

THE REPUBLIC OF SENEGAL

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Introduction

This report looks at the science, technology and innovation system of the Republic of Senegal and is structured in three main parts. Section 1 briefly deals with the national political environment; Section 2 looks at the key country characteristics including the economic, demographic and health, education and information and communication technology infrastructure. Finally Section 3, which forms the main part of the report, gives an overview and analysis of the science and technology system. This section is subdivided into seven thematic subsections covering the governance of the science and technology, science and technology landscape, S&T human resources, funding, research outputs, technological innovation and lastly international co-operation and networks activities.



Section 1: The political environment

Senegal gained political independence from France on 4 April 1960 and was ruled by the Socialist Party for forty years until current President Abdoulaye WADE was elected in 2000. Located in Western Africa, Senegal has a total area of 196,722 km² and bounded in North and Northeast by Mauritania (813 km), in the Southeast by Mali (419 km), and the South by Guinea (330 km) and Guinea-Bissau (338 km). The Gambia constitutes an enclave of 10,300 km² within Senegal's territory. In 1982, Senegal joined with The Gambia to form the nominal confederation of Senegambia, but the envisaged integration of the two countries never materialised, and the union was dissolved in 1989.

A southern separatist group known as the Movement of the Democratic Forces of Casamance (MFDC) has waged a campaign for the independence of the Casamance region and has sporadically clashed with government forces since 1982. Casamance is largely divided from the rest of Senegal by The Gambia, a finger of land just some 175 km long that cuts into Senegal from the coast. There is a cultural divide as well. The MFDC rebels say Casamance has been marginalised and under-developed because of its differences. The UN estimates that more than 60,000 people have fled from their homes in towns and villages across the lush farmland of the Casamance and joined the rows of homeless in Ziguinchor or in The Gambia to the north or Guinea Bissau to the south.

However, Senegal remains one of the most stable democracies in Africa.¹ Senegal has a long history of participating in international peacekeeping and adopted a new constitution on 7th January 2001.

Section 2: Country characteristics

2.1 Basic economic outlook

In January 1994, Senegal undertook a major economic reform program with the support of the international donor community. This reform began with a 50% devaluation of Senegal's currency, the CFA franc, which was linked at a fixed rate to the French franc. Government price controls and subsidies have been steadily dismantled. After seeing its economy contract by 2.1% in 1993, Senegal made an important turnaround, with real growth in GDP averaging over 5% annually during 1995-2004. Annual inflation had been pushed down to the low single digits. As a member of the West African Economic and Monetary Union (WAEMU), Senegal is working toward greater regional integration with a unified external tariff and a more stable monetary policy. However, Senegal still relies heavily upon outside donor assistance. Senegal reached the IMF's Highly Indebted Poor Countries (HIPC) debt relief program decision point in June 2000 and completion point in 2002 and will benefit from eradication of two-thirds of its bilateral, multilateral, and private-sector debt for about \$800 million (see World Bank 2003; <https://www.cia.gov/library/publications/the-world-factbook/geos/sg.html>).

Although the agricultural sector is of great importance to the Senegalese economy, the sector contributions to GDP have been declining over the years from 18.8% over the 1960-86 to 11% between the period from 1987-1993. The main industrial exports include textiles, groundnuts and phosphate. Diversification of the economy became a one of the major policy thrust of the 9th Economic and Social Development Plan. Table 1 below indicates some basic economic data in recent years.

In terms of economic competitiveness, evidence from the African Competitiveness report for 2004 as (see Table 2 below) indicates that Senegal has dropped from 8th position in the 2000/2001 report to 13th in the 2004 competitiveness ranking, thus making it one of the biggest drops in the rankings.

Table 1: Senegal Selected Basic Economic Data

Category	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gross domestic product, real (US \$ million, constant 2000 prices)	3730	3945	4142	4373	4617	4670	4971		5577
Gross domestic product Growth Rate (%)	5.0	5.7	5.0	5.6	5.6	1.1	6.5	6	
Net aid from all donors, Real (US\$ millions, constant 2002 prices)	391	466	502	431	433	445	387		
Net aid from all donors as share of recipient GDP (%)	9.7	10.8	11.3	9.7	8.9	8.8	6.9		
National Inflation Rate (%)				1.9	3.0	2.0	1.7		

¹ Leaders of the MFDC signed a peace deal with the government of President Abdoulaye Wade in December 2004 but banditry and occasional clashes continues. A disarmament programme has never been launched to clear the area of weapons.

Table 2: Changes in Senegal Competitiveness Ranking in Africa, 2004

Country	2004 Rank (out of 25)	2004 Score	2000 Rank (out of 24)	Rank changes 2000-2004
Botswana	1	4.56	3	+2
Tunisia	2	4.49	1	-1
South Africa	3	4.37	7	+4
Mauritius	4	4.12	2	-2
Namibia	5	3.99	4	-1
Gambia	6	3.93	n/a	n/a
Egypt	7	3.84	6	-1
Morocco	8	3.77	5	-3
Tanzania	9	3.49	14	+5
Ghana	10	3.46	9	-1
Algeria	11	3.39	n/a	n/a
Malawi	12	3.36	19	+7
Senegal	13	3.34	8	-5
Uganda	14	3.25	17	+3
Kenya	15	3.21	22	+7

Source: Own compilation from WEF Africa Competitiveness Reports 2000 and 2004.

2.2 Demographic and health characteristics

Senegal is one of 50 least developed countries in the world with total population of 11.7 million in 2005. It qualified for debt relief in April 2004 and has submitted a request to the Millennium Challenge Corporation for support for the years 2004-2005. In May 2002, the country's Poverty Reduction Strategy Paper was finalized, providing a framework to address poor living conditions and other development related challenges. More than 20 percent of the Senegalese population lives on less than one dollar per day.

Progress has been made towards achieving some of the goals and targets of the ICPD Programme of Action and the MDGs. Infant, childhood and maternal mortality dropped between 1990 and 2000 - the maternal mortality ratio was halved (from 1200 deaths per 100,000 live births to 690). The number of attended births increased from 40 percent in 1990 to 51 percent in 2000. Over the same period, total fertility fell from 6.5 lifetime births per woman to 5.5, a trend reflected in the population growth rate, which is reflected in a population growth rate of 2.3 in 2005. Senegal is viewed as a success story in containing HIV/AIDS, in large part because of early policy and programme action. The HIV prevalence rate is 1.8 percent for those between the ages of 15 to 49 (UNFPA&PRB, 2006). Currently, Senegal is ranked among the low human development category of countries. Table 3 presents some demographic and health data for Senegal.

Table 3: Selected demographic and health characteristics

Indicator	Source Year	Estimate	Sources for the estimation
Demographic data			
Total population (million)	2005	11.7	AfDB
Population aged 15-49 (thousands)			
Annual population growth (%)	2005	2.5	AfDB
Percentage of urban population	2005	53.9	
Crude birth rate (per 1,000 population)	2005	35.9	AfDB
Life expectancy at birth (years)	2005	57	AfDB
Total fertility rate	2005	4.7	AfDB
Infant mortality rate (per 1000 live births)	2005	20.5	AfDB
Adults aged 15-49 with HIV/AIDS (%) ²	2005		
Human Development Index Ranking	2004	0.460	UNDP
Health*			
Doctors	2004	594	
Dental Surgeons	2004	97	
Professional Nurses	2004	3287	
Public and Environmental health	2004	705	
Pharmacist	2004	85	
Lab technicians	2004	66	

* Health data from WHO *World Health Report 2006*; WHO *Africa Health Report 2006*, p144

2.4 Education

According to Senegal's *9th Social and Economic Development Plan (1997)* the development of skills in a country is a priority. Recent estimates are that 67 percent of girls and 83 percent of boys are enrolled in primary school. More women than men are illiterate (67 percent compared to 48 percent). The enrolment in primary education increased from 1,287,093 in 2002/2003 to 1,382,749 in 2003/2004 school years. Total secondary education enrolment during the same period rose from 71,316 to 82,910. At the higher education level data shows that over a 12 year period, UCAD student population increased by 77% from 21,061 in 1992 to 37,192 in 2004 (GoS, 2004:19-21; also see section 3 discussion human resources). The current national adult literacy is estimated at 39.3% in 2004.

² Figure represent national HIV/AIDS prevalent rate.

2.5 ICT infrastructure

Expansion in the telecommunication infrastructure began with massive investments from 1985-86. By the time of the formulation of the 9th Social and Economic Development Plan in 1997, the telecommunications sector attracted 18 millions CFA F investments annually. The number of administrative regions with automatic telephone network increasing from 3 to 10 and the number of main lines rose from 20,000 in 1985 to 78,000 in 1995 and telephonic density from 0.5 in 1985 to 0.90 in 1995 (GoS, 1997:35). However, the Senegalese government only announced its plan to liberalize Senegal's telecoms market by issuing a unified license for fixed, mobile and Internet services to a second national operator (SNO) in 2005. This announcement came months after the formal ending of the monopoly of the incumbent, France Telecom's Sonatel in July 2004. Despite the attractiveness of the license, the SNO faces many challenges (Pyramid Research 03/19/2005; Balancing Act). Table 4 highlights some ICT indicators for Senegal.

Section 3: Science and technology system

The centrality of modern science and technological innovation in the socio-economic development of Senegal has long been recognized since attainment of political independence. This important recognition has led to the systematic development of scientific and technological infrastructure over the past four decades. Some of these research infrastructures were inherited from the French Colonial Science and Technology System (see Appendix A). However, "the interface between research and development has not always been satisfactory, despite the considerable efforts made by the government and its development partners" (GoS, 1997:36). In actual fact, despite the setting up of the Scientific and Technical Potential (PST) that was meant to help better define the orientations, carry out arbitration and co-ordinate the overall activities, the sector of Scientific and Technical Research has not yet played its role as the engine for economic and social development due to a number of reasons, which include the following:

- "Inadequacy, and even the absence of systematic internalization of the international dimension in the definition and orientation of the national policy of Scientific and Technical Research (RST);
- An ineffective institutional framework for the co-ordination of the national policy of research, programmes and projects;
- An inadequate legal framework for the vocation of research centres and institutes;
- A status of the researcher, not yet established, due to its effects on public finance;
- A very strong dependence as regards external resources owing to the absence of reliable, sustainable and internal mechanism for financing the RST sector;
- A flexible balance in the management of human resources (mobility of research personal, tendency for the final appointment of researchers sent for training or specialization);
- Partitioning research structures not endowed with substantial means leading to a dispersal of means and energies;
- A poor development of technological innovation and research" (GoS, 1997:37)

Furthermore, during the recent preparation of a new Strategic Plan for scientific and technological development, the Ministry of Scientific Research visited some public research institutes and from these interactions the following common constraints are identified:

- Inadequacy of qualified human resources;
- Poor control of equipment;
- Substandard equipment levels;
- Insufficient financial resources;

- Absence of synergy between institutions;
- Poor levels of transfer of research results;
- Partitioning of research;
- Absence of controlling frameworks for traditional medicine (MRS, 2006).

The above constraints towards harnessing the scientific and technological potential in support of the country's development efforts show that Senegal still have much to do as far as the application of scientific knowledge in an increasingly globalizing knowledge-based economy is concerned. The discussions look at how Government of Senegal intends to confront these developmental challenges.

3.1 *Governance of science and Technology*

3.1.1 *Ministry of Scientific Research*

Although Senegal recognizes the centrality of modern science and technological innovation in the socio-economic development, creating the appropriate institution to promote the development and governance of science and innovation system has not been smooth just as the case in most African countries. The first attempt at institutionalizing science and technology governance system was the creation of the directorate for Scientific and Technical Affairs in 1968 almost a decade after the attainment of political independence. Later in 1983, Senegal created its first Ministry of Scientific and Technical Research in April 1983 only for it to be abolished in three years down the line in January 1986. A substantive ministry was recreated again in 1995 but not long before it was merged with the Ministry of Higher Education and Scientific Research in 2000. However, the fusion of Higher Education and Scientific Research did not last as the current government re-established the Ministry of Scientific Research and Technology in 2002. Our observation in these processes in such locational uncertainties of science and technology ministry is that it can be very disruptive to the science governance system. In fact this is more or less a mirror image of our observation of the Ghana science and technology ministerial and institutional governance uncertainties in the recent past.³

The Ministry of Scientific Research has three main directorate including Scientific Research; Technology Research; and Biotechnology Research as well as administrative and technical services (see Appendix B). The Ministry has formulated a new Strategic Plan for 2006-2010 has identified three main objectives of its operational mandate:

- Contribute to the achievement of sustainable development through science and technology;
- Ensure a co-ordination of research activities through science and technology at the national level; and
- To reverse the brain drain tendency and contribute to the loss of expertise in the in Diaspora (MRS, 2006)

However, the challenge, which the re-established Ministry of Scientific Research faces, is that it does not have any research institutes falling directly under its jurisdiction and therefore the management and co-ordination of the research system has become monumental task since other Line Ministries will seek direct control and co-ordination of their respective research

³ There seem to be uncertainty as to whether science and technology should have a separate line ministry or combined with higher education or education in general. In Mozambique and Rwanda, science and technology were separated from higher education recently, while in Ghana and Malawi science and technology were integrated into the ministries of education. Kenya and Tanzania among others have science and technology under their ministries with higher education functions. Whether separate ministries or not what is needed in the science and innovation systems across the countries in Africa is a certain degree of stability at the system level.

institutes and centres. Hence, the current drive by the new science ministry to create new research institutes under its jurisdiction, which include the African Centre for Research and Applications (CARA).

3.1.2 *Other line Ministries*

The Ministries of Agriculture, Rural Hydraulics and Food Security; Ministry of Health, Ministry of Education, and Ministry of Information and Communication Technology as well as the Ministry of Industry etc are some of the key line ministries whose activities also affect scientific and technological infrastructure development and sustainability. For example, prior to the re-establishment of the Ministry of Scientific Research, both the ministries of Agriculture and Health had research institutes and laboratories undertaking research and development activities. As mentioned above, proper co-ordination of scientific research by MRS will depend on the extent to which these ministries relate to one another.

3.1.3 *Science and technology priorities*

Senegal functioned with a Vision – Senegal 2015 – in which the research sector featured strongly. Following this the 9th Plan identified six strategic programmes including a reorganisation of the national research system, better industrial exploitation of research results and thematic objectives in health, energy, food and natural resources, and low cost habitation.

- The agricultural research (agronomy, forestry, animal production and halieutics) with ISRA, DEFCCS, the Veterinary laboratory of Hann and CRODT;
- The agro-industrial research activities with ITA in collaboration with the ORSTOM, ENSUT and ORANA
- The pharmaceutical and medical research activities with UCAD, the institutes and Centres of Specialised research, the laboratories, etc;
- The energy and technological research on solar , nuclear and biotechnology;
- Computer sciences, Mathematics and physical sciences, and building and public works;
- In addition, the research in social and human sciences and geological, mineral and oil research.

However, in line with the new Strategic Plan for science and technology, the government intends to establish a Science and Technology Parks around priority areas including Information and communication technologies, biotechnologies, the textile-manufacturing sector and aquaculture. These efforts will be complimented by the Ministry of Industry industrial development and competitiveness strategies.

3.2 *Science and Technology landscape*

3.2.1 *S&T agencies*

Currently there is no formal scientific and technological advisory agency or national higher education council in Senegal (Interview, October 2006). The only organisation, which may fit into this category, is the Senegalese Academy of Science and Technology but how strong it can perform this advisory role cannot be clearly established now. The Academy is hardly mentioned in the current strategic plan of the science ministry. However, the various public research institutes could provide such individual advice on key issues of national development interest. Meanwhile there are plans as part of the on-going reforms to improve the proper functioning and effective co-ordination of research and development in the country, to establish a Scientific Committee whose members would be derived from various sectors

including academia, research, industry, agriculture, commerce and private sector. The functions of this scientific committee will be among others to:

- Reflect and propose salient points of research;
- Propose a plan of action and strategic programmes to submit to the Minister of Scientific Research;
- Formulate guidelines on the subject of integration of science and technology in primary socio-economic sectors;
- Evaluate in a continual manner the academic programmes and structures to enable the introduction of necessary changes and providing answers to new challenges;
- Defining the condition of assignment of the allocation of resources to researchers and control mechanisms (MRS, 2006).

3.2.2 *R& D Performing Institutes*

The R&D performing institutions in Senegal may be categorized into the higher education sector institutions, public sector research and technology institutes as well as private sector research institutes. In addition, there are a number of public bilateral research centres, especially those supported by the French government as well as some multilateral research centres whose operational mandate extends beyond the Senegalese national research system, though useful to it. The private sector still performs limited research. The discussion below deals with the first two sectors only.

3.2.2.1 *Higher Education Sector*

Senegal has two main public universities - the Cheikh Anta Diop (Université Cheikh Anta Diop de Dakar, UCAD) and Gaston Berger (Université Gaston Berger, UGB). In addition, it has Advanced National Professional Schools, and private institutes that constitute higher education institutions in Senegal. The University Cheikh Anta Diop de Dakar, which is the oldest and largest university, was created on February 24, 1957 (founded in 1949) with an initial enrolment of 575 students. It has 6 faculties and, 16 schools and research institutes working in about 117 research laboratories (*INTERFACE*, 2006). The faculties include medicine and pharmacy and of sciences and techniques, and research institutes in psychopathology, leprosy, paediatrics, renewable energy, applied tropical medicine, applied mathematics, health and development, environmental science, adontology and stomatology, applied nuclear technology, and the teaching of mathematics, physics, and technology. The University of Saint Louis has an applied mathematics unit. Other facilities for scientific training include a polytechnic school at Thiès; an international school of sciences and veterinary medicine, representing 13 French-speaking countries, at Dakar. Due to a growing demand for access to higher education and training, the government plans to open three more regional universities in three other regions during the 2007 academic year. Table 5 illustrates the two public universities and faculties.

Table 5: Public Universities and Key Faculties in Senegal

Institution	Faculty/Schools/Institute
Université Cheikh Anta Diop, Dakar (UCAD)	<ul style="list-style-type: none"> • Institut des Sciences de l'Environnement (ISE) • Centre d'Etudes des Sciences et Techniques de l'Information (CESTI) • Institut de Recherches sur l'Enseignement de la Mathématique, de la Physique et de la Technologie (IREMPT) • Institut Fondamental d'Afrique Noire (IFAN) • Ecole Supérieure Polytechnique (ESP) • Ecole Normale Supérieure (ENS) • Institut Supérieure de Gestion (ISG) • Ecole des Bibliothécaires, Archivistes et Documentalistes (EBAD) • Institut des Sciences de la Terre (IST) • Institut National Supérieur de l'Education Populaire et du Sport (INSEPS) • Institut de population, Développement et Santé de la Reproduction (IPDSR)
L'Université Gaston Berger de Saint-Louis	<ul style="list-style-type: none"> • Faculty of Arts and Humanities (UFR Lettre et Sciences Humaines) • Faculty of Economic Sciences and Management (UFR Sciences Economiques et Gestion) • Faculty of Applied Sciences and Technology (UFR Science Appliquées et Technologie) • Faculty of Law and Politics (UFR Sciences Juridiques et Politique)

The World Bank report on the Senegal's Higher Education Project notes that the framework for the Government's policy for higher education and university research was established by the State-General for Education and Training (EGEF), and draws on recommendations from the National Commission for Reform of Education and training (CNREF, 1984), Law No. 91-22 of February 16, 1991, and decisions taken by the National Consultation on Higher Education (CNES, 1993). This policy also reflects recommendations of the study "Senegal 2015" of 1989 and the conclusions of the World Conference on Education for All (Jomtien 1990) and is included in the 9th Plan of economic and Social Development (World Bank, 1996: 51). The Poverty Reduction Strategy document reckons the need to promote research and training in higher education.

3.2.2.2 Public Research Institutes

Most public research facilities in Senegal deal with agricultural and health subjects. Besides UCAD, the Senegalese Institute of Agricultural Research (ISRA), with headquarters at Dakar, is the major public research institute in Senegal. ISRA has 11 regional research centres and 33 stations. It operates a national centre of agronomical research at Bambey, a national laboratory of livestock and veterinary research at Dakar, an oceanographic centre at Dakar, and numerous other technical facilities throughout the country. Dakar has centres for mining and medical research and a research institute on African food and nutrition problems. An institute of research for oils and oilseeds is at Bambey. There is Institute of Food Technology at Dakar. The research activities are enhanced by the presence of the Pasteur Institute of Dakar and the IRD of Senegal as well as sub-regional and continental institutions as the West and Central African Council for Agricultural research and Development (CORAF⁴/WECARD) and the Council for Development of Economic and Social Sciences Research respectively.

⁴

Conseil Ouest et Centre Africain pour la recherche et le Développement Agricoles.

3.3 *Human capital for S&T*

As one of the former French Colonies in Africa, Senegal gained little high-level skills training and had few scientific workforces by the early 1960s. However, since attaining political independence, Senegal has made remarkable efforts in building human resource capacity, specifically in terms of replacing expatriate staff with national researchers. This was followed by a further expansion in the number of national staff,⁵ as well as an improvement in the quality of their training in terms of postgraduate training first through external training abroad and second through expansion of postgraduate training programmes at UCAD, the main national centre of teaching and learning. For instance, in 2000 over 94% of researchers working in the agricultural sector in Senegal had MSc or PhD training. In fact close to 50% (i.e. 46%) of them (researchers) were trained to the doctorate level (Beintema and Stads, 2006:10).

3.3.1 *Size and structure of the R&D workforce*

The scientific workforce in Senegal has increased over the years. For example, agricultural sector researchers' number had an average increase of 10.2% per year during 1971-1985 before falling to 2.5 there after (Stads and Sene, 2004:3). However, overall the current S&T human resource capacity is still relatively small. In 1987-97, there were four technicians and three scientists and engineers per million people who were engaged in research and development activities. An inventory of scientific and technological human resource capacity from 1997 to 1999 that produced a directory established that there were 800 researchers working in the public research system. However, it should be noted that this figure is understated since current comprehensive data is not available as periodical science and technology indicators are not produced. Even the data produced by Senegal's national statistical agency does not provide adequate information, for example on the higher education sector up to date.

At the individual institutional level, UCAD and its research institute is the largest single research performing and training institution and followed by ISRA as the biggest public research institute, excluding UCAD. The number of teaching and research staff at UCAD has increased to 1110 in 2006 with a total administrative and technical support staff of 1153 (*Interface*, 2006:14). While UGB employed 215 professors in 1994/95, 146 of whom were either temporary or visiting professors (World Bank, 1996). Today UGB teaching and research staff is still estimated at 140. ISRA has total research staff strength of 490 of which 120 are full-time equivalent (FTE) with 60% of them with either masters or doctoral degree. A key problem in human resource sustainability is the aging of teaching/research staff and a lack of interest in the sciences on the part young candidates. Table 6 below gives an illustration of some human resource strength of selected research institutions in Senegal.

⁵ For example, with a total teaching staff of 661 in 1992, the rate of africanisation of teachers in the higher education sector reached 91%.

Table 6: Human Resources in selected Research Institutions June 2006

Institution	Total Staff	Number of Teaching/ Researchers
Higher Education		
UCAD		1110
UGB		140
ISRA	490	120
ITA	80	
IRD	390	
LBV	54	17
CIRAD		18

Source: Own compilation, *Interface*, 2006

3.3.2 Trends in Masters and doctoral enrolments

The University Cheikh Anta Diop was created on February 24, 1957 (founded in 1949) with an enrolment of 575 students. The total enrolment at UCAD then increased from 1012 students in 1960 to 21722 in 1992/93 for an accommodation capacity estimated at 10,000 students. At the outset, UCAD was designed to accommodate 3500 students. In the 2003/2004 academic year, UCAD enrolled 37,192 students and it has been estimated to attain 50,000 student enrolments in 2005/2006. The growing demand for higher education led to the opening of a second public University in October 1990 in Saint-Louis with a number of 600 students which rose up 1822 students in 1994 and 2659 students in 2002 (GoS, 1997:44; GoS, 2005). In 1987–97, science and engineering students accounted for 21% of college and university enrolments. However, a recent World Bank's country appraisal report for the higher education sector suggests that the share of scientific streams in total UCAD enrolments at entry level (1st year) has reduced from 17% in 1996/97 to 14% in 2001/2002. Such reduced enrolment of SET students at UCAD could negatively affect the future human resource development in SET fields at the postgraduate level given that UCAD is the largest research and training institution in the country.

Table 7 gives the evolution of student enrolments over 1992-2004. Although Table 7 does give the proportion of student enrolments in different faculties, it is estimated that Arts and Humanities accounted for 43% and Sciences and Techniques 13% of total enrolments at UCAD in 2004. Excluding UGB, UCAD runs post graduate programmes in 47 scientific fields. Table 8 shows the postgraduate enrolments at UCAD in 2005/2006.

Table 7: Student enrolment at UCAD and UGB, 1992-2004

Year	Institution		
	UCAD	UGB	Total
1992	21061	991	22052
1993	22602	1279	23881
1994	22386	1607	23993
1995	19869	1822	21691
1996	21397	1974	23371
1997	23760	2086	25846
1998	23076	2157	25233
1999	23926	2187	26113
2000	24776	2224	27000
2001	28293	2495	30788
2002	28513	2659	31172
2003	31167		
2004	37192		

Source: GoS, 2005

Table 8: Third Cycle (Postgraduate) enrolment at UCAD, 2005-2006

Establishment	Number
CESTI	6
ENSEPT	115
ESP	108
FASEG	496
FASTEF	97
FLSH	758

Table 8 Continued

Establishment	Number
EMPOS	1749
FSJP	650
FST	914
IFRPDSR	24
INSEPS	78
Total	4994

Source: Interface, 2006, p15.

3.3.3 *Masters and doctoral graduate output*

UCAD remains the biggest postgraduate training institution in Senegal. Recent data available indicates that research institutes at UCAD produced 1978 doctoral theses from 1996 to 2005 and produced 734 DEA (Diplôme d'Etudes Approfondies) between 1996 and 2005. Of the doctoral output, the Faculty of Medicine accounted for 1736, while at the masters and postgraduate diploma level the Faculty of Science and technology was responsible for 552 of the total output (*Interface*, 2006:19). Based on these statistics we can argue that the strength of UCAD at the postgraduate training is in the field SET-related areas.

3.3.4 *Human and institutional capacity development Strategies*

The government of Senegal is improving upon the educational infrastructure through expansion of facilities at UCAD with a new extension known as UCAD II and disagreed with the World Bank over the expansion of access to higher education enrolment and expenditure.

In addition, the government is opening three more public universities at different regions in the country to improve upon enrolments and to address the growing disparity in the higher education provision, which has been concentrated largely in Dakar over many decades.

A recent report also indicates that in November 2002 the government took the initiative to:

- "Create professional training centres in sectors with growth potential (e.g. ICT);
- Create training centres aimed at women; and
- Alignment of technical and vocation education to the needs of national" (World Bank, 2006).

3.3.5 *Scientific mobility*

Scientific mobility is an important human resource development and capacity retention issue in Senegal. In the 1990s, the Senegalese Ministry responsible for External affairs officially conducted a census and estimated that about 640000 Senegalese were living in other countries (GoS, 1997:10). Although these figures do not give the proportion of the high-level skills, it is of major concerns. Thus, with a threat to the sustainability of producing and retaining the skilled human resources, the Ministry of Scientific Research has identified the issue of brain drain as critical and at the same time intends to devise appropriate policy

mechanisms to make use of the Senegalese Diaspora in order to promote scientific and technological development in Senegal (Interview, October 2006).

3.4 *Financial resources (funding)*

3.4.1 *National Financial Resources*

Financing scientific and technological innovation remains a major challenge to the Government of Senegal (GoS). Currently the resources devoted to scientific research and development is less than 1% of Gross Domestic Product, perennial problem facing most Africa countries. In fact, the government accounted for 32% of total research funding in Senegal in 1997. The general budgetary allocation for the Ministry of Scientific Research is CFA 2.364.566.000 for the 2006 financial year.

The public higher education in Senegal benefits from a subsidy system, which until recently provided for 96% of the institutions' budgets. In 1997, the budget allocated to education and training was estimated at more than 93.3 billion francs or 33% of the government's budget, with 24.7% allocated to higher education (7% of the total budget). However, at the university level, and more especially at UCAD, salaries account for 86% of the state subsidy, and less than \$3 million dollars are left for all recurrent expenditures (World Bank, 2003:33). Table 10 gives the proportion of national education budget allocated to higher sector. This increasing budgetary allocation for the higher sector went contrary to World Bank's prescription, however.

In order to improve the funding of research and innovation, the government through the Ministry of Scientific Research has formulated a new five-year Strategic Plan (2006-2010), and has set up its new and very ambitious target of spending 2% of GDP on research and development by 2015 from its current low base of 0.05%. This target is very ambitious because Senegal has been signatory to the Lagos Plan of Action of 1980 which set a target of 1% for African countries by 2000, which was never achieved by any African country. Senegal is also a major political player within the context of New Partnership for Africa's Development Programme, which under its First Ministerial Conference for Science and Technology in November 2003 set another target of 1% of GDP to be committed to research and development activities by African government by 2010. The concern here is that if lower S&T expenditure targets cannot be achieved, it remains to be seen how such a higher target could be. Table 12 shows the projected provisional budget towards implementation of the S&T strategic plan drawn up by the Ministry of Scientific Research in 2006.

Table 10: Recurrent (voted) budget for Education by level

	2000	2001	2002	2003	2004(*)
Primary	38.1%	38.4%	42.2%	48.2%	44.6%
Tertiary	25.6%	26.1%	26.5%	23.9%	26.3%

(*)Proposed

Sources: Adapted from World Bank, 2003

Table 11: Provisional Budget for Strategic Plan 2006-2010 (CFA Millions)

Category	2006	2007	2008	2009	2010	Total
CARA						82 474 243 557
Investment	15 100 050 000	8 295 000 000	2 668 000 000	1 680 000 000	1 092 000 000	28 835 050 000
Function	1 124 517 000	14 343 266 120	12 976 730 120	12 723 596 120	12 471 084 197	53 639 193 557
Scientific and Technological Park						4 531 259 200
Investment	400 000 000	320 000 000	102 400 000	32 768 000	29 491 200	884 659 200
Function		720 000 000	1 080 000 000	972 000 000	874 800 000	3 646 600 00
Centre for Science and Experiments						5 031 000 000
Investment	650 000 000	975 000 000	975 000 000	975 000 000	312 000 000	3 887 000 000
Function		208 000 000	312 000 000	312 000 000	312 000 000	1 144 000 000
Innovation and transfers	100 000 000	250 000 000	375 000 000	120 000 000	120 000 000	965 000 000
Planetarium						9 934 427 885
Investment	1 973 300 000	2 959 950 000	947 184 000	284 155 200	85 246 560	6 04 9 835 760
Function		989 705 000	1 484 557 500	742 278 750	668 050 875	3 884 592 125

Table 11 Continued

Category	2006	2007	2008	2009	2010	Total
FIRST						2 122 958 000
Research	251 000 000	376 500 000	451 800 000	496 980 000	546 678 000	2 122 958 000
Finance						
Funds						
Publication Funds						338 215 000
Funds for publication and documentation	34 000 000	51 000 000	76 500 000	84 150 000	92 565 000	338 215 000

Source: MRS, 2006.

3.4.1.1 *University Research Funds*

In Senegal University, research benefits from the University Research Funds (Fonds de Recherche Universitaires, FRU) which contributes up to 50% of the financing of research and development activities, which was initiated under World Bank education reforms programme in 1995. The FRU was supposed to stimulate research proposals on a competitive basis. But this project activity has been rated unsatisfactory as early as July 1997 by the Bank's team and according to the Bank's project implementation report; it will remain so until the project completion, with the exception of 13-month period in 1999/2000 (World Bank, 2003). Government subsidies allocated for university research are increasingly contractual, with precisely defined missions, performance criteria, and clear objectives.

3.4.1.2 *Fonds d'Impulsion de la Recherche Scientifique et Technologique (FIRST)*

The key government funding instrument is the Fonds d'Impulsion de la Recherche Scientifique et Technologique (FIRST) to support research and training in the national research and innovation system. As a member country of the Islamic Development Bank (IDB), Senegal stands to benefit from the IDB 2005 policy decision to support at least 10% of member countries annual budget for science and technology development programme. Under this new policy initiative, the IDB intends to support S&T programme in three main areas:

- "Assistance to build physical facilities and infrastructures;
- Forge collaboration and exchange of knowledge through activities such as short-term exchange of experts, on-the-job training, and conferences; and
- Financing research and development projects by designated centres of excellence" (IDB, 2007).

3.4.2 *International donor funding*

It has been stated in the 9th Social and Economic Development Plan that about 68% of research activities in Senegal is financed by external resources through multilateral and bilateral co-operation. The remaining is largely mobilised by the Government through the budgetary endowments allotted to research centres and institutes (GoS, 1997:47). However, the conditionality linked to the utilisation of external resources and management of co-operation policy caused bias in the orientation of the national policy on technical and scientific research in the programmes and projects (GoS, 1997:47-48). Since the publication of the 9th Plan, it is not very clear to what extent this situation has changed in terms of both the funding structure and research agenda setting due to over reliance of the research and innovation on external financial resources. Such friction occur due to the differences between the Senegalese and the World Bank towards implementation of \$30.9 million Bank supported reform in the higher education sector both regarding the management of the University Research Funds and the enrolments which the World Bank preferred to decrease rather than increase as has happened.

Major sources of external donor funding to the Senegalese science and technology system include France, Canada, Belgium, Switzerland, Italy, USAID, the European Union and the World Bank. Other partners contribute to targeted research programs. For example, under the World Bank's higher education project support the following proposal for funding and performance indicators were made (see Table 12 below), while Table 13 shows the level donor funding. An observable trend in Table 15 is the decreasing percentage of French government funding to Senegal's external resources from 56% in 1972 to 35.5 % in 1986, and United States support increased from 0.5% in 1975 to 7.6% in 1986. This is an indication of the diversification of external support from over dependence on France up to the mid-1980s. It is most likely that this trend will continue given that Senegal international co-operation in science and technology is growing with non-traditional partners.

Table 12: World Bank's projected support for the Senegal Higher Education Sector

Indicator/FY	1997	1998	1999	2000	2001	2002
<i>Project inputs</i>						
Counterpart funds (\$,000)	250	250	350	350	400	400
Research proposals received	100	150	300	300	400	400
<i>Project Outputs</i>						
Books Catalogued (,000)	10	10	15	15	20	20
Research projects complemented		50	75	150	150	200
Accreditation completed		1	2	3	3	4
<i>Sector Impact</i>						
%private higher education	5	8	10	12	14	15
% female	24	25	27	28	29	30

Source: World Bank, 1996, p44.

Table 13: Sources of research funding in Senegal

Sources of Funding	1972	1975	1986	1997
Senegal	25	33	32	32
Foreign Sources	75	67	68	68
France	59	57	35.5	
World Bank	--	0.5	16	
United States	--	0.5	7.8	
United Nations	9.5	3.4	1.1	

-- No data available for 1972

Sources: Gaillard, 1997, p 175; GoS, 1997

3.5 Research outputs

More than 90% of researchers nationwide are involved in developing research competencies. This is reflected by more than 47 doctoral majors and 35 professional specializations. Recent analysis of African countries knowledge productions in ISI-indexed Journals articles shows that between 2001 and 2004, Senegal produced 618 articles. However, this database is not reflective of the total knowledge production in Senegal. For example, using the same period the University of Cheikh Anta Diop alone reported that 2967 scientific articles and books were produced by its researchers. From 1996 to 2005, research and teaching establishments of UCAD produced 1978 doctoral theses, of which the Faculty of Medicine accounted for a greater percentage (i.e. over 50%). The UCAD publications figures indicate that 74% of the articles were published in collaborations with partners from the North, while 83 of the publications were published outside Senegal. Table 14 gives a list of scientific journals published at UCAD, none of which are indexed in the ISI-database and only one is currently indexed in the African Journals Online database.

Table 14: List of Scientific Journals in UCAD

TITRES	Directeur	Adresse
Journal de la Faculté des Sciences	Doyen Faculté des Sciences et Techniques	Faculté des Sciences et Techniques, Université Cheikh Anta Diop de Dakar
Bulletin de l'IFAN Cheikh Anta Diop, Série A, Sciences de la Vie, Sciences de la Terre	Directeur de l'IFAN	Direction de l'Institut Fondamental d'Afrique Noire, Université Cheikh Anta Diop de Dakar-Dakar
Journal des Sciences pour l'Ingénieur	Directeur de l'Ecole Supérieure Polytechnique	Comité de Rédaction JSPI-Ecole Supérieure Polytechnique-UCAD-Dakar
Dakar Médical (Bulletin de la Société médicale d'Afrique Noire de langue française)	Doyen de la Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie	Dakar Médical-Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie- UCAD-Dakar
Revue Africaine de Communication	Directeur du Centre d'Etudes des Sciences et Techniques de l'Information	Direction du Centre d'Etudes des Sciences et Techniques de l'Information (CESTI)-UCAD-Dakar
Annales de la Faculté des Lettres et Sciences Humaines: Philosophie, Littérature, Langues, Sciences humaines	Doyen de la Faculté des Lettres et Sciences Humaines	Faculté des Lettres et Sciences Humaines, Université Cheikh Anta Diop de Dakar
Initiations et Etudes Africaines	Directeur de l'Institut Fondamental d'Afrique Noire	Institut Fondamental d'Afrique Noire-UCAD-Dakar
Notes Africaines	Directeur de l'Institut Fondamental d'Afrique Noire	Institut Fondamental d'Afrique Noire-UCAD-Dakar

Sources: Adapted from UCAD website.

3.6 *Technological innovation*

3.6.1 *Patents*

Data from the USPTO indicates that from 1965 to 2005 the total number patent applications filed by country of origin from Senegal was 16 the highest was 5 applications in 1969 and the last, which is 1 application, was filed in 1996. There are no records from 2000-2005. Between 1996 and 2006, only two patent applications were filed by UCAD researchers in France and the USA (*Interface*, 2006:19).

3.6.2 *Innovation Strategies*

In order to promote scientific and technological innovation capacity, the Senegal is establishing science and technology parks and regional industrial development poles. In fact, Senegal was one of the four countries in Africa that were identified as having the necessary criteria and was considered for the development of Science and Technology Parks under the United Nations Department of Economic and Social Affairs (UNDESA) development account project on "International Partnerships on New and Emerging Technologies for Sustainable Development". These new and emerging technologies include ICTs, biotechnologies, nanotechnologies, new energy and fuel technologies. Based on the declaration produced by the 2002 Beijing Science and Business Forum on New and Emerging Technologies for Sustainable Development, the project is designed to provide assistance to developing countries in Africa for the development of Science and Technology Parks.

The government is also creating national research centres to drive the process of knowledge production and industrial transformation under Ministry of Scientific Research and the Ministry of Industry and Trade that completed the country's draft industrial development policy in 2005. In addition, there is a Senegalese Agency for Technological Innovation and the need to pursue improve international standardization and quality measures highlighted in the industrial policy.

3.7 *International co-operation and networks*

Senegal considers international co-operation at both the bilateral and multilateral levels as important to building its scientific and technological capacity and to ensure economic competitiveness in an increasingly globalising knowledge based economy. As mentioned above, the UCAD publications figures indicated that 74% of the articles were published in collaborations with partners from the North, while 83 of the publications were published outside Senegal therefore showing a strong link with the international research system in term of knowledge production.

3.7.1 *Bilateral Co-operation*

Primarily, Senegal still has extensive scientific and technological co-operation initiatives with the French government and research institutes in France. The Pasteur Institute of Dakar and the Institute of Research for Development of Senegal are among the key research centres in Senegal that offer strong links with the former colonial power and its research system. The parent IRD is also playing an important role in the NEPAD Water research and Management initiative.

3.7.1.1 *Co-operation with Brazil and India for bio fuel production⁶*

In order to decrease its dependence on oil and produce environmentally friendly energy, Senegal signed an agreement to co-operate with Brazil and India to launch a bio fuel production programme by 2007. Through public-private partnerships, Brazil will provide scientific and technological expertise, Indian entrepreneurs will supply the capital, and Senegal will offer land and labour.

Bio fuels, such as bio-ethanol, bio-diesel and biogas, are renewable fuels generally produced from agricultural crops or organic matter. The project is part of a plan by the Senegalese government to regenerate its rural economy through investment in bio-fuels to eventually replace the country's daily consumption of 33,000 oil barrels.

This initiative was announced on 27 October 2006 by Farba Senghor, Senegal's minister of agriculture, rural hydraulics and food security during a meeting with a delegation of Brazilian bio-fuel experts in Dakar, Senegal. According to Senghor, the issues are enormous for the country, as bio-fuel will help diversify energy sources and reduce the increasing oil bill, and at the same time protecting the environment from pollution. José Neiva Santos, head of the Brazilian delegation, told reporters "Senegal has considerable advantages to develop the bio-fuel sector, because the country presents good climatic and geological conditions necessary for the increase in plants used as raw materials for ethanol production".

In an initial pilot project to reduce Senegal's oil imports by 10 percent, jatropha plants will be grown on 4,000 hectares of land in Touba. The extracted oil will be transformed into bio-diesel in production units to be set up in Khelcom, some 100 km from Dakar. The pilot project also aims to provide a knowledge hub from which other plantations could develop, according to Biopact, an organisation working for cooperation in bio-fuel and bio-energy between Europe and Africa. Senghor indicated that Senegal would carry out an experiment of growing castor oil plants, sunflowers or jatropha over an area of 50,000 hectares in Kolda and Tambacounda, in southern and eastern Senegal. This will help determine costs -and the optimal conditions for bio-fuel production — examining the best way to extract the oil, as well as finding out what crop produces better bio-fuel at minimum cost. News of the bio-fuel investment programme, which is part of a government plan called 'retour vers l'agriculture' ('back to agriculture'), comes ahead of the green power energy conference BiofuelsMarketsAfrica scheduled for 30 November 2006 in Cape Town, South Africa.

⁶

Adapted from Scidev.net

The International Atomic Energy Agency, the International Development Research Centre (IDRC), Institute of Research for Development (IRD); SIDA, USAID, DFID are some of the agencies that support both bilateral and multilateral research efforts in Senegal either at the higher education level or in the public research institutes and networks.

3.7.2 *Multilateral Co-operation*

At the multilateral level, Senegal participates and plays host to a number of regional scientific and technological research institutions and networks. At the continental, the country is presently the Chairs of the African Ministerial Council on Science and Technology (AMCOST) (after South Africa served as the first Chair), under the New Partnership for Africa's Development for Africa's Development programme. The Senegal Institute of Agricultural Research (ISRA) is hosting and co-ordinating the West African Biosciences Initiative as part of NEPAD S&T programmes.

Senegal currently hosts the African Laser, Atomic, Molecular and Optical Sciences Network (LAM Network) at the University Cheikh Anta Diop of Dakar. LAM Network was formed in May 1991, following the first International Workshop on the Physics and Modern Applications of Lasers that was held at the University Cheikh Anta Diop of Dakar with the participation of more than 50 physicists from many African countries. On that occasion, LAM Network was launched with the financial support of the Abdus Salam International Centre for Theoretical Physics (ICTP). ICTP, the Swedish International Development Agency (SIDA) and the International Program in Physical Sciences (IPPS) as well as Senegalese government support this network. The LAM Network laser research centres in Africa are located in centres in Algeria, Egypt, Ghana, Senegal and the Sudan. Interesting, however, there seem to be no formal links between the LAM Network and the African Laser Centre initiative under the NEPAD S&T programmes even though some of the individual researchers participate in the activities of ALC. Since 1996, the LAM Network has been involved in a new program in diode laser spectroscopy with the Atomic Physics division at Lund Institute of Technology in Sweden.

The Council for the Development of Social Science Research in Africa (CODESRIA), headquarters is based in Dakar Senegal. It was established in 1973 as an independent Pan-African research organisation with a primary focus on the social sciences.

The African Regional Centre for Technology (ARCT), with membership of 30 African states, has its headquarters in Dakar. South Africa is currently not a member. The Executive Director of ARCT has indicated there was ongoing discussion with South Africa about its membership (interview, October 2006).

In addition Senegal plays host to the West and Central African Council for Agricultural Research and Development (CORAF/WE CARD), which is a regrouping of the national agricultural research systems (NARS) of twenty-one (21) French-speaking, English-speaking countries and Portuguese-speaking countries of West and Central Africa (see regional report for West Africa).

3.10 *Conclusion*

Science and technology are considered critical to Senegal's development and future competitiveness. There are good prospects for the expansion of scientific and technology activities for socioeconomic transformation to address issues of poverty and underdevelopment given that the country is still one of the least developing countries in the world. A key challenge is the expansion of physical infrastructure to train and nurture future scientists, engineers and other professionals, as well as providing the necessary financial resources to promote and sustain scientific research and technological innovations. At present FIRST is the main government funding programme supporting scientific research and development in the country. However, the science and innovation system still relies heavily on external donor funding but this trend cannot continue forever if the country is to become

competitive in line with national development objective and setting research priorities. This is one of the key challenges to all stakeholders in the Senegal's national research and innovation system. Increasingly, Senegal continues to play a key role in regional science and technology development efforts and the expansion of its current research infrastructure base will further enhance that role within the sub-region and the continent.

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Appendix A: Evolution of Major Senegalese R&D Institutions

Period	Institution	Comments
1913-1921	Creation of first agricultural research stations i.e. the National Centre for Agricultural Research in Bambey 120 km east of Dakar which became the site for successive Modern Agricultural Farm	
1918	Dakar School of Medicine was created	First unveiling of university of university education in West Africa. It began offering instruction in biology, chemistry and physics in 1949.
1921-1938	Groundnut Experimental Station	
1924	Creation of Institut Pasteur of Dakar successor to the Bacteriological Laboratory of Saint Louis (1896)	Agreement between the general government of AOF and the Institut Pasteur in Paris
1936	French Institute of Sub-Saharan Africa was established (IFAN)	
1938-1950	Experimental Station for Soudanese Agricultural Research	
1950	Institute of Higher Education created on 6 April 1950 form the foundation for the creation of University of Dakar	
1943 (11 Oct)	Creation of Office Colonial Scientific Research which later became ORSTOM	Preceding debates in France (1931-37) aimed at putting science at the service of the colonies
1949	Creation of geographical observatory in M'Bour	The process started in 1946
1946	Establishment of ORSTOM Soil Research Centre in Dakar-Hann	It had a regional focus of soils in the Sahelian, Soudano-Guinean zones until 1960 when it became a ORSTOM Centre of Dakar but reduced its focus in 1958 and 1964 following the creation of centres in Niamey and Ouagadougou respectively
1950-1960	Federal Agricultural Research Centre	The transformation of the federal centre into national centre for Agricultural research after independence sparked the decline of its regional focus
1957	The official foundation of the University of Dakar on 24 February 1957	About 61% to 74% of student population was largely French until 1967. Major Africanization of programmes stated in 1969. University of Dakar later became University of Cheikh Anta Diop (UCAD) in 1983.
1960s		Most higher education and/or research institutes were created in 1960s besides IFAN
1963	Creation of Institute of Food Technology (ITA)	
1968	Inter-State School of Sciences and Veterinary Medicine (EISMV) was created	EISMV was created as a regional school
1966	Establishment of an executive level Office of Scientific and Technological Affairs	1970
1970	Direction of Scientific and Technological Affairs with secretariat at the prime minister in charge of planning	
1973	Délégation Général a la Recherché Scientifique et Technique (DGRST) was created	

	Creation of the Senegalese Institute of Agricultural Research (ISRA); Centre for Applied Economic Research (CREA) was created in 1971 under the auspices of the School of Law and Economics at UCAD)	
1979	Délégation Général a la Recherché Scientifique et Technique (DGRST) was transformed into the Secretariat of State for Scientific and Technological Research (SERST)	
1983	SERST became Ministry of Scientific and Technological Research (MRST)	
1986	MRST was dissolved and its duties conferred to new Direction of Scientific and Technological Affairs (DAST) created within the Ministry of the Plan and Co-operation	ISRA became incorporated into the Ministry of Rural Development as DAST could not perform its coordinating duties effectively
1990	Establishment of a second national university in Saint Louis with initial enrolment of six hundred student	
1992	DAST was moved to Ministry of National Education and then to Ministry of State Modernization and Technology	
2002	Re-establishment of the Ministry of Scientific Research	

According to Gaillard (1997:162) the creation of the university in 1957 and of the teaching and research institutions affiliated with the University in 1960s was accompanied by an institutionalization of research activities in the public sector and by the progressive creation of national bodies responsible for science policy in Senegal.

Appendix B: Organisational Structure of the Ministry of Scientific Research

