop Immeuble Sicap B	Aïssatou Sophie Gladima Siby	(+221) 33.859.43.70

APPENDIX 2: GEOGRAPHIC LOCATION OF HIGHER EDUCATION AND RESEARCH INSTITUTIONS IN SENEGAL

Regions	PUBLIC INSTITUTIONS			Cities/ Places	PRIVATE INSTITUTIONS			Cities/ Places
	National	Regional	International		National	Regional	International	
Dakar	<ul style="list-style-type: none"> • ANRSA • ANSD • CEPOD • CEREQ • CERER • CERES/LOCUSTOX • CFJ • CRES • CSE • DGP • DPEE • DPV • ENA (administration) • ENA (Arts) • ENDSS • ENEA • ENFM • ENP • ENTSS • FNRAA • INP • ISRA • ITA • Petrosen • UCAD • UCSPE 	<ul style="list-style-type: none"> • CESAG • CRAT • EISMV • ESMT • IDEP • SAR 	<ul style="list-style-type: none"> • BREDA/UNESCO • CIRAD • IDRC • IFPRI • IPD • IRD 	Dakar	<ul style="list-style-type: none"> • IAM • Groupe AFI-UE, l'Univ. de l'Entreprise • ISM • Suffolk University Dakar • Sup de Co • University of Amadou Hampâté Bâ • University of Dakar Bourguiba - UDB • University of du SAHEL-UNIS • University of Foundation and Management College 	<ul style="list-style-type: none"> • CODESRIA • PROMETRA • UCAO • WARC 		Dakar
	<ul style="list-style-type: none"> • CRODT (ISRA Centre) 			Thiaroye				
Diourbel	<ul style="list-style-type: none"> • University of Bambey • CNRA (ISRA Centre) 			Bambey				
Fatick								
Kaffrine								
Kaolack	ISRA Centre				ISM Kaolack			Kaolack

Regions	PUBLIC INSTITUTIONS			Cities/ Places	PRIVATE INSTITUTIONS			Cities/ Places
	National	Regional	International		National	Regional	International	
Kédougou								
Kolda	CRZ (ISRA Centre)							
Louga					ISM Louga			Louga
Saint Louis	<ul style="list-style-type: none"> • University of Gaston Berger • ISRA Centre 	<ul style="list-style-type: none"> • Africa Rice Station 		St Louis	ISM Saint-Louis			St Louis
Sédhiou								
Tambacounda					Sub regional Polytechnic School (IAM Group affiliate) Tamba			Tamba
Thiès	<ul style="list-style-type: none"> • University of Thiès • EPT • ENSA 			Thiès	<ul style="list-style-type: none"> • ISM Thiès • ISM Mbour 			Thiès
				Mbour				<ul style="list-style-type: none"> • AIMS
Ziguinchor	<ul style="list-style-type: none"> • ISRA Station 			Djibelor	<ul style="list-style-type: none"> • ISM Ziguinchor 			Ziguinchor
	<ul style="list-style-type: none"> • University of Zig 			Ziguinchor				

APPENDIX 3: LIST OF SENEGAL EMERGING PLAN (PSE) FLAGSHIP PROJECTS

1. Establishment of 100-150 aggregation projects targeted on HVA and livestock sectors;
2. Development of 3 grain corridors;
3. 150-200 micro-projects supporting family farming;
4. Restructuring of the groundnut sector ;
5. Accelerated Development of Aquaculture;
6. Acceleration Program Social Housing Offers;
7. Creation of 20 craft development centers;
8. Pilot Sector Plan: Crafts;
9. Sector development of Micro-Tourism Plan;
10. Development of Trade Infrastructure;
11. Development of the phosphate/fertilizer industry;
12. Renewal of the integrated project on the iron-Falémé / south axis;
13. Accelerating the exploitation of gold sector - Kédougou Region;
14. Accelerating the exploitation of zircon deposits;
15. Regional Hub Mining;
16. Integrated Industrial Platforms;
17. Integrated Industrial Park;
18. Integrated Logistics Hub;
19. Digital Economy: areas dedicated to ready-export services;
20. "Business Park" center head offices in the region and basic life;
21. Dakar Medical City;
22. Dakar Regional Campus of Reference;
23. Laying out 3 to 6 integrated tourist areas;
24. Recovery Plan of the regional air hub;
25. Integrated Plan of Electricity Recovery;
26. Hydrocarbon Procurement Strategy;
27. Universal Energy Service.

Source: Republic of Senegal: Senegal Emerging Plan, February 2014
(Appendix VII, page 137, extract).

