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Updating the Case studies of the Political Economy of Science Granting Councils in Sub-Saharan Africa

National Case Study Report of

Senegal

Science Granting Council

To the International Development Research Centre (IDRC)

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1 Context of Senegal's STI System

1.1 Recap of contextual factors identified in PE1

The Republic of Senegal has been among Africa's most stable countries, with three major peaceful political transitions since independence in 1960. The country is also the second fastest growing economy in West Africa. Economic growth has been above 6% since 2014. Agriculture and fisheries are the mainstay of the economy although services provide more than half of total GDP. Poverty remains a major challenge in Senegal. It affects almost half of the population (46.7%), which could potentially intensify with the focus on capital-intensive exports, limiting the creation of new jobs. There are also important geographic inequality divides with two out of three residents considered poor in rural areas, especially in the South, compared to one in four in Dakar (the capital city of Senegal).

In 2014, President Macky Sall launched the Plan Senegal Emergent (PSE, Emergent Senegal Plan). The objective of PSE is for Senegal to become an "emerging market" by 2035. In order to achieve this, it elaborates a long-term development strategy for Senegal, including a series of flagship large-scale infrastructure projects such as a dry port and the development of a Special Economic Zone.

The country has had a long history of scientific research since independence. Research, innovation, science and technology activities have been under the Ministry of Higher Education and Research (MESR) or its equivalent since 1983. MESR is tasked with priority setting and the coordination of policy formulation. In Senegal, research grants have been disbursed at an institutional level since 1973 (Mouton et al., 2015). The country has a well-established education system, being one of the three countries in Africa that devotes more than 1% of GDP to education (UNESCO, 2016). However, the higher education sector is predominantly teaching focussed with a low researcher density (Diallo, 2013). Despite this, Senegal is one of the few Francophone countries that have dedicated science funding systems. The Finance Directorate, which is responsible for the various funding platforms available for scientists and researchers in Senegal, is considered to be the equivalent to the SGC in the country.

A significant push towards promoting research, innovation, science and technology started in 2013. One outcome of the PSE is a series of 11 Presidential Decisions on Higher Education and Research adopted by Macky Sall in 2013 to change the organisation of, and funding for, higher education in Senegal. The PSE also places a strong emphasis on tertiary education and STI and building up further education institutions in the country, including a plan for a second university in Dakar to focus, among other things, on science and technology.

1.2 Contextual factors arising between 2017 and 2019

1.2.1 Political overview

The February 2019 re-election of Macky Sall for a five-year second term presents an opportunity to ensure continuity in the long-term national strategy and continued investments under the PSE. The PSE has three main axes: structural transformation of the economy, promotion of human capital, and governance and rule of law. Government ministries are working towards achieving development priorities set in the Plan and defining the country's long-term development strategy (PSE, 2014) as laid out in their respective Sectoral Development Policy Letter (LPSD). Of particular relevance is the current Presidency's focus on "Education and Hydrocarbons, as the new driving force in Senegal's development" (Presidency of Senegal, 2018). The

two key topics championed by President Macky Sall are (1) the distribution of oil and gas revenues and allocation to various extraction actors as well as (2) contributions towards future generations, education and sustainable development. Oil and gas revenues are expected to strengthen the State budget, contribute to its commitment to develop human capital outlined in the PSE, and accelerate the structural transformation of Senegalese public education and the move towards universal schooling (Presidency of Senegal, 2018). There are ongoing efforts to finalise, by 2022, several texts and measures towards the organisation and funding of higher education, research, and innovation, in line with the 11 Presidential Decisions.

1.2.2 Economic context

Economic performance has remained strong over the past three years, notably boosted by the implementation of the country's PSE. The economic growth momentum recorded since 2015 remained strong in 2018, with an estimated real GDP of 7.0%, down slightly from 7.2% in 2017 (World Bank, 2019). The primary sector expanded by 7.8% in 2018, driven by agriculture and related activities. The secondary sector recorded 6.9% growth, driven mainly by mining subsectors, agrofood, and construction while the tertiary sector saw 6.7% growth, reflecting strong performance by the retail segment. While all sectors recorded growth in 2018, agriculture performed particularly well due to support programmes, robust external demand, and large infrastructure investments in the context of the PSE (World Bank 2019). In the energy sector, various reforms and investments have doubled installed capacity in six years to 1,250 MW in 2018. The energy mix plan has increased production and lowered the price of electricity by 10%. The economic growth momentum is expected to continue in 2019 and 2020 and above 6% in the coming years due to continued public investment under the PSE (AFDB, 2020; World Bank, 2019). Forecasts for economic growth remain optimistic with the production of oil and gas expected in 2022.

1.2.3 Science and technology system overview

There has been an increased awareness towards STI in Senegal over the past few years although the country does not yet have an explicit policy for the sector. The Senegalese government's stated aim to "fully invest in research development" (MESRI, 2018, p.28) and Axe 2 of the PSE on human capital, places high expectations for STI to contribute to the country's structural transformation and objective of becoming an emerging economy. As well as the higher education reforms, MESRI is seeking to align its strategy with the PSE, particularly Axe 2 on Human Capital, Social Protection and Sustainable Development. MESRI has seen the first year of implementation of its Sectoral Development Policy Letter (LPSD), aligning its objectives with the Senegal Emergence Plan for the 2018-2022 period (MESRI, 2018).

The ongoing implementation of higher education reforms has led to procedural, organisational and structural changes within the STI system. The adoption of a new framework law under the 11 Presidential Decisions has expanded the Ministry's remit to include innovation and responsibilities for two new missions: universities' contributions to community services and graduates' access to employment (MESRI, 2018). The Ministry, now renamed as the Ministry for Higher Education, Research and Innovation (MESRI), is responsible for implementing the reforms and has oversight for STI activities in Senegal. More specifically, its responsibilities include higher education, research and innovation, and student social and welfare issues. MESRI has also adopted several texts towards the implementation of the reforms.

Internal changes within the Ministry have led to the creation of the General Directorate for Research and Innovation (DGRI) to implement policies for research and innovation, ensure the coordination and

harmonisation of related activities and resources pooling. Its responsibilities include strengthening the different components of the national research system to enable synergies, promoting the diffusion of research results and their valorisation, implementing a funding system for research activities and diversification of funding sources, and developing a scientific and technical culture. In order to achieve this, the DGRI's responsibilities are split between four distinct directorates with respective responsibilities for research strategies planning; innovation, intellectual property and technology transfer; scientific research and technological development financing; and the promotion of scientific culture.

While MESRI has overall responsibility for leading STI developments, research activities are fragmented between institutions under the supervision of different ministries. For example, the Institute for Food Technology (*Institut de Technologie Alimentaire*, ITA) comes under the responsibility of the Ministry of Industry, while the Senegalese Institute for Agricultural Research (*Institut Sénégalais de Recherche Agricole*, ISRA) is attached to the Ministry of Agriculture. As a result, research and innovation, and associated funding streams, are dispersed and fragmented with multiplication and superposition of priorities, leading to lack of visibility and synergies between actors (Cissé et al., 2019).

1.2.4 Science and Technology indicators overview

Current STI indicators are sporadic pending a planned survey to provide exhaustive official data. MESRI is working with the National Agency for Statistics and Demography (ANSD) towards a survey, with the objective of providing official and reliable data on STI. The operationalisation of the survey has been delayed. Nevertheless, the Ministry has provided a series of indicators as part of its 2018 Annual Report (MESRI, 2019). These update previously available data as provided by UNESCO (2016) based on 2010 indicators. The lack of a specific target before activities, and the lack of some indicators, prevents an in-depth analysis for research and innovation. Consequently, some indicators are partially informed (for example in 2018, see Table 1 below). Furthermore, several research and innovation initiatives designed to strengthen the STI system are taken by different actors to research and innovation, making it difficult to assemble relevant data and information under one source, using the same indicators.

Table 1: Senegal STI indicators

	2017	2018	2022 (target)
Number of researchers[1]	14335	22185	
Researcher density	956	1411	1850
Female researchers	29%	No data available	32%
Scientific publications		7197	
R&D spending (percentage of GDP)	0.75%	No data available	

Source: MESRI (2019)

[1] This includes 56.63% research masters, 33.18% PhD students, 9.98% lecturer-researchers and 0.21% researchers.

1.2.5 Science Granting Council (SGC) in Senegal

There is no dedicated formal SGC in Senegal. MESRI's Scientific Research and Technological Development Financing Directorate (DFRSTD), which is in charge of various funding platforms available for scientists and researchers in the country, carries out the functions of the SGC. The responsibilities of DFRSTD include implementing the national budget for scientific research and technological development, monitoring and controlling the use of funds, implementing management procedures, preparing and organising sessions for the National Council of Higher Education, Research, Innovation, Science and Technology, and implementing measures to increase participation of the national scientific community (MESRI, 2019).

Over recent years, the Senegalese SGC has benefited from the SGCI's activities to help in strengthening its capacities for STI policy. These have included training sessions and capacity building in surveys and STI indicators, and interactions and engagement with its peers within regional platforms. The embeddedness of the SGC within MESRI ensures that individuals are able to participate in training activities, depending on topics covered. While moving MESRI's DFRSTD towards a formal SGC status may not necessarily change how the financing directorate operates, further efforts towards harmonisation and adoption of a common language may be needed within the SGCI to enable mutual understanding across the SGC's different contexts and clarity over expectations and objectives among its members.

Funding provided by the SGCI towards collaborative projects between Burkina Faso and Senegal has also enabled the SGC to identify a community of high-level researchers in health and agriculture, which both countries agree are priority sectors. The DFRSTD received a total of 17 research proposals co-written by teams including three researchers for each country. Based on the SGCI funding available, two out of the 17 projects – one for each sector – were selected, totalling FCFA 50,897,200 (USD 87,528).

Providing adequate resources for research projects and infrastructure to develop researchers' capacities and having the organisational capacities to address STI issues are key challenges for the Senegalese SGC. As MESRI's funding directorate body, the DFRSTD plays a key role in interacting with researchers but faces challenges in meeting their expectations. Low budgets mean it is not able to meet local research needs. For example, while all researchers involved in the SGCI-funded call for proposals for cooperative projects with Burkina Faso welcomed the opportunity to work together, availability of funding for only two projects meant that the SGC could not meet researchers' expectations, which can stifle their motivation.

Although there is potential for elections to slow down activities in the country, political constraints are limited given Senegal's stability. Nevertheless, processes within MESRI, and the duration and bureaucracy associated with funding disbursement, can raise trust issues between the SGC and funding beneficiaries. While the SGC interacts directly with researchers, manages funding and conducts evaluations, disbursement of funding comes from another structure. This generates trust issues between the SGC and researchers, who do not understand why their applications are dealt with by another body. Project monitoring and evaluation (M&E) is also a challenge, which training and capacity building activities can help to address.

1.2.6 Research funding of the Science Granting Council

As it stands, the main source of funding for the Senegalese SGC comes from the government, which contributes 80% of project funding. Nevertheless, there is a funding deficit for high level STI research at

the local level. For example, the SGC has been able to cover only 10% of the research projects it would like to fund under the Impulse Fund for Scientific and Technical Research (*Fonds d'Impulsion pour la Recherche Scientifique et Technique*, FIRST) funding stream. The funding deficit also impacts negatively on researchers' capability development and investment in infrastructure to conduct local research, which are not up to the level of what is needed.

The SGC's main objective is to contribute to research that focusses on priority areas and is looking for further support to increase funding available for research. In order to increase financial resources, the SGC is seeking to develop partnerships with domestic and international actors and would welcome further support to establish such links. Another approach that the SGC adopts is to develop partnerships with industries, private sector (national or international) and engage in private-public partnership (PPP) initiatives. Furthermore, efforts to increase sources of funding include the management and securing of additional partners with financial capacity for research funding. Financial capacity from partners is needed as well as finding partners for financing and developing additional resources and funds.

Pending an exhaustive STI survey in Senegal, there are no exact figures on sectoral allocation for research budgets. However, agriculture, health, and energy are likely to dominate, considering limited resources and the need to align state funding with national priorities. The share allocated to Information and Communication Technologies (ICTs) is likely to be on the rise in the distribution of funding allocation, given the emphasis on the sector in the national development strategy. Bearing in mind the fragmentation of research and innovation activities and associated funding, other sectors may also receive support through private institutions.

1.2.7 Policies governing the Science Granting Council and R&D in Senegal

In the absence of a dedicated STI policy, sectoral measures related to higher education reforms and the PSE guide the SGC's funding and R&D, and MESRI's activities on STI. The 11 Presidential Decisions and associated directives provide a roadmap for the SGC to follow and objectives to be achieved by 2022. These objectives include expanding higher education institutions to the entire country and diversifying the university map, developing Science, Technology, Engineering and Mathematics (STEM), and promoting the use of ICTs for teaching and research, as a way of increasing students' access to professional work. The reforms aim to increase investment in higher education and research. One way to achieve this objective is to increase training of human resources and create the necessary knowledge towards emergence, placing a specific emphasis on research and innovation. For example, Decision 8 outlines measures to "provide a fresh impetus to research and innovation" in Senegal, including identifying the country's main research priorities as they relate to its socio-economic development ambitions and implementing an appropriate system of performance indicators to evaluate national policy for STI.

The PSE also provides the direction for development of STI activities in Senegal. The Plan places an emphasis on tertiary education and building further education institutions. In addition, the PSE emphasises the need to increase access to education for a larger number of people and from a wider range of socio-economic and marginalised groups. Furthermore, the plan allocates funding to the creation of a second University of Dakar (with a focus on S&T), the creation of the City of Knowledge – creating higher education, research, and business, a Network of higher education and training institutes, and University residences for over 40,000 students. The City of Knowledge in Diamniadio is also expected to host a dedicated space for governance and evaluation, as well as specific spaces for research and innovation,

learning, and the promotion of scientific culture. Implementation of the PSE started in 2016 and the Ministry of Economy is expected to publish its LPSD at the end of 2019. Lastly, the government reform agenda and the PSE place specific emphasis on the development of ICTs to promote access to higher education and STI.

2 Senegal science, technology, and innovation system

2.1 Recap of STI ecosystem in Senegal

Senegal has a number of well-established universities and research institutes. MESRI's mandate covers all higher education institutions, including universities and higher institutes of vocational training (ISEP) as well as the Senegal Virtual University (*Université Virtuelle du Sénégal*, UVS). The 2013 President Decision mandated the creation of a virtual university and 50 Digital Open Spaces or ENOs, with at least one in each government department across the country. Research institutes fall under the remit of sector Ministries. The most well-known of these is the Senegalese Institute for Agricultural Research (ISRA). In total Senegal had 16 functional research centres and test centres in 2015, up from 9 in 2014. The aim of the government was to have 33 functional centres by 2018.

MESRI is supported by a National Council of Higher Education, Research, Innovation, Science and Technology, established in 2015[2]. The council acts as a consultative mechanism to the Minister of Higher Education and Research (UNESCO, 2016). MESRI is also supported by a number of other allied agencies who promote research activities in the country. In addition, there are several other private research organisations operating out of Senegal as either Senegalese non-profits or as international organisations, including the National Academy for Science and Technology of Senegal (ANSTS), the National Agency for Applied Scientific Research (ANRSA), and the Senegalese Agency for Industrial Property and Technological Innovation (ASPIT). International organisations include l'Institut Pasteur de Dakar, Institute of Research for Development (IRD), the Council for the Development of Social Science Research in Africa, and the African Institute of Mathematical Sciences.

There have also been efforts to strengthen cooperation between universities and the domestic private sector, which remains low. Relatedly, there have been efforts towards the establishment of innovation hubs and incubators such as the creation of CTIC Dakar in 2011, Ker-thiossane Defkoakniep founded in 2014, and Yessali Agrihub founded in 2016. As part of the Presidential reforms, the government announced that it would reform university administration boards and at least 50% of board members would come from outside academia or the "socio-professional world of work". Finally, the construction of Senegal's first planetarium and mini astronomical observatory "could also be a sign of a growing science culture" (UNESCO, 2016, p.494).

2.2 Evolution of STI ecosystem 2017-2019

2.2.1 Higher education

To reiterate, the Ministry for Higher Education, Research and Innovation (MESRI), is responsible for all aspects of higher education, including university and vocational training. It has oversight for Senegal's eight public universities, six of which are operational, one polytechnic and one higher institute for vocational training (ISEP), which provides short two-year graduate training post-*Baccalaureate* (MESRI, 2019). Two new universities are being built: UAM (*Université Amadou Mahtar Mbow*), specialised in science and

[2] A government official noted that this is a project. A relevant draft document has been in existence since 2015/2016, but not yet acted upon.

technology, and USSEIN (*Université Sine Saloum El Hadji Ibrahima Niasse*), specialised in agricultural activities. A network of institutes for vocational training organised around socio-economic potentials of the country's regions is being developed with four new institutes for vocational training. There has also been an increase in private higher education over recent years, which now trains around a quarter of Senegalese students.

2.2.2 University Access

Increasing university access and reducing urban-rural discrepancies are major challenges in Senegal, where only a small minority of the population (around 10%) have access to higher education. There were about 190,145 students in 2018 compared to 174,674 in 2017 (MESRI, 2019). This translates to a density of 1209 students per 100,000 inhabitants, which is still below the 1414 target and the 2000 international norm (MESRI 2019). Out of these, about 114,100 are male and 76,135 are female[3], providing a 0.67 parity rate, and 6% are PhD students compared to 4% in 2017. Most of higher education comes from the public sector with 123,281 students but there has been an increase in private sector education which now has 66,864 students.

The government efforts towards more inclusive higher education are twofold: expanding the university map and the geographical location of higher education institutions, and increasing access in terms of origin of the students. This aims to overcome the concentration of universities in large cities on the coastline, which raises geographical and distributional issues in terms of access and the need for dissemination of universities in landlocked areas where there is far less urbanisation. This is important not only because education is centralised but also because there are socio-economic barriers to its access. Concentration in urban centres means that access is very expensive for people from disadvantaged areas. Transport and accommodation are expensive, raising questions around the potential for success in such socio-economic conditions. Gender equality in access to higher education is also an issue. While, generally, there are as many female as male secondary school leavers, only 30% of higher education students are female. The retention rate is weak because of social, cultural and economic factors such as parents' reticence in sending their daughters to large cities and associated living conditions as well as difficulties in attending studies for women who are wives and/or mothers.

In order to diversify the university map, the government has planned a vast programme towards the creation of new institutions and rehabilitation of existing universities. Despite delays in the execution, extension work was finalised in three universities (UCAD, UADB and UGB) and eight new digital spaces (ENOs) were created in 2018 (MESRI, 2019). The Thies vocational training centre also became operational, although there have been delays with the other expected ISEPs.

As part of the drive to increase inclusive access to higher education, the reforms have also introduced measures to promote the development of digital activities and enhance distance learning. One notable effort is the opportunity provided by the Senegal Virtual University (UVS). There has been a significant increase in students' participation in online courses for higher education, quickly catching up with traditional physical structures. UVS has become the second university in Senegal for the last two years, increasing its

[3] The total is now expected to be more than 190,145.

number of students from 2000 five years ago to almost 30,000 in 2019. The promotion of distance learning is also supported by the creation of open digital spaces (ENOs) throughout the country, providing physical facilities with internet connections that enable interactions between students and teaching staff and secure spaces for exams. Students taking this mode of learning receive a free computer. There are currently 13 ENOs in Senegal, but this is expected to increase to 50 within the next few years.

2.2.3 STI courses in higher education

Senegal has recorded an increase in the availability of STEM and STI courses in higher education over recent years. As part of its emphasis on tertiary education, the PSE has set a target for 50% of students to follow STI disciplines. The future Dakar University and City of Knowledge, which are both under construction, are to offer new STI courses and training opportunities. Efforts towards revising or creating available training have increased the number of curricula dedicated to STI and STEM to 342 compared to 253 in 2017 (MESRI, 2019).

Of particular interest is the emphasis on promoting ICTs in higher education, both for online learning and as a growing sector. Integration of ICTs into teaching and learning strategies has seen an increase of online courses from public higher education institutions from 943 in 2017 to 1605 in 2018, as well as further developments of the "one computer for each student" programme to strengthen digital activities with 10,053 beneficiaries. There are also incentives such as competitions, prizes and awards to direct students towards the field.

Recent developments have also seen the creation of a new training centre to provide postgraduate training to develop skills in oil and gas. Following oil and gas discoveries between 2014 and 2016, and with production expected to start from 2021, a Senegalese State decree adopted on 27 December 2017 established the National Oil and Gas Institute (*Institut National du Pétrole et du Gaz*, INPG[4]). It aims to develop national expertise and contribute to employment and job creation for Senegalese women and men in the oil and gas sectors. INPG aims to train human resources to take charge of the multisectoral dynamics emerging from exploitation, production and management of oil and gas resources. The first cohort for this specialised masters started in October 2018. Entry is very selective and open only to students from scientific backgrounds, not social sciences or humanities.

Despite delays in the developments of the new ISEP centres, there are also increasing incentives for young people to follow higher education vocational training instead of going to universities. Students can already specialise in vocational training for their Baccalaureate. After this they have the option to do an internship in a company and, following two years' training, create their own companies or become operational and join the job market.

2.2.4 University-private sector linkages

Despite attempts to strengthen university linkages with the private sector, progress has been slow. According to an interview respondent, only two universities have implemented measures to change administrative boards' composition to include 50% of representatives from outside academia or the "socio-

[4] Institut National du Pétrole et du Gaz (INPG) (2019): National Oil and Gas Institute, https://www.inpg.sn/ (accessed August 2019)

professional world of work". Measures to promote young people's access to employment have enabled 2248 students to be supported within public university incubators and 2453 in the PSE-J (MESRI, 2019). A total of 120 projects were incubated and 19 enterprises created in public universities in 2018. The PSE-J has supported 298 incubators and enabled the creation of 106 enterprises, creating 1936 jobs.

2.3 STI for socio-economic development

2.3.1 Human resources and skills for socio-economic transformation

The PSE's emphasis on STI also calls for attention to human resources and skills needed to achieve structural economic transformation and the role of tertiary education in the process. While the Plan sets a target for 50% students in STI disciplines, challenges exist at the university entry level where 80% come from a Baccalaureate specialising in literary studies. One of the challenges in teaching STEM relates to students' profiles, most of who come from a literary background. Senegal has inherited from the French secondary education system whereby college pupils specialise in literary, scientific, or technical studies for their Baccalaureat (A-level equivalent). Most students, however, have a literary background, which is not directly applied to provide jobs and/or deliver value-added products from agricultural raw materials or extractive and agricultural activities that require transformation in order to add value to the raw products. Furthermore, the supply of secondary education vocational studies remains low. The Ministry is planning to introduce a vocational training college in each of the 45 departments with specialisations in line with the local economy. For example, a college located in an area relying strongly on agriculture could specialise in agrarian studies.

As such, the challenge remains on training and education to adapt to the needs of the economy and deliver qualified human resources for economic transformation. Such developments may require a nomenclature to define the boundaries of the STI field. While indicators exist for scientists within each school, innovation may relate to technological innovation, management innovation and organisational innovation. In the context of oil and gas, for example, innovations could extend from exploration and exploitation platforms, and engineering disciplines, to considering ancillary activities and related sectors that involve other types of technologies for the transformation of oil and gas. An important point to consider is whose responsibility it is to foster innovations in these areas. The national private sector and higher education would need to work together to create jobs that do not yet exist in Senegal but are already in other oil producing countries. The ability to create such jobs could boost Senegal's socio-economic prospects and ambitions.

In that context, there are ongoing discussions to further articulate the link between STI and the needs of the economy. The Ministry of Economy is in dialogue with the private sector to discuss innovation challenges and opportunities from the perspective of the economy and the role of universities in the innovation process. Furthermore, ongoing talks are taking place with the Korean Development Institute to learn from the country's experience in articulated skills and training demand for specific sectors. The aim is to map the number of skilled labour personnel needed for each sector and devise what kind of engineering training and teaching staff will be needed to support the sector. While there is a list of established activities and sectors, the question is how to direct vocational training to meet this demand, in collaboration with the private sector, which can provide technical teaching, including higher education.

2.3.2 A system-wide approach to education

A broader understanding of increasing the role of STI for socio-economic development also requires a systemic approach to education, starting from primary school all the way up to higher education. A key question is how to simplify teaching so children understand from an early stage opportunities provided by STI. At the secondary level, this includes increasing the number of students' specialisation towards scientific studies so they can follow up in higher education. Transition from secondary school to college is also a challenge as the number of pupils specialising in scientific studies stagnates or decreases. As a result, it is essential to develop a strategy for education and a pedagogic approach to STI teaching that helps to overcome social barriers and mental blocks from pupils' subconsciousness, both in primary and secondary schools. An interview respondent summarised it thus:

> If we want 50% of students in STI disciplines, we need to start from the base and start from primary school and acquisition of scientific knowledge through secondary school and vocational training all the way to higher education.

Aligning with the PSE objectives for STI also requires a cross-sectoral understanding of education policy as a whole to find synergies for engaging young people. Such a systemic approach necessitates further interactions between the three ministries responsible for education in Senegal: MESRI, the National Education Ministry (*Ministère de l'Education Nationale*) and the Ministry for Labour, Vocational Training, and Craftsmanship (MEFPA). While the three ministries have worked together at a high-level towards planning of the report for the general education policy, further participation of those directly involved in teaching, higher education, research and innovation such as teachers, professors, research staff, students and basic education specialists, is needed. Interactions between specialists in national education, vocational, and higher education would help in defining a strategy for the realisation of STI training in education. Teachers are the bridge to ensure there is no discrepancy between knowledge acquired from primary to secondary and from secondary to higher education, and to ensure a smooth transition across different stages.

2.3.3 Gender considerations in STI

Promoting STI in Senegal through an inclusive approach also requires taking into account gender considerations – as girls and women are under-represented in the STI field. This means raising their awareness – prior to university, from an early age and through secondary school – that there are career opportunities for women in the STI field in Senegal. This should aim to overcome socio-political barriers and provide support to remove the stumbling blocks facing young girls and parents towards the STI and STEM fields. Attention to representation in decision-making bodies is also a key point, as lack of gender considerations within processes of institutional transformations and political decisions could add further stumbling blocks. Following the 2010 Parity Law, Senegal is one of the few governments to take into account women's representation with an important percentage of women at the National Assembly and within government bodies. Stumbling blocks, however, remain in the way of effective implementation of STI strategies for girls and women. Increasing the number of women in higher education and decision-making, and improving implementation of development strategies, could increase the space for advocacy and gender-aware solutions that help address gender-related STI issues.

2.3.4 Regional and national governance of STI and research initiatives

Regional initiatives have helped to raise awareness of STI in Senegal. The African Union Development Agency (AUDA, formerly NEPAD), for instance, has provided technical and financial incentives to support Africa Union (AU) member countries. The support has helped to create partnerships, thereby contributing to the development of a common governance framework. Regional initiatives from AUDA and the AU, therefore, provide references (in terms of documents and institutions) with which stakeholders and national governments can align, in line with national development agendas of individual country's needs. One research participant deplored the lack of financing behind regional initiatives:

> There are declarations at high level, which are in line with national policies, but no follow-up on ground. Even if resources are agreed, they do not trickle down to the institutional level. Decision makers need to provide concrete facts/evidence with funds/financing – we see in documents that funds are available – we really need them. This aligns with our STI policy: we have reference documents, and we have Presidential decisions and directives in is our policy environment.

Participants also raised concerns of a disjuncture between high-level political discourses at the national level compared to the lack of the necessary funding allocated to these activities for concrete actions on the ground. Further high-level support from executive and legislative powers and associated funding is also needed. However, more engagement by the Presidency and politicians would provide a strong sense and clarity that STI is a priority for national socio-economic development and job creation.

2.3.5 Pending STI Policy

Unlike Anglophone countries, Senegal is still lacking a dedicated STI policy. This is a stumbling block. Despite institutional and organisational changes within MESRI, implementing the Presidential Decisions towards research and innovation, progress towards a fully-fledged STI policy framework has been slower than expected. For example, the STI survey to provide robust indicators and a dedicated STI policy are still pending. While the creation of the General Directorate for Research and Innovation (DGRI) and new developments for STI are positive, concrete actions on the ground remain to be seen. A research participant emphasised:

> With STI, there is a long way to go. It is there in discourse but this negligible when it comes to practices.

Having an explicit STI policy in place may not address all the challenges in the sector. However, it would enable the actors to see a roadmap for STI and clarify lines of responsibilities. The lack of a national framework and STI policy is particularly problematic as there is no clear roadmap towards activities and prioritisation of STI in the country. A formalisation of STI activities in policy instruments would enable Senegal to articulate the main drivers to conduct specific activities.

2.3.6 Fragmentation and weak coordination

Governance of all STI and actors also remains a challenge. Although MESRI has improved some of its governance capacities in the field of research with new texts for executions in the STI field and policy documents, as outlined in its LPSD (MESRI, 2019; MESRI, 2018), there is also the need to gather and coordinate the range of actors involved in STI. Actors include MESRI itself, research labs, universities, and

private enterprises, the National Agency for Statistics and Demography (ANSD), research think-tanks, NGOs and other research structures, and foreign countries. There have been prior attempts to improve coordination. However, these attempts have been carried out at thematic levels with specific topics rather than addressing governance across the STI field. As one research participant pointed out:

> Each actor is huddled up on itself. Actors have kept on asking for more action. MESRI has tried to respond and provide more stability with the creation of the General Directorate to improve governance and provide texts. [But] creating a directorate in charge of governing is not enough, you also need implementation.

The coordination challenge highlights the need for a dialogue framework as well as guidance towards establishing targets and an implementation plan for the directorate within a national framework. Although there are plans to develop a national framework for STI, this has not yet happened. Discussions on how to develop the strategic plan have been ongoing since 2018, with a national framework expected within the next two years. As a result, it is possible that many relevant STI activities are not necessarily captured.

Furthermore, there is lack of clarity, common understanding, and discrepancies around the role of what constitutes "research excellence" and its contributions to local needs and socio-economic development. As one interviewee put it, "If there is no agreed definition, each strategy adopts a different understanding and there is a cacophony of definitions and criteria that vary from one structure to another as there is no governance towards harmonisation".

3 Progress against indicators

3.1 Science and research funding

Pending the STI survey, detailed data on research funding are scarce. While more than 1% of the country's GDP is devoted to education, higher education is predominantly focussed on teaching. There is not much funding for research in the university budget: about 90% of the budget goes to, for example, salaries, administration and teaching-related functions. Universities continue to focus heavily on teaching compared to research. Inadequate government funding for scientific research means that, even if the State allocates funds to research activities, oftentimes there is no clear budget line for research at universities. There are also instances where individual allowances are managed by universities but no research funding.

The predominance of education is reflected in expected spending for the reforms, most of which is allocated to higher education. A total of FCFA 302 billion is planned for the reform, 78% of which has been allocated to increasing capacities for students in higher education and diversifying the university map while the remaining share is split between governance and research (MESRI, 2013). Research and innovation accounted for 2% of the budget in 2018 (MESRI, 2019) compared to student's welfare and social issues (49%), higher education (46%), and control programmes (3%). There are no details of how this breaks down although previous data from UNESCO state that 41% of GERD was from foreign sources compared to 48% from government and 4% from the private sector. The majority of GERD (52%) went to government institutions or higher education (31.4%).

A total of 0.75% of the country's GDP is allocated to R&D (MESRI, 2019). Most R&D funding comes from the State through grants to various research structures, including universities, public scientific institutions, and high schools as well as through postgraduate scholarships and competitive funds (Cissé et al., 2019). MESRI operates different funding streams for which it has oversight. These include:

- **FIRST/FNRI**: Impulse Fund for Scientific and Technical Research, which has now become the National Fund for Research and Innovation (FNRI)[5]. MESRI received a total of 85 applications for project funding under the FIRST stream in 2017, 50 of which were selected for potential funding. A final decision allocated funding to 13 projects, totalling FCFA 254,253,150 but no disbursement for these projects or others had taken place in 2018 (MESRI, 2019).
- **Funds for Female Researchers and Lecturers in Senegal (*Projet d'Appui à la Promotion des Enseignantes-chercheures du Sénégal*, PAPES)**: PAPES provides opportunities for female researchers and teachers to apply to a dedicated fund to support costs for further education in Senegal or abroad, publishing costs, and costs to attend conferences to present papers. It can also provide up to half of the funding for the publications in international journals and scientific books. So far, PAPES has provided funding to 107 research activities from female academics, including 72 lecturers and 35 PhD candidates, for a total amount of FCFA 287,642,773 (EUR 438,507) (MESRI, 2019c). A total of 32 female PhD students received funding under the PAPES scheme in 2017 (MESRI, 2019).

[5] The Act is not yet adopted.

There were no funding streams in 2018 for either PAPES or FIRST as the year was spent evaluating projects submitted in 2017.

The fragmentation of the research system in Senegal also means that research institutes fall under the remit of sector ministries and not MESRI or under the scope of the SGC. As reported in the first PE report (Chataway et al., 2017), Senegal had 16 functional research centres and test centres in 2015, up from 9 in 2014. There are plans to establish more research centres. Funding systems promoting agricultural research have been recently established. For example, the FNRAA, a sectoral fund for agriculture and food research (set up in 1999), is hosted within the Ministry in charge of the economy. While MESRI and its finance directorate have oversight for research, specific sectoral ministries also allocate research funding as well as the private sector. In general, funds for research and innovation activities are made up of the totality of State subsidies and funding from international donors or "technical and financial partners". Some of the funds from international donors come in the form of international calls for proposals/research projects and others through direct donor funding (Cissé et al., 2019).

Beyond specific funds administered by MESRI and other research funds under different ministries, different reward schemes have been put in place to support "excellence". These include:

- The Presidential Award for Innovation
- The Presidential Award for Science and Technology (*The Grand Prix du Président de la République pour les Sciences et la Technologie*, GPRST): a national distinction whose objective is to reward the researchers who have particularly distinguished themselves by their creativity, the importance or the originality of their works
- An African exhibition of Research and Innovation in Senegal (SARIS), which is regularly organized by the *Agence Nationale de la Recherche Scientifique Appliquée* (ANRSA) in partnership with all national components of research and innovation (Cissé et al., 2019).

While funding streams under MESRI have been successful so far, low public funding is an issue for both research and infrastructure, resulting in weak capacities in labs and research units across the country.

3.1.1 Private sector funding

Despite the public rhetoric on research-business linkages and recognition that enterprises could be key actors, domestic private sector funding plays a minor role in R&D in Senegal. In Senegal's economic fabric, whereby around 12,000 companies are in the modern sector and 97% of activities are in the informal sector, the perception is that R&D is still an activity predominantly reserved for the academic world. Besides the contribution of few telecommunications companies, private sector funding of research and innovation is small in Senegal (Cissé et al., 2019). Due to paucity of data, a gap which the pending STI survey would seek to fill, the private sector's role in the funding of research and innovation is considered to be marginal. Nevertheless, some initiatives are taken up by international private sector actors, either on an individual basis such as MasterCard or the Bill & Melinda Gates Foundation, or through partnership with the government.

3.1.2 External funding

International donors play significant roles in financing research in different forms. According to UNESCO, 50% of research funding comes from external sources. This raises questions of whether research is addressing Senegal's development issues (see, for example, the PE1 report, Chataway et al., 2017). As discussed earlier, some of this external funding comes from technical and financial partners, who play a key role in supporting MESRI's activities. In order to diversify and strengthen funding for research, Senegal, through MESRI, has joined different partnerships, notably between Europe and Africa (MESRI, 2019). These include:

- **Leap Agri** (Long term European African Partnership for food security in Africa, previously ERA-Net Cofund): 27 projects have been selected for funding, 6 of which involve Senegalese researchers. Senegal's participation also enables the country to fund four projects, while two projects are funded by a top-up from the European Union and the *Agence Française de Dévelopment* (AFD). The total budget for the 27 projects is EUR 22.7 million. This is the first time Senegal has participated in co-financing the Leap Agri programme. The programme has enabled MESRI to organise researchers from several institutions in multidisciplinary teams working in priority fields. Furthermore, through the programme, researchers are able to develop partnerships at national, regional and international levels, and acquire additional sources to fund research.
- **SGCI** (cf above): collaborative project with Burkina Faso (FCFA 24,750,000 for health project and FCFA 26,147,200 for agriculture project). Implementation of the projects started in September 2018.
- Application for **Leap4FNSSA**: AU-EU partnership for food security and sustainable agriculture. The aim is to establish a platform for research and innovation partnership between the African Union and the European Union (AU-EU).

In line with Senegal's past, the country has maintained close research links with France. The French have, through some of its institutions – for example, Institute Pasteur (CNRS) in April 2019 – launched a call for proposals to support joint France-Senegal research. The objective of the programme is to initiate or develop scientific cooperation between research centres and universities in both countries, through support for joint research excellence, involving the mobility of researchers. The programme promotes a multidisciplinary research approach, the emergence of new Franco-Senegalese collaborations (thematic and/or institutional) and favours the participation of young researchers (MESRI, 2019). According to UNESCO (2016), there had been 1009 co-publications between Senegalese and French researchers between 2008 and 2014, compared to 403 with the USA, 186 with the UK, and 139 with Belgium.

Recently, the World Bank has opened two new higher education African Centres of Excellence (ACEs) in Senegal in the fields of STEM (mathematics and ICTs) and health (child and maternal health). This brings the total number of World Bank ACEs in Senegal to four:

- African Center of Excellence in Mathematics and ICT (CEA MITIC), Gaston Berger University, Senegal
- *CEA pour la Sante de la Mere et de L'enfant* (CEA-SAMEF), Cheikh Anta Diop University, Senegal (CEA-SAMEF in Maternal and Child Health, Universite Cheikh Anta Diop, UCAD)

- *CEA: Agir en Environnement et Sante*, Cheikh Anta Diop University, Senegal
- *CEA: Agriculture pour la Securite Alimentaire et Nutritionnelle* (CEA AGRISAN), Cheikh Anta Diop University, Senegal

The four new centres are part of the World Bank's wider network of collaboration with West and Central African countries, which aims to strengthen the capacities of participating universities to deliver high quality training and applied research[6].

3.2 Science impact

Senegal had the 3rd highest publication rate (338 journal publications in 2014) in West Africa after Nigeria (1961) and Ghana (579). The majority of scientific papers published by researchers between 2008 and 2014 were in the field of biological or medical sciences (1037) as opposed to agriculture (118 papers) (Chataway et al., 2017).

3.3 Science capacity

Table 2: Research capacities in Senegal

	2017	2018	2022 (target)
Number of researchers	14,335	22,185	
Researcher density	956	1411	1850
Female researchers	29%	No data available	32%
Number of lecturer- researchers	No data	2214	
Number of full-time researchers (UCAD)	No data	46	
Number of researchers at PhD level	6013	7361	
Number of submitted PhD theses	158	287	
Number of researchers Master 2 (research Master)	10,824	12,564	
Number of technicians	No data	21	

Source: MESRI (2019)

The government of Senegal has made efforts to strengthen human resources for R&D. Although the number of researchers has increased to 22,185 compared to 14,335 in 2017 (see Table 2), the number of full-time researchers remains small. Out of all researchers, 56.63% are research masters, 33.18% PhD students, 9.98% lecturer-researchers and 0.21% researchers (MESRI, 2019). Furthermore, there is a shortage of laboratory technicians (MESRI, 2019). Establishing research teams and having the necessary human resources to support them is also a challenge. While there are individual researchers, their actions are not adequately coordinated at the national level and are often not tailored towards national needs. Furthermore, there is a lack of administrative staff to provide support for research activities.

[6] For more on this, visit https://ace.aau.org/about/

3.4 Infrastructure

Despite some investment in infrastructure, often supported by international donor financing or private sector partnerships, the necessary physical environment and equipment to conduct high-quality research in Senegal remains a challenge. The lack of adequate infrastructure can lead to brain drain as researchers move abroad. Concerted efforts are being made to improve the situation. While not yet operational, the *Cité du Savoir* (Knowledge City) includes laboratories, spaces for shared working and equipment. The recent acquisition of the supercomputer equipment to strengthen research structures with support of ATOS, is another example. And there are plans to establish a molecular genetics platform as part of the City of Knowledge (MESRI, 2019). As a multi-partnership, the platform will include genopole from the University of Evry (France) and the Institute for Advanced Sciences and Techniques (*Institut des Sciences Techniques Avancés*, ISTA), which hosts the National Centre for Scientific Calculation (*Centre National de Calcul Scientifique*). The platform will offer masters courses in strategic scientific fields, knowledge exchanges, training and acquisition of material towards a vegetal biotechnology platform that will be hosted at ISTA (MESRI, 2019, p 45).

4 Conclusion and recommendations

4.1 Main findings and conclusion of the report

This report has highlighted some issues in Senegal. These include the welcoming of STI references in the national policy agenda as part of a key contributor to socio-economic development. However, efforts are needed in articulating specific goals and allocation of funding. As it stands, the majority of funding for research (STI and R&D) is from the government. This source, and share, of funding is still small, and needs to be increased significantly.

4.2 Recommendations for the STI actors in Senegal

i. There needs to be recognition at a high level (Presidency and parliamentarians) on the importance to increase efforts towards more interactions between all actors in the STI system.

ii. It is important for policy makers and politicians (led by the Presidency) to complete the formulation and adoption of the anticipated national STI policy, and further emphasise the role of STI for socio-economic development and transformation.

iii. Address the challenges in (STEM) education and gender participation in research and STI. Actions in this regard must take a systems approach and cover primary and secondary education as well as access to higher education, and review the roles of researchers and teachers.

iv. Funding for research remains a major challenge in Senegal. Greater efforts need to be made in this regard. Policy interventions must, as in the recommendations above, take a systems approach that involves a broad spectrum of actors – public and private sector funders, development partners, SMEs and actors considered to be in the informal economy.

v. Improve the availability of data on STI, alongside data transparency.

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Annex: Interview details

Interviewee	**Interview Mode**	**Interview Date**
Representative, MESRI, Scientific Research and Technological Development Financing Directorate (DFRSTD)	WhatsApp	14 June 2019
Representative, MESRI, Study and planning unit	WhatsApp	11 July 2019
Representative, MESRI, Strategies and Research Planning	WhatsApp	11 July 2019
Representative, MESRI, General Directorate of Research and Innovation	WhatsApp	16 July 2019
Representative, Planning Direction of the Ministry of Economy (DGPPE)	WhatsApp	14 August 2019
Professor, University of Alioune Diop of Bambey (UADB)	WhatsApp	13 August 2019
Professor, Université Virtuelle du Sénégal (UVS)/Senegal Virtual University	WhatsApp	23 August and 13 September 2019
Representative, AFSTech/Sénégal (Women in Science Association)	WhatsApp	29 August 2019