BRITISH COUNCIL

DAAD Deutscher Akademischer Austauschdienst
German Academic Exchange Service

RESEARCH AND PhD CAPACITIES IN SUB-SAHARAN AFRICA: SENEGAL REPORT

Mamadou Dimé, PhD

International
Higher Education

www.britishcouncil.org/education/ihe
www.daad.de

Acknowledgements

The German Academic Exchange Service (DAAD) in partnership with the British Council conceived this research project and co-funded it together, with support from the German Federal Ministry of Education and Research.

The overall study was commissioned to the African Network for Internationalisation of Education (ANIE), and their network of researchers across Sub-Saharan Africa. In particular, the work of the following individuals should be acknowledged:

James Jowi and Dr Charles Ochieng Ong'ondo for their oversight of the role of ANIE, and Mamadou Dimé PhD, Department of Sociology, University Gaston Berger of Saint-Louis, Senegal for leading the research in Senegal.

ANIE led the empirical research and produced the initial analysis, and then worked together with Dr Tristan McCowan and Elisa Brewis at University College London Institute of Education to finalise this country report.

Helmut Blumbach from the DAAD and Michael Peak from the British Council drove the study forward.

WITH FINANCIAL SUPPORT FROM

Federal Ministry of Education and Research

Contents

List of tables

Foreword

This report forms part of a broader study commissioned by the British Council and the German Academic Exchange Service (DAAD) that surveyed research and doctoral training capacity in Sub-Saharan Africa. The study includes six country case studies covering Ethiopia, Kenya, Ghana, Nigeria, Senegal and South Africa.

This report addresses the outcomes of the study in relation to Senegal. The country reports include expanded contextualisation of the national level context and policies for research training,[1] while a synthesis report is also available highlighting key policy implications for PhD provision specifically.[2] The aims of the study were to investigate: (i) the availability, quality and thematic priorities of PhD programmes and how they have changed over the last ten years; (ii) the national-level research agenda; (iii) the extent to which research training at the institutional level is aligned with the national agenda; (iv) national-level systems (policies, legislation) that enable alignment between institutional-level research training with the national agenda; (v) how institutional priorities reflect the needs of universities and emerging research and development systems, including local industry and societal needs; (vi) funding sourcesto develop and sustain PhD provision; and (vii) the role of international collaboration in building PhD capacity. The research, analysis, interpretations, conclusions and recommendations included in this report are those of the report authors.

1. Country reports can be found on the British Council website https://www.britishcouncil.org/education/ihe/knowledge-centre/developing-talent-employability/phd-capacities-sub-saharan-africa and the DAAD website https://www.daad.de/en
2. Synthesis report can be accessed on the British Council website at https://www.britishcouncil.org/education/ihe/knowledge-centre/developing-talent-employability/phd-capacities-sub-saharan-africa; and the DAAD website https://www.daad.de/download/phd201806

1. The context of the higher education system in Senegal

1.1 Historical development

The history of higher education in Senegal dates back to 1957 when the University of Dakar, currently known as the University Cheikh Anta Diop de Dakar (UCAD), was established. It is the oldest Francophone university in Africa. For several years from its inception the university was affiliated to the University of Paris and the University of Bordeaux. This was mainly due to Senegal's history of French colonial rule, which aligned its higher education system to the French model, including the strong responsibility of the state in providing education to its citizens. This affiliation to the French model continued after independence in 1960 until 1972, when some reforms were introduced in the higher education system. These reforms followed in the aftermath of the violent socio-political protests of 1968 after which the Senegalese government, among other changes, initiated the 'Senegalisation' of the University of Dakar. One of the key changes was in staff composition, which led to the recruitment of more Senegalese staff into the university. The other was the change in the academic programmes which were then mostly programmes of the affiliated French universities. The university embarked on efforts to develop programmes that were relevant to Senegalese society.

The 1980s and 1990s were also marked by continued calls for reforms in the Senegalese higher education sector by international organisations like the World Bank and the International Monetary Fund. These reforms were applied in the context of Structural Adjustment Programmes. They had enormous impacts on the higher education sector, some of which were detrimental to student and staff welfare. This period also coincided with the onset of the sharp rises in student enrolments at the university. By this time – three decades after independence – the Senegalese higher education system was limited to UCAD. This meant serious capacity crises as student numbers grew over the years. Consequently, under-capacity led to the establishment of the University of Saint-Louis (now University Gaston Berger (UGB)) in 1990, and the creation of another three new universities in 2007, namely the University of Thiès (UT), University Alioune Diop of Bambey (UADB) and University Assane Seck of Ziguinchor (UASZ). At the same time, from the 1990s, private universities have been allowed to operate in Senegal. By 2016 there were 75 higher education institutions authorised by the state. Most of them are management schools with a capacity of about 200 students each. A further way the government is addressing the capacity challenge is investment in non-traditional and e-learning avenues, for instance through the creation of the Senegalese Virtual University, which specialises in online courses. Other Senegalese universities are also trying to develop online teaching models.

Nonetheless, research undertaken for this study revealed that several structural issues deriving from under-capacity continue to pose challenges for the higher education system overall. They include overcrowding, especially in public universities, leading to students lacking access to basic facilities and resources, inadequate facilities, inadequate levels of academic staff (especially those with PhD qualifications), inadequate funding and weak regulatory frameworks especially for strengthening governance and academic quality. As an illustration of the situation in public universities, by 2016 UCAD had a student population of 79,943 in facilities designed to accommodate fewer than 30,000 students.[3] It is not the sheer numbers that is the challenge but the lack of capacity to deal with the growing numbers.

Doctoral training and research in Senegal have also faced related challenges. The capacity for doctoral education in Senegal has not expanded over the years to levels that are commensurate with the expansion of higher education in the country and the attendant need for doctoral graduates in the country's higher education sector and other knowledge-related sectors.

3. According to an interview with colleagues from the Directorate of Research and Statistics at UCAID, 2016.

1.2 Current research and doctoral training landscape

The government of Senegal holds research and knowledge production as key for the future development of the country. Senegal's Poverty Reduction Strategy Paper (International Monetary Fund, 2013) underscores the role of higher education in knowledge production and research for societal development. As such, the government has been deliberately involved in the development of proactive policies for the higher education sector that includes research and the development of doctoral education in Senegal.
A range of national policies have defined the Senegalese higher education system, leading to several transformations over the years. An important actor in the formulation and execution of these policy reforms has been the Ministry of Higher Education and Research. Apart from the periods 1983–86 and 1995–2000, when the government included a ministry of scientific research with full powers, research has often been attached to other departments. However, since 2000, the purview of research falls under the Ministry of Higher Education and Research, which develops the national research policies and strategies for the education sector and oversees the bulk of the research in universities[4] and also focuses its priorities on addressing other educational challenges.

The two main stakeholders in the research system in Senegal are CAMES (African and Malagasy Counsel for Higher Education) and ANAQ-Sup (National Quality Assurance Authority of Higher Education). While the first is 'an advisory, monitoring, facilitation and integration body of higher education and research in the African and Malagasy francophone systems',[5] the second is in charge of assuring quality in private and public higher education institutions. Among the reforms to be introduced in 2017 in the mission of ANAQ-Sup, the quality assessment of research is of crucial importance.

It is also notable that apart from the nationally driven reforms, reforms have also been driven by regional associations, mainly the West African Economic and Monetary Union (WAEMU) made up of eight Francophone and a few Lusophone countries. Through this avenue, the bachelor's-master's-doctorate system was adopted in 2007 to improve efficiency, quality, recognition of qualifications and closer collaborations between institutions in the region including for the mobility of students and staff. It also facilitated the setting up of national qualification frameworks. Therefore, programmes aiming to support PhD capacity in Senegal should take account of any existing networks with member countries in these kinds of regional associations, and how these may provide opportunities for staff mobility or for influencing policy formation more generally.

Doctoral education in Senegal is regulated in Law No. 2011-05 of 2011, which stipulates that the doctorate is a 'postgraduate higher education degree certifying a level corresponding to obtaining 180 credits after the Master's degree and gives its holder the Doctor's degree'. It views doctoral studies as training in research through research. This principle has always guided the organisation of doctoral studies in Senegal.

The provision of doctoral education via research-focused doctoral schools was further reinforced by the 2012 LMD reform. This marked the adoption of the structure of *licence-maîtrise-doctorat* (LMD), meaning bachelor's-master's-doctorate. Accordingly, Senegal now organises higher education in a three-cycle system as in most countries. The 2012 LMD reform also led to reforms in the structure of doctoral education in Senegal. Doctoral education remains an exclusive responsibility of graduate schools in Senegalese universities. The operation, regulatory requirements, role definitions and organisation of doctoral studies, as well as the requirements and structure of the doctoral programmes, are stipulated in the decree on the doctorate (Law No. 2011-05). Graduate schools are structured and located within tertiary institutions authorised to award doctorates, especially those with research teams, requisite infrastructure and facilities able to support the teaching and supervision of doctoral students and sustain the quality of the programmes.

4. Under the supervision of the Ministry of Higher Education and Research, this role is now devoted, since September 2014, to the Research General Directorate. The latter is composed of four main directions all dedicated to helping the universities and research centres enhance research activities for pro-development results.
5. CAMES' Strategic Development Plan 2015–2019.

These graduate schools manage multiple responsibilities including the academic and administrative requirements of doctoral programmes such as admission to programmes, support systems for students, organisation of seminars, academic development of doctoral students, organisation of defences, mentoring doctoral systems and support for professional integration, among many other functions.

Before the implementation of the LMD reforms, doctoral training in Senegal was largely dependent on the French 1967[6] FOUCHET reform which established the doctorate first degree (*doctorat de 3ème cycle*) and the doctorate second degree (*doctorat d'État*). This degree is essential in arts and sciences to obtain the rank of professor. In addition, this architecture includes various other qualifications such as Diplomas of Higher Studies and the Diploma of Specialised Higher Studies[7] (Ndiaye, 2011). The requirement of the doctorate first degree was a major stumbling block in the career of scholars, especially in the humanities and social sciences. This factor was the main justification for the implementation of the LMD reform to also facilitate the recognition of Senegalese degrees internationally and promote student mobility, accelerate the professionalisation of education and increase the PhD production capacities of Senegalese universities (Ministry of Higher Education and Research, 2013). In order to achieve these objectives, the doctorate first degree and doctorate second degree were removed. This led to the establishment of a new and single doctoral qualification referred to as the PhD.

With the implementation of the LMD reform, the PhD has become the minimum requirement for employment as a teacher-researcher in public universities. Before this requirement became compulsory, the DEA (postgraduate diploma) provided access to a first academic career through the assistant grade. However, it should be emphasised that local PhD holders face strong competition from those who studied at overseas (French, Canadian or American) universities. The last of these hold a 'competitive edge' because of the prestige, quality and reputation associated with their degree and scientific output.

Currently, there is only a small market or demand for those with doctoral qualifications within Senegal, and limited employment opportunities for PhDs. Many doctoral graduates are employed as contract or part-time lecturers and researchers while waiting for full-time permanent positions. The study on obstacles to employment among doctoral graduates in Senegal conducted by the Social Policies Research Centre, which is affiliated to UCAD, revealed that 86.4 per cent of respondents considered the university as the only employer of young doctoral graduates. Only six per cent of respondents felt they could find opportunities in other sectors such as industry and in NGOs; (Doucouré, 2014). Figures from 2010 show that almost 94 per cent of the country's researchers worked within the universities, with four per cent in government institutions, 0.84 per cent in non-profit organisations and only 0.08 per cent in private enterprises (UNESCO Institute of Statistics, n.d.).

6. The law that fixed the functioning rules of UCAD was issued in the same year. Twenty-three years later, the law governing UGB's creation was inspired by the same legal text. This shows a certain uniformity in the management system of Senegalese public universities as influenced by the French one.
7. Senegal's official journal, 25 June 2011, Bill No. 2011-05 of 30 March 2011 on the organisation of the LMD system (bachelor, masters and doctorate) in higher education institutions.

2. Methodology

In line with the aims of the study to capture a cross-section of diverse higher education institution types, ten higher education institutions were selected for the study. To ensure diversity, the sampling criteria included the number of doctoral programmes in the institution, research productivity, geographical location, institutional type (i.e. public or private), staff and student profiles as well as status in rankings. Based on these factors, five public universities and another five private universities were selected for this study. The profiles of the sampled institutions are presented in Table 1.

It is important to mention that due to lack of proper institutional data tracking mechanisms both at institutional and national levels, this study faced serious challenges in obtaining relevant and current data.

Table 1: Profiles of the sampled institutions

Institution	Status/type	Location	Year of establishment	No. of students	No. of PhD students enrolled in 2015–16	No. of PhD students graduated 2015–16
UCAD	Public	Dakar	1957	79,943	1,252	217
UGB	Public	Saint-Louis	1990	11,159	625	25
UASZ	Public	Ziguinchor	2007	3,480	60	2
UT	Public	Thiès	2007	2,500	80	12
UADB	Public	Bambey	2007	2,487	0	0
Superior Institute of Management	Private	Dakar and 13 regions of Senegal	1992	3,500	0	0
African Institute of Management	Private	Dakar	1996	1,400	25	0
Sup de Co	Private	Dakar	1993	<1,000	4	0
African Centre for Superior Studies in Management	Private	Dakar	1985	1,300	13	0
School of Tourism and Languages	Private	Dakar	2006	<150	0	0

Source: Data collected by research team from the institutions in 2016.

Data was gathered from the above institutions using desk research, questionnaire surveys and interviews from university directorate staff, deans and heads of department, PhD candidates and alumni. A detailed breakdown of the questionnaire respondents and interviewees is provided in Table 2. In order to provide cross-sector context to the institutional data, we also conducted five interviews with stakeholders outside these institutions, namely from the Employers' Confederation of Senegal (two interviews), the National Council of Employers, a representative of an NGO and a CEO of a manufacturing company.

Table 2: Summary of data collection

Institution	University directorates		Deans and heads of department(s)		Alumni		University directorates	DVC and registrars	PhD candidates	Alumni
	Sent	Valid Received	Sent	Valid Received	Sent	Valid Received				
UCAD	2	2	7	4	15	10	3	5	8	5
UGB	2	2	4	3	18	11	2	2	5	4
UT	1	0	1	1	0	0	1	1	0	0
UADB	0	0	0	0	0	0	0	1	0	0
Superior Institute of Management	1	0	1	0	0	0	1	1	0	0
African Institute of Management	1	1	1	1	0	0	2	1	1	0
Centre for Advanced Studies in Management	1	0	1	0	0	0	0	0	0	0
Sup de Co	1	0	1	0	0	0	1	0	0	0
School of Tourism and Languages	0	0	0	0	0	0	1	1	0	0

3. Availability, thematic priorities and quality of doctoral training

3.1 Availability and thematic priorities

A number of challenges face doctoral training in Senegal, including opportunities for employment for new PhDs; inadequate finances to support doctoral students; challenges to set up new doctoral programmes; lack of multidisciplinary research teams; poor links of doctoral programmes to labour market demands; ageing qualified faculty members reducing the capacities for supervision of doctoral students; increasingly high dropout rates among PhD candidates and longer time taken to attain the PhD qualification than the prescribed period; and the persistence of traditional practices[8] in the organisation and management of PhD programmes which do not allow for flexibility and the interests of diverse students groups. There are also serious gender disparities, with most doctoral students being male.

Despite these challenges, the Senegalese higher education system has some strengths within its research and doctoral training systems. Compared to its neighbours, Senegal has a long tradition of doctoral training with a diversity of themes covered by the doctoral schools, organised in a national network of doctoral programmes. Doctoral schools have signed partnerships not only with private and public institutions but also with foreign universities to facilitate scientific mobility and promote mutual research programmes. The establishment of new regional universities expanded opportunities for doctoral training to several other parts of the country, away from Dakar, where for several decades UCAD had been the only doctoral training institution in the country. The new efforts in implementing doctoral programmes in private universities in partnership with public universities oriented towards new training needs (e.g. PhD in Business Administration) is also beginning to bear fruit and is contributing to diversifying the provision of doctoral training opportunities.

This study noted that UCAD, the oldest and largest university in Senegal, had seven doctoral schools with an enrolment of 1,252 doctoral students in the 2015–16 academic year. UCAD leads in research productivity in Senegal, accounting for close to 90 per cent of the country's research publications. Growth in the number of thesis defences from 2008 to 2015 at this institute is represented in Table 3. The second largest university, UGB, had 625 PhD students enrolled and 25 graduated in the 2015–16 academic year. This is an enrolment increase of more than three-fold since 2005. Details of UGB enrolments are depicted in Table 4.

Table 3: Number of thesis defences at UCAD, 2008–15

2008–09	1
2009–10	48
2010–11	70
2011–12	113
2012–13	169
2013–14	183
2014–15	170

Source: Directorate of Research and Statistics, UCAD, 2016.

Table 4: Growth in doctoral student enrolments at UGB, 2005–15

2005–06	188
2006–07	215
2007–08	325
2008–09	359
2009–10	515
2010–11	642
2011–12	622
2012–13	657
2013–14	624
2014–15	610
2015–16	625

Source: Directorate of Education, Guidance and Statistics, UGB, 2016.

As can be seen in the tables above, enrolments in UCAD and UGB have been stagnant in recent years. This trend is in part due to a quota established for professors authorised to supervise theses, of a maximum of ten doctoral students per teacher (before the number was not limited). At the same time, there are many retirements of professors whose offices have not been filled. There is a lower rate of supervision which significantly reduces the possibilities of doctoral enrolment.

8. We consider persistence of a hierarchical system, the lack of promotion of the scientific autonomy of students, and the theoretical orientation of theses with a tendency to address general themes and not articulated to practical questions as examples of this.

While it was not possible to collect comprehensive data on thematic priorities of doctoral research nationally or at all the ten sampled institutions, disciplinary trends can be surmised for UCAD in Table 5. As UCAD is the largest producer of doctoral research in the country, trends in doctoral research there serve as a useful indication of the national picture. Contrary to findings from a recent bibliometric study of science, technology, engineering and mathematics (STEM) research output in Sub-Saharan Africa (World Bank and Elsevier, 2014: 3), health science and agriculture do not dominate in Senegal, at least at the level of doctoral research output. Rather, STEM subjects are distributed fairly evenly between health, environmental and life sciences, and mathematics, physics and other STEM subjects. A notable trend is the large share of enrolments in management, economic, and political and legal sciences (about a third of enrolments from 2010 to 2014).

Table 5: Number of PhD enrolments by discipline at UCAD, 2008–15

Year	Doctoral schools							Total*
	Environmental, Health and Life Science	Studies on the Human Being and the Society	Arts, Cultures and Civilisations	Water Quality and Water Use	Mathematics and Computer Science	Physics, Chemistry, Earth and Universe Sciences and Engineering	Management, Economic, Political and Legal Sciences	
2008–09	119	135	NR	NR	NR	NR	ND	254
2009–10	167	118	NR	NR	NR	NR	ND	285
2010–11	236	113	281	58	181	262	646	1,777
2011–12	295	143	205	63	164	276	625	1,771
2012–13	302	157	172	55	147	140	509	1,482
2013–14	327	191	203	49	159	180	494	1,603
2014–15	305	255	172	49	159	168	361	1,469
2015–16	266	ND	NR	42	170	188	586	1,252

Source: 2015–2016 Inquiries, UCAD, DAP.

NR: No responses (doctoral schools had not collected the relevant data for that year).

ND: No data available, either because: (i) doctoral school not open yet (2008–09 and 2009–10); (ii) data from the various programmes had not been synthesised.

*Although the total number of enrolments appears to have dropped in 2015–16, interviews with staff indicated that the figure actually increased if the missing data for ETHOS and ED-ARCIV are taken into account.

Our interviews with the heads of various graduate schools and departments indicated that they mainly utilise trans-disciplinary approaches which bring departments and faculties together as part of a doctoral school. Most graduate schools bring together a set of doctoral programmes with related specialisations to create a multidisciplinary scientific environment. The interviewees indicated that this was important in enabling them to address some of the capacity challenges within the institutions. This growth of trans-disciplinary relations between doctoral departments has facilitated opportunities for the sharing of resources, research facilities, funding and supervision capacities that has enabled the production of doctoral graduates to rise, especially in recent years. This is one of the innovative approaches to addressing the research and doctoral training deficits in Senegal.

Despite the progress made by private higher education institutions, public universities are still the main producers of PhD graduates in Senegal. It was notable that the majority of private institutions mainly offer programmes for first and second cycles of the MBA degree. This could be because of regulatory requirements for programmes and also their lack of adequate capacities to introduce other programmes which demand more infrastructure. Some institutions such as Sup de Co or the Centre for Advanced Studies in Management have developed ways of dealing with such constraints by collaborating with national universities (mainly UCAD and UGB) or foreign universities to establish doctoral programmes.

3.2 Quality

Senegal has attempted to put in place quality-assurance frameworks to strengthen its research and PhD training at system, institutional and student levels. Following the implementation of the LMD in 2012, the doctoral programmes are subject to the regulatory and accreditation mechanisms of ANAQ-Sup. This authority has exclusive responsibility in terms of accreditation and institutional recognition of training programmes in both public and private universities. It is the first step in the recognition of the training and qualifications. Apart from ANAQ-Sup, there is CAMES, which has even more stringent requirements especially with regard to the supervision and quality of doctoral studies. Assessing the quality of doctoral programmes in Senegal focuses mainly on elements such as the description of the regulations monitoring the doctoral student and the support of the employment of persons with PhDs, the duration of relevant doctoral programmes, and additional courses, seminars and workshops organised to support doctoral students. It further considers the objectives of doctoral training in the different units and whether these objectives are being met.

Interviewees and respondents for this study noted that there have been some major changes in doctoral training in Senegal over the past ten years. One of the main changes was the introduction of more flexibility into PhD programmes especially after the implementation of the LMD reforms in 2012. At the same time, the selection criteria for PhD programmes became more rigorous and were mainly based on the CAMES standard. It was also noted that the quality-assurance management systems of doctoral programmes improved as a result of the ANAQ-Sup and CAMES regulatory frameworks.

There are also governance reforms within the higher education sector which are attempting to distance the system from the French model towards a newer public management approach that is expected to bring more efficiency and better governance models into that system which could have positive impacts on research and doctoral training. Evidence of this was the involvement of people from the private sector in the public universities management system, with the reform of the university system of governance expected to be managed by a board chaired by an actor from the socioeconomic sector.

Regarding structure, the Senegalese system has coursework that usually covers 60 credits, while the writing and defence of the thesis account for 120 credits. The doctoral schools have scientific councils responsible for the development and adoption of internal rules and regulations, the examination of PhD applications, the establishment of new doctoral programmes and research projects as well as the approval of budgets for the doctoral school. The councils also have an executive body consisting of the head of the doctoral school, a scientific secretary and a representative of each specialty who undertake some of the administrative tasks on behalf of the council within the regulatory provisions.

The graduate schools aim at creating optimal conditions to increase the enrolment and graduation of doctoral students, and to promote research and collaborative relations between departments and within Senegalese universities.

Unlike the old training system where the student after the validation of their research topic and the choice of their mentor worked in relative isolation throughout their doctoral studies, the current system seeks to break this isolated approach. Accordingly, it promotes the organisation of doctoral seminars to provide PhD students with an opportunity to overcome their isolation and be monitored more regularly. While this change is promoted, it is not felt in reality by doctoral students who responded to our surveys. According to them the thesis continues to be an exercise carried out in 'solitude'. Discouragement and a lack of motivational incentives are significant barriers to the perseverance and retention of doctoral students. Even though they find it very demanding (compared to the former one), a majority of students think this system is highly favourable to enhance the quality of their PhD productions, namely through the permanent involvement of external collaborators from external laboratories and state-owned or private companies. This, to some extent, brings their research works closer to development needs and facilitates their professional integration. What stood out in the experiences of doctoral students especially at UCAD were the doctoral training seminars in which leading scholars and experts were invited to guide and mentor doctoral students in different fields.

In addition to possible isolation of PhD researchers, a further challenge cited was supervision. The system does not have adequate supervisors for the PhD candidates. This clogs down the supervision cycle as one supervisor has to attend to a large number of students in addition to their other duties such as teaching. This led to long waiting times to meet supervisors and finally leading to delays in graduation. This has led to some PhD students being caricatured by undergraduate students as 'eternal students who do not want to get out of the campus' as cited by one UCAD PhD candidate. The new regulations for PhD supervision allow one professor to be responsible for a maximum of ten doctoral students in a year, which may alleviate this problem in the future. However, this is still quite a high number of students per supervisor and has implications for the quality of supervision.

4. National research agenda and doctoral training

4.1 Defining the national research agenda

As summarised in the Senegal Poverty Reduction Strategy Paper (International Monetary Fund, 2013), Senegal has committed to promoting research and development in national priority areas by progressively increasing the research and development budget and promoting different forms of international collaborations for research and making full use of research results. In addition to the LMD reform discussed in the preceding sections, the Decadal Education and Training Development Programme has also led to significant reforms in the research training system. This was developed in line with the Educational Policy Letter 2000–17, and called for the promotion of research as a crucial lever for the economic and social development of Senegal. It encompassed a special emphasis on science and technology, although overall progress towards the achievement of this objective remains slow. From 2007 to 2012, when the implementation of the LMD reform started in Senegal, research was the responsibility of the Ministry of Higher Education and Research. However, some aspects of research fell into other relevant line ministries such as Agriculture and Rural Equipment, Industry and Mines, Health and Social Action.

These reforms have led to the reorganisation of the Senegalese higher education and research system in different ways. One of the structural reforms was the creation of the office of Director General of Research within the Ministry of Higher Education and Research with the responsibility and mandate of facilitating, advancing and managing research in Senegal.

The other development was the establishment of the National Research Scientific and Technical Centre responsible for the management of research and co-ordination of some national and mutualised research centres. The government also created a National Fund for Research and Innovation (FNRI) to fund priority research areas and expanded the mandate of ANAQ-Sup to oversee the quality of university education and research. In the Decadal Education and Training Development Programme, formulated in line with the Educational Policy Letter 2000–17, and the Strategic Development Plan of the Ministry of Higher Education (2013–17), another important package of measures was also enumerated. These included the definition of a strategic research agenda specified in a law which sets out the priorities for the next ten years, and the creation of the Strategic Council for Research under the authority of the prime minister.

In addition to the above developments, the Senegal Emerging Plan – which has been the reference document of Senegalese authorities on research – was another important boost to the management and support of research in Senegal. The Senegal Emerging Plan summarises Senegal's development priorities and projections to be achieved by 2035. Most national development agendas including education and research have to be aligned to this vision. Though our review did not identify a singular document defining Senegal's research priority, this document provided important insights. National research priorities could also be found in the Strategic Development Plan for Higher Education and Research 2013–17 which was adopted by the Ministry of Education and Research in 2013. Among other things, the plan specifies priority research fields to which universities and other research institutions have to focus attention. In addition to this plan, there are also more sectoral strategies for the promoting of research. Much priority for research is in the fields of health, food security, agriculture, climate change, energy, and information and communication technology.

4.2 Alignment between institutional research priorities and the national agenda

Research in Senegal remains fragmented at the institutional level. In part this reflects the diversity of actors involved in co-ordinating research at the national level, with the main actors being the Ministries of Higher Education and Scientific Research, Agriculture and Rural Equipment, and Health. In the field of agricultural research, the Senegalese Institute of Agricultural Research falls under the Ministry of Agriculture and Rural Equipment. The Institute of Food Technology depends on the Ministries of Mining and Industry, Food Processing, Agricultural Products and Small and Medium Enterprises. There are also some international centres or national research centres with international collaborations in research such as the Development Research Institute (environment and resources, health and societies), the Pasteur Institute (public health, epidemiology and bacteriology) and the International Centre for Agricultural Research for Development. It is clear from the above that there is a need for more co-ordination and frameworks for the governance and management of research in Senegal.

As noted in the above section, no single document was found containing a national research agenda for Senegal. However, the policy documents collectively underscored the fact that much priority for research is in the fields of health, food security, agriculture, climate change, energy, and information and communication technology. This is given more clarity within the stipulations of the Fund for the Development of Scientific and Technical Research (FIRST[9]), which was established in 2007. The fund awards research grants to faculty and researchers as well as PhD students. (The FIRST Fund is discussed in more detail in Section 9.) Since the last national consultation on the future of higher education, new orientations in the national policies place great priority on the promotion of research in the STEM fields. In this respect, all the existing PhD programmes and new ones are required to be elaborated in line with the national policy of development and on the demand of the private sector. This has been especially so for the public universities.

Meanwhile, the private institutions find it rather difficult and even inefficient to adopt the same practices in this respect. Instead, they seem much more concerned with the relevance of research themes to the needs of the employment market. In Sup de Co, for example, the selection criteria for PhD careers refer to two main aspects: *excellence and relevance* – an excellent application (with outstanding scores in a master's) and a relevant research theme to present development needs. Aligning research programmes to STEM subjects has been a challenge especially due to the capacity requirements of these programmes and the fact that most of the existing programmes are in the social sciences.

9. In French: *Fonds d'impulsion de la Recherche Scientifique et Technique.*

5. Engagement with industry, the private sector and social challenges

5.1 The need for greater engagement with local industry

Based on its French tradition, higher education (including doctoral training) in Senegal historically had mainly followed the vocational mode, which created a link with the industrial sector as most trainees would fit there. However, in recent years there have been calls for more theoretical programmes, which are also being viewed as important as they make a contribution to this dimension of knowledge. A new brand of doctoral programmes is thus developing with a focus on STEM, as has been discussed in relation to the national research agenda. The theoretical programmes, however, limit the chances of the universities to have meaningful engagements with the industry and at times the general private sector. An exception is the Institute of Food Technology, which develops applied research for the benefit of industrial agribusiness. In general though, universities do not have fruitful links or engagements with the industry and private sectors. An associate professor from University Alioune Diop of Bambey cited the following reasons: (a) lack of interaction between the university and their local contexts; and (b) lack of stakeholder involvement in designing programmes, including a lack of industry and private sector involvement. Professionals rarely teach in Senegalese universities. Most of the time, professional training is carried out without prior exposure to the field, for example via internships or other relevant work experience.

As mentioned in Section 2.2, the overwhelming majority of doctoral graduates are employed in the higher education system. The private sector presents opportunities but mostly in certain fields such as agronomy, environment, natural sciences and biomedical sciences. Data collected for this study showed that the majority of doctoral students were within the arts and humanities, with significantly fewer numbers in the STEM subjects. This could explain why there was not much integration of graduates into the industrial sector, where appropriate skills in sciences or business are required.

However, efforts are being made at the institutional level to address the lack of higher education–industry engagement. The setting up of incubators in most public universities is a relevant illustration of this new orientation. Private companies and private individuals can now offer expertise and specific training to students through specialised agreement frameworks. In some cases, students find their first internship thanks to those contacts. These efforts should be seen in the context of the constraints that researchers face in their challenges to get promoted and the conditions they have to meet in order to be promoted, which do not encourage industry-oriented activities. In fact, in French-speaking countries, CAMES is responsible for promoting lecturers based on their scientific production. That process is very important insomuch as it motivates the activity of research by lecturers, whose ambitions can only be fulfilled through the focus on scientific production at some point. The success of institutions in their attempt to take the activity of research to another level that can help them generate prominent industry-relevant results must be supported by the stakeholders, namely the National Council of Employers and Employers' Confederation of Senegal. Thus, the private sector needs to work alongside the university by providing them with the means. This approach will benefit both parties.

A further illustration of this orientation towards industry is a recent reform affecting public universities. As of 2017, they will be administered by boards involving actors from the private sector, business communities, local government, professional corporations, including employers' organisations such as the National Council of Employers, Senegal's Movement of Enterprises, the Confederation of Senegalese Employers, and the National Union of Industry Owners and Tradesmen.

From the industry perspective, knowledge and research outcomes from the universities were not utilised especially due to a lack of relevance to the industry needs. A respondent from a manufacturing company in Dakar indicated that due to the low interaction between the two sectors, universities were not aware of the needs of industry and vice versa. There were no forums in which the two sectors could interact. The research conducted in universities and higher education institutions as a whole was not accessible to the industry nor was it suitable for addressing the issues of the industries. This disarticulation explains why Senegalese universities have been cartooned as 'factories to produce unemployment' – turned in on themselves and not open to the external environment. However, it should be noted that ineffective collaboration between universities and the business world was presented as a handicap mainly in the context of the public universities only. The new stipulation to include industry and professional representation in the governance structures of public universities may help to alleviate the current lack of engagement with industry needs.

5.2 Addressing societal challenges with private sector collaboration

As mentioned in Section 5.1, public universities and dependent institutions of ministries have set up incubators whose aims are, among others, to use research output to give impetus to social and economic innovations. One of the most well-known projects is the so-called PRODAC,[10] whose implementation is related to research results in the fields of agronomics, aquaculture and aviculture. These are important structures that can assist researchers to promote and share the results of their research.

National companies in particular can benefit from the findings of research, provided that they logistically support those researchers by co-operating with the institutions that employ them. An illustration of a company benefiting directly from research activity at a doctoral centre was cited by a company representative from the field of water treatment. They have representatives on the scientific committee in a doctoral school that specialises in the treatment of water and that is carrying out important research in the field. It is indeed through co-operation of this kind that Senegalese universities can play their role in the dissemination and development of research findings. It is also a means to reinforce the relationships between universities and industry, thereby participating in the economic development of the country. Related to this point, it will become increasingly important to ensure that the country has a quality-assurance agency that can ascertain the quality of the findings of research on the national and institutional level.

10. *Programme des domaines agricoles communautaires* (National Programme for Agricultural and Community Fields).

6. Funding research and doctoral training

6.1 National and international sources of funding

Funding has already been cited as one of the main challenges facing the Senegalese higher education system and its knowledge production system (Hathie, 2009). The Senegalese higher education system was for a long time highly subsidised by the state, but this picture has changed. Currently, research funding comes mainly from two sources, namely, the state (47.61 per cent) and from international sources (40.53 per cent), with the business sector contributing only 4.09 per cent.[11] While previously institutions charged no tuition fees and students benefited from government bursaries and subsidised accommodation, registration fees were introduced in 1994.

Despite a restrictive budgetary context, the government has implemented a national research funding mechanism through the Ministry of Higher Education and Research. The ministry has two major levers of research funding which include doctoral training. One is FIRST, which was established in 2007 to award research grants to faculty, researchers and PhD students. For example, in 2014, 13 research projects were funded for a total of 209,917,788 FCFA (about $359,808). The FIRST research priorities are health, food security, agriculture, climate change, energy and the digital economy. The FIRST will be replaced in the near future by the FNRI, with a larger budget and more regular funding that will focus on the financing of innovation. (At the time of writing, the FNRI is yet to be implemented, so FIRST currently remains the main government mechanism for funding research.) The second research funding mechanisms is an initiative to support the promotion of female researchers and teacher-researchers, which only funds projects that may enable women from educational and research institutions to advance in their career (publications, invitations to scientific meetings and participation in thesis juries) or to complete their doctoral thesis in Senegal. The Ministry of Agriculture also shares responsibility for funding research. It administers the National Agricultural and Food Research Fund dedicated to research projects in the fields of agriculture, livestock, fisheries, agro-industry, water and forestry, hydraulics and environment.

According to most heads of the doctoral programmes consulted in this study, they nonetheless felt that their responsibility was to a great extent undermined by the current levels of state funding,[12] leading to stagnation of possible advancements that could have been made in certain strategic fields. To address this need, almost all heads of doctoral schools in the four public universities (UCAD, UGB, UT and UASZ) resort to external partners for research funds. In this regard, the University Agency of the Francophonie has become a key partner of doctoral schools to finance scientific mobility programmes and research stays for doctoral students. Graduate schools are using co-operation agreements and partnership projects with foreign universities as leverage for logistical, financial or additional scientific resources (access to databases, hosting visiting professors, summer schools, thematic seminars, scientific workshops and subscriptions to online magazines).

In addition to institution-level efforts to attract external sources of funding, the government is also making efforts to do so, with some successful projects having come from the World Bank, the Islamic Development Bank and the African Development Bank, which have played a key role in funding the sector. These include examples such as scholarship programmes in agriculture, and funding of research centres of several countries researching the same topic.

6.2 Institutional and student experiences related to funding

From the interviews with the directors of research in the top two research and PhD producing universities, UCAD and UGB, it was noted that a serious lack of financial resources was a major handicap to production of more PhDs and research outcomes. The context of 'massification' of students, especially at the bachelor's level, had stretched institutional funds, leaving research and doctoral education struggling. According to the heads of the doctoral schools consulted in our sample, university research budgets were considered insignificant or difficult to access. For example, thesis defences can sometimes be repeatedly postponed because the means to support the combined costs of participation of an external examiner from abroad (e.g. airfare and living expenses) are not available. The scarcity of funds also leads to competition rather than collaborations between researchers as they had to compete for the meagre research resources. The trend among the university teaching staff is to neglect basic research in favour of a greater investment in financially profitable consulting studies.

11. Ministry of Higher Education and Research (2013).
12. Information collected during the ordinary meeting of the Pedagogical and Scientific Board of the Doctoral School on 30 November 2016.

From the perspective of doctoral students, funding was also cited as a challenge. This was despite the fact that financing of doctoral programmes in Senegalese public universities, where most doctoral training takes place, is largely provided by the state. PhD students pay an annual registration fee of 75,000 FCFA (about $128). Prior to this amount being set in 2013, doctorate registration fees had for several decades remained the same at the higher rate of 150,000 FCFA (about $250). PhD training in Senegal is hence relatively affordable. Moreover, PhD candidates can benefit from financial support through the national programme of doctoral grants, and there is a scholarship system for doctoral students. (There is no student loan system as part of the financial aid provided.) The generalisation of PhD scholarship was decided during the year 2000. This decision was a powerful incentive for the doctorate and has created a boom in the demand for doctoral studies. This situation can be summarised by the expression 'the thesis for all'. The amount of the government scholarship is 60,000 FCFA per month ($97 per month) for at least three years. An inscription guarantees access to monthly income, social status and professional opportunities (other scholarships, teaching tasks and research contracts) and the benefit of social services (accommodation and meals at modest amounts). According to the findings of this study, most PhD candidates meet the costs of their studies through a combination of state scholarship, temporary teaching contracts and consultancy work. This suggests that the scholarship forms one essential component of doctoral researchers' income. This financial support to doctoral training, among other factors, may be having a positive impact on graduation rates. As can be observed in Table 3, graduation rates at UCAD increased substantially between 2008 and 2015. As shown in Table 4, UGB has also witnessed a substantial rise in doctoral student enrolments; the figure has risen three-fold from below 200 in the 2005–06 academic year, to above 600 from 2010 onwards. If the current level of financial aid were not in place, it is unclear whether the same growth in number of enrolments and graduations would have been achieved.

While funding was considered a constraint according to a majority of the interviewed PhD alumni and PhD candidates, it was also noted that some private universities such as the Centre for Advanced Studies in Management, for instance, where the doctoral programme enjoys more autonomy than in any other non-state institution, research programmes benefit from different sources of funding, like the WAEMU member states or the Central Bank of West African Countries. WAEMU has an annual Support for Training and Research Excellence programme, which covers installation costs, allowance for insurance and living allowances for doctoral students in each of its eight country members, through an annual competition.[13] Thus, it was felt that this institution stands today as offering the most efficient research programmes among non-state universities and schools.

13. www.uemoa.int/fr/bourses/bourses-dexcellence

7. The role of international collaboration in building PhD capacity

7.1 International collaboration beyond Sub-Saharan Africa

The internationalisation of higher education could play an important role in strengthening institutional capacities for research and doctoral training. The International Association of Universities (2010) has recognised this point as the main rationale for African universities to engage with internationalisation. Senegal's universities likewise pursue internationalisation for this reason. All public universities which were part of this study have a director or a vice-president in charge of international co-operation. It was noted that international collaborations in the institutions took different dimensions including exchange of researchers, joint academic programmes, mobility of students and staff, institutional strengthening projects and joint supervision of doctoral students. Due to the colonial history, France has been a dominant player in international collaboration with Senegalese universities. For example, the two French institutions the Centre for Agronomic Research for Development and the Research Institute for Development are international research centres based in the country.

One example of this at the doctoral research level is the GHI and Sorbonne Political Research Centre, Dakar, which offers an innovative doctoral training programme accompanied by scholarships for doctoral degrees attainable at UCAD. The programme is also open to students from France and Germany, thus opening opportunities for knowledge-sharing between doctoral candidates from different countries.

In recent years, other countries have also gained prominence in collaborations with Senegalese universities. The USA is now a very active player especially in the field of agricultural research through the USAID-Education Research in Agriculture, whose aim is to strengthen the capacity of Senegal in training in agronomy. Other partner countries are Canada, Switzerland, Germany (through DAAD), the UK (through the British Council), Belgium and recently Asian countries such as China, Japan and South Korea. Other examples are programmes like the Swiss–African Research Cooperation building Swiss–African links, and the Austrian-led APPEAR[14] partnership. UCAD runs a number of academic partnership projects with other international universities, including Wells College, Indiana University, the University of Oregon (all from the USA) and several other partnerships with European universities. Most of these involve doctoral training and joint research.

7.2 International collaboration within Sub-Saharan Africa

Senegal still plays a crucial role in the development of research and doctoral training, especially in Francophone Africa. Its strong relationships with other international universities open up more opportunities even for universities in the neighbouring countries. Regionally, Senegal has played an important role in hosting students from French-speaking countries, especially within the framework of CAMES. Most Francophone African countries have always considered Senegal as a high-quality system with good public and private programmes. This is highlighted by the diversity and huge number of foreign students at UCAD and UGB. In 2016, according to the Directorate of Studies and Statistics, at UCAD, foreign students were 3,882 out of a total of 79,943 or 4.8 per cent of the total student population. At the same time, in UGB, there were 667 students out of a total of about 10,000 students (6.6 per cent). Of these foreign students, 140 are enrolled in doctoral studies.

With regard to the development of PhD programmes in partnership with Sub-Saharan African countries, co-operation programmes with African countries are set up within the framework of organisations such as WAEMU and the Economic Community of West African States and with neighbouring countries. Research is not only conducted at Senegalese public institutions, but also with foreign private institutions especially from France. The creation of the Network for Excellence of Higher Education in Africa in 2007 triggered new forms of co-operation that enabled African member universities to propose harmonised doctoral training programmes. As a key member of the network, Senegal plays a prominent role in the preparation of joint PhD projects in the fields of information technology and mathematics. The Centre for Excellence in Mathematics and Information Technologies, which was recently opened in UGB, is a relevant illustration of the achievement of this model of co-operation between African countries by developing programmes geared mainly to applied research.

14. APPEAR: Austrian Partnership Programme in Higher Education and Research for Development.

WAEMU is increasingly looking to position itself as an institution that contributes to the promotion of academic research in the eight member countries through a programme called PAES/UEMOA.[15] The funds for these programmes are awarded each year according to a competitive selection for scholarships and research grants to individual researchers and research laboratories.

UCAD has partnerships with several other universities in Africa. One of the most notable was its being a member of several university associations and networks which have been useful in expanding research frontiers and strengthening doctoral training. It is also a member of the recently launched African Research Universities Alliance, which brings together 14 African universities from eight countries to unite their distinctive fields of expertise to achieve complementary and co-ordinated programmes of research and training. The alliance is committed to the development of Africa's knowledge base through research and doctoral training. Due to its international collaborations and regional reputation, UCAD has a diverse student population, with international students coming from several other countries in the region and beyond.

15. In French: *Programme d'appui à l'enseignement supérieur et à la recherche* (Support Programme to Higher Education and Research).

8. Conclusion

The study notes that though Senegal still has a very small postgraduate education sector in its higher education system, the sector is growing and this has been mainly due to government interventions over the past few years. Currently, doctoral provision is concentrated at UCAD. There is a fairly even distribution of thematic areas, with doctoral schools often adopting a multi-disciplinary approach in order to pool resources. A recent development has been the introduction of doctoral provision in the private sector in partnership with public universities, resulting in diversified disciplinary availability such as Business Administration. Although doctoral training has undergone a series of regulatory enhancements, the quality of doctoral programmes was still viewed by interviewees and respondents as a crucial challenge, in particular in terms of creating a more networked and industry-relevant research training experience, and sufficient and frequent supervision.

The study noted that at the national level there is no well-articulated policy agenda guiding research and doctoral training in Senegal, and as such it was difficult to assess the alignment of institutional research priorities with those of the national-level research and development agenda. However, it can be surmised that much priority for research is in the fields of health, food security, agriculture, climate change, energy, and information and communication technology. At the institutional level, the research priorities were clear as could be discerned from the research policies and doctoral programmes of the four main public universities. Nevertheless, the country still lacks a national research policy with clear vision, strategies, and an ambitious and sustainable funding mechanism.

The study further noted that the knowledge production system was poorly linked to the needs of other key stakeholders such as industry, the private sector and the needs of society. Partnerships between the Senegalese higher education sector and the industry/private sector were almost non-existent except in a few isolated cases, notably at UCAD. Additionally, the Faculty of Sciences and Technics at UCAD has created viable partnerships with AfricaRice, the Senegalese Institute of Agricultural Research and the Institute Pasteur of Dakar, which have research components and internship opportunities for students from the university. Nonetheless, Senegalese universities continue to be cartooned as 'ivory towers', barely open to communities and the external environment. Private companies, industries or employers' organisations show limited interest in universities and are weakly involved, although a new regulation mandating industry and professional representation in university governance at public universities may help to address this.

Funding is a major constraint. Funding for research hardly meets the New Partnership for Africa's Development goal requiring the allocation of at least one per cent of GDP to research. Facing this crucial issue, we have seen that some programmes are addressing their funding challenges through novel and innovative approaches. The establishment of the FNRI represents a first step towards helping institutions tackle the problem of funding.

While internationalisation and university partnerships could play an important role in strengthening and providing more opportunities for research and doctoral training, it had not been fully utilised despite Senegal's advantageous position as one of the leading Francophone countries. The study reports on networks established by West African universities and those by French-speaking universities in which Senegal is playing a lead role. They have been used to strengthen its capacities for research and doctoral programmes in Senegal and in the participating countries. Future programmes that aim to enhance PhD capacity should take account of these existing networks.

9. Recommendations

The following recommendations are made for some possible interventions that could be adopted to take up the challenges that research and doctoral training are facing in Senegal.

- One of the main findings of this study is that the country urgently needs to establish new doctoral programmes and graduate schools in addition to strengthening the capacities of the existing ones. This is to address the inadequacy of opportunities for doctoral training and capacity deficits within the existing doctoral training programmes.
- The capacity of graduate schools as key players in doctoral training should be strengthened to ensure the more high-quality provision of doctoral studies. This should be done within the legal framework of the LMD reform, which has brought about major changes that are reshaping the training and research programmes in both public and private universities. The promotion of STEM subjects and pro-development research appears to be one change that institutions will need to respond to. At a very specific level, there is a need to strengthen and improve the supervision of doctoral students in order to increase efficiency in graduation rates.
- Universities should develop training programmes and research that address and provides solutions to pertinent issues in industry and the private sector. Universities should review in depth their research and training programmes to make them more interesting and attractive for companies. Additionally, one of the main challenges to take up in the short run is to bring those programmes in line with the priority development needs of the country.
- The country needs to establish a coherent, ambitious and well-articulated research agenda centred on social demands and social issues and in tune with contemporary scientific needs. This agenda should be supported through well-resourced programmes and be based on an allocation system that stimulates research and values its results. To this end, public and private companies, industry and employers' organisations can be tapped through partnership schemes with universities and research institutions.
- Given the non-existence of a clear national agenda for research and PhD training, higher education and research institutions should work hand in hand with state organisations (General Directorates for Research and Higher Education) and private sector organisations to bring their programmes in line with the main requirements of the national agenda. The remit of the ministry has expanded to now explicitly include innovation (the Ministry of Higher Education, Research and Innovation), but so far intentions to forge a national agenda have not been translated into specific actions.
- Increasing enrolment in PhD programmes requires more qualified teachers and efforts should be focused on building the capacity of teachers and researchers to obtain qualifications to get involved in PhD training.
- It is also important to develop support mechanisms to integrate young researchers into the academia or other areas where their expertise is needed. Mentorship programmes by senior scholars and post-doctoral programmes for newly graduated PhD students would therefore be crucial. In Senegal, there are rarely any opportunities for post-doctoral trainings.

References

Doucouré, B (2014) L'insertion professionnelle des jeunes docteurs au Sénégal. *Hommes et migrations* 1307: 87–92. Available online at: http://journals.openedition.org/hommesmigrations/2884

Hathie, I (2009) *État des lieux de la Gouvernance de la Recherche Universitaire en Afrique de l'Ouest et du Centre: Rapport de Synthèse.* IDRC-CRDI. Available online at: https://www.aau.org/wp-content/uploads/sites/9/2018/04/Etat-des-lieux-de-la-Gouvernance-de-la-Recherche-Universitiaire.pdf

International Association of Universities (2010) *Internationalisation of higher education: Global trends, regional perspectives.* Paris: International Association of Universities.

International Monetary Fund (2013) *Senegal: Poverty Reduction Strategy Paper.* Available online at: https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Senegal-Poverty-Reduction-Strategy-Paper-40739

Ministry of Higher Education and Research (2013) *Plan de développement de l'enseignement supérieur et de la recherche au Sénégal 2013–2017.* Available online at: http://ifgu.auf.org/media/document/Plan_de_developpement_de_lenseignement_superi_eur_et_de_la_recherche_PDESR.pdf

Ndiaye, N (2011) *Les technologies de l'information et de la Communication et l'Enseignement à Distance dans un environnement de massification des effectifs d'étudiants: le cas de l'UCAD.* Doctoral thesis. University of Bordeaux.

Sagna, O (2013) *L'enseignement supérieur sénégalais à l'heure de la réforme. Direction générale de l'enseignement supérieur, ministère de l'enseignement, Programme des réformes prioritaires, PDSER 2013–2017.*

Sy, M (2009) Rapport sur la gouvernance de la recherche à l'université Cheikh Anta Diop de Dakar, IDRC-CRDI. UNESCO Institute of Statistics (n.d.) Senegal: Science, Technology and Innovation. Available online at: http://uis.unesco.org/en/country/sn?theme=science-technology-and-innovation

World Bank and Elsevier (2014) *A Decade of Development in Sub-Saharan African Science, Technology, Engineering & Mathematics Research.* Working Paper No. 91016. Available online at: http://documents.worldbank.org/curated/en/237371468204551128/pdf/910160WP0P126900disclose09026020140.pdf