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Project

Science, Technology  
and Innovation  
Review and  
Technology Needs  
Assessment for The  
Gambia

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# Science, Technology and Innovation Review and Technology Needs Assessment for The Gambia

## 1. Introduction

This report presents the Science, Technology and Innovation (STI) review and technology needs assessment (TNA) for the Republic of The Gambia conducted by UNESCO and the UN Technology Bank for Least Developed Countries (UNTBLC). The STI review mainly draws on the UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments (GO-SPIN) methodology[1], a tool developed to analyse national STI systems (see section 1.1).

The overarching objective of the UNTBLC is to help the Least Developed Countries (LDCs) build the STI capacity that they need to promote the structural transformation of their economies, eradicate poverty and foster sustainable development. Its specific objectives, as outlined in its Charter, are to[2]:

- Strengthen the STI capacity of LDCs, including the capacity to identify, absorb, develop, integrate and scale-up the deployment of technologies and innovations, including indigenous ones, as well as the capacity to address and manage Intellectual Property Rights issues;
- Promote the development and implementation of national and regional STI strategies;
- Strengthen partnerships among STI-related public entities and with the private sector;
- Promote cooperation among all stakeholders involved in STI, including, researchers, research institutions, public entities within and between LDCs, as well as with their counterparts in other countries;
- Promote and facilitate the identification, utilisation and access of appropriate technologies by LDCs, as well as their transfer to the LDCs, while respecting intellectual property rights and fostering the national and regional capacity of LDCs for the effective utilisation of technology in order to bring about transformative change.

Therefore, the UNTBLC implements myriad activities through partnerships and direct support to build STI capacities, ecosystems and regulatory frameworks that can harness the benefits of newly available technologies by[3]:

1. Attracting outside technology and facilitating technology transfer on voluntary and mutually agreed terms and conditions;
2. Supporting homegrown innovation and research; and
3. Bringing imported and indigenous technologies to market

The Gambia is among the five LDCs for which the STI review and TNA study was launched in 2019 by the UNTBLDC.

This report includes six sections. The first section presents a brief introduction and description of the methodology of the study. The second section will present an overview of the contextual background that shapes the framework in which STI policies and interventions will be formulated and implemented. The third section describes the current status of the STI system and policy framework in the country. An analysis of the STI-related Strengths, Weaknesses, Opportunities and Threats (SWOT) for The Gambia is given in the fourth section. The assessment of the technology needs of the country as expressed by the stakeholders through field research and identified by desk study is presented in the fifth section. The last section provides a brief summary of conclusions as well as the recommendations formulated for the Government of The Gambia.

### 1.1. Methodology

The main tool used in this study is UNESCO's GO-SPIN (Global Observatory of Science, Technology and Innovation Policy Instruments) methodology[1]. GO-SPIN is used to analyse STI systems in different national contexts. For this purpose, it maps STI landscapes and reviews STI policies and their implementation through stocktaking exercises that precede policy development. Building on previous efforts from The Gambia to map its research and innovation landscape[4] and considering the limitations as well as the fact that the STI system in The Gambia is at its nascent stage, a simplified version of the GO-SPIN methodology was used in this study.

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*GO-SPIN (<https://en.unesco.org/go-spin>) is a methodological tool to map national science, technology and innovation (STI) landscapes and analyse STI policies and their implementation. GO-SPIN Country Profiles in Science, Technology and*

*Innovation Policy is a series of reports published by UNESCO. The GO-SPIN programme is run by UNESCO's Division of Science Policy and Capacity Building. The aim is to generate reliable, relevant information about the different landscapes of STI policies around the world. The published information is based on replies to the GO-SPIN surveys, combined with government reports and statistical data from the UNESCO Institute for Statistics and other international sources. The open-access platform of GO-SPIN offers innovative databases with powerful graphic and analytical tools for the use of decision-makers, parliamentarians, universities, knowledge brokers, companies, specialists and the general public, with a complete set of diverse information on STI policies.*

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GO-SPIN draws on a comprehensive stocktaking process through which primary and secondary data and information are collected. The techniques used in the primary research included interactive and participatory approaches and comprised interviews, a national workshop and an online survey.

Visits to 11 institutions belonging to the STI system of The Gambia were conducted between 25 and 28 November 2019. The workshop organised with the collaboration of the Ministry of Trade, Industry, Regional Integration and Employment and Ministry of Higher Education, Research, Science and Technology on 27 November 2019 attracted some participants. The survey, which was implemented in collaboration with the Ministry of Higher Education, Research, Science and Technology aimed to collect information on technology needs in key sectors and was answered by participants. The secondary data and information sources reviewed included the documentation published by national and international organisations. The study benefited from the input by the Working Group created and led by the Ministry of Trade, Industry, Regional Integration and Employment and Ministry of Higher Education, Research, Science and Technology.

## 2. An overview of the contextual background

The Gambia is situated on the West African coast and stretches out around 500 kilometres inland. The width of the national territory ranges from 24 to 28 kilometres, with a total area

of 10679 square kilometres, bordered on the North, South, and East by the Republic of Senegal. The Gambia is the smallest nation in mainland Africa, yet it is amongst the top ten most densely populated nations in the continent with 174 persons for each square kilometre[5].

According to the 2013 census, The Gambia population is young due to a high fertility rate of 5.48 children per woman and low life expectancy 63.4 (62.5 years for male and 65 for female). Nearly 42% of the population is below 15 years, 21% between 15-24 years, and only 3.2% above 65 years.

The climate of The Gambia is Sudano-Sahelian characteristics of short rainy seasons with rainfall varying from 900 mm to 500 mm and between 14 °C to 40 °C. The country has five ecosystems such as forest ecosystems (close & open woodland ecosystem), agricultural ecosystems (arable and rangeland ecosystems), marine and coastal ecosystems; inland water ecosystems (wetlands), and terrestrial ecosystems (tree/shrub savanna).

These ecosystems host rich biodiversity of plant and animal species, which are vital to the population's economic and social development; yet these are suffering from increasing anthropogenic pressure. The recognition by government authorities of biological diversity as a global asset of tremendous value to present and future generations; drove the commitment to conserve at least 5% of terrestrial and inland water and 10% of coastal and marine areas through systems of protected areas[6].

The Gambia is classified as a least developed country (LDC), with a Gross National Income (GNI) per capita of US\$ PPP 2570 in 2018[7]. With an open economy and limited natural resources, it is ranked 174 out of 188 in the 2019 Human Development Index Ranking[8]. In the last ten years, The Gambia's GDP (normalized by Purchase Power Parity) has enjoyed growth starting 2009 at US\$ PPP 4.158 Billion and reaching US\$ PPP 5.956 Billion in 2018, except for a temporary drop in 2011, associated to weather shocks that left the GDP at US\$ PPP 4.179 Billion[9]. The main sectors driving economic growth are Services<sup>1</sup> and Agriculture,

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<sup>1</sup> Includes Tourism, a recent driver of the economy and primary foreign-exchange earner.

forestry and fishing. From 2009 to 2018 the contribution to the overall GDP of the Agriculture, forestry and fishing sector has been decreasing from 31% to 19%. During the same period the Service sector has from 51% to 56% of the total GDP; as well as the industry sector starting 2009 with 10% of the GDP, reaching a 20% peak in 2016 and stabilizing in 15% of the GDP in 2018[10].

## 2.1. Development agenda

The Gambia National Development Plan (2018-2021) is the first overarching planning document developed by the country in 22 years. The initiative was led by the current President Adama Barrow to transition from a 22-year-government, through a document that provides greater clarity and focus for government action, citizens' engagement and also for international development partners[11].

The document establishes as a vision "a country that upholds the highest standard of governance, accountability and transparency; where social cohesion and harmony prevails among communities; citizens enjoy a standard of living and access to basic services to enable them to lead decent and dignified lives; youth, women, children realize their full potential, and a nurturing and caring environment exists for the vulnerable; there is an enabling environment for our private sector to thrive; and our natural heritage is nurtured and preserved for future generations". Therefore, the government's goal is to "deliver good governance and accountability, social cohesion, and national reconciliation and a revitalized and transformed economy for the wellbeing of all Gambians".

The Government developed a set of priorities instrumental in realizing the Agenda 2030 for Sustainable Development and the First Ten Year Implementation Plan of the African Agenda 2063. The strategic priorities are:

4. Restore good governance, respect for human rights, the rule of law, and empowering citizens through decentralization and local governance (aligned with SDG 16).
5. Stabilise the economy, stimulating growth, and transforming the economy.
6. Modernise the agriculture and fisheries for sustained economic growth, food and nutritional security and poverty reduction (aligned with SDG 2).

7. Invest in the people through improved education and health services, and building a caring society (aligned with SDG 3, 4, 6, 10).
8. Build the infrastructure and restoring energy services to power our economy (aligned with SDG 7).
9. Promote an inclusive and culture-centred tourism for sustainable growth.
10. Reap the demographic dividend through an empowered youth.
11. Make the private sector the engine of growth, transformation, and job creation (aligned with SDG 9).

Likewise, the plan includes the following cross-cutting priorities:

- A public sector that is efficient and responsive to the citizenry.
- Empower the Gambian Woman to realize her full potential (aligned with SDG 5).
- Enhance the role of the Gambian Diaspora in national development.
- Promoting environmental sustainability, climate-resilient communities and appropriate land use (aligned with SDG 13, 15).
- Make The Gambia a Digital Nation and creating a modern information society.
- A civil society that is engaged and is a valued partner in national development.
- Strengthen evidence-based policy, planning and decision-making.

The development agenda of The Gambia promotes factors relevant to the development of a functional STI System. For example, the fourth strategic priority aims at “Improved access and quality learning and relevant life and livelihood skills for all graduates, with special emphasis on STEM, Health, and Agriculture”. Likewise, the crosscutting priority guiding the country into digitalisation aims at taking actions for the establishment of technology parks to spur Research and Development in the nation. Another cross-cutting priority fundamental for a functional STI system is evidence-based policies, which is supported by the Gambia strengthening National Statistical System and promoting generation and dissemination of reliable data for result-based planning, monitoring and evaluation.

The total gross budget for The Gambia National Development Plan (2018-2021), discounting available resources, stands at \$US2.4 billion. The main cost drivers are energy and infrastructure (57%), agriculture (11.2%) and human capital (8.34%)[11]. As of 2018, total

funds committed amounted to US\$ 972.92 million. Commitments from multilateral partners were US\$ 903.64 million (93%), and bilateral partners committed US\$ 68.28 million (7%)[12].

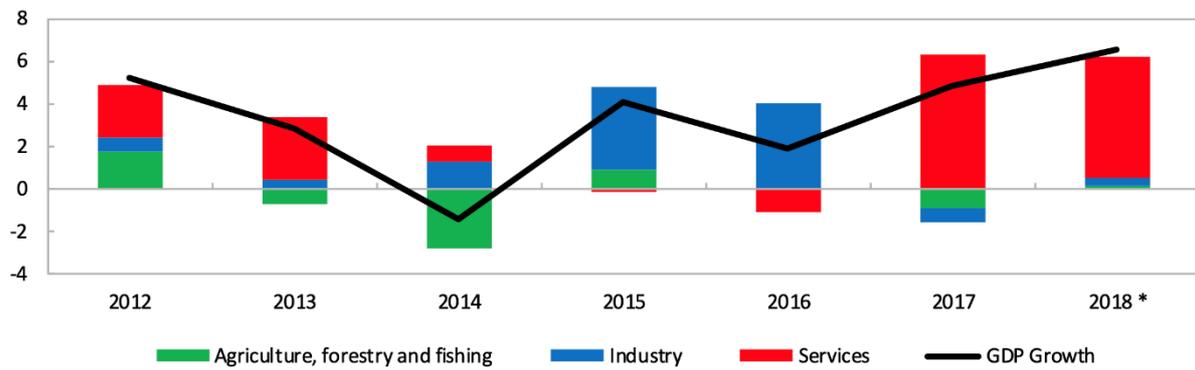
## 2.2. The political and economic environment

The Gambia is a multi-party parliamentary democracy with a government divided into independent executive, legislative and judicial branches. A coup d'état in 1994 deposed the first president, who had ruled since independence in 1965, and suspended the country's 1970 Constitution. A presidential election held in 1996 brought in the then Military leader, retired Col. Yahya A.J.J. Jammeh as the Head of State. President Jammeh led the country for 22 years in relative stability and peace in a turbulent region. Nevertheless, during this period, the human rights context came under intense scrutiny by the international community providing several recommendations to the government[13].

Presidential elections in December 2016 resulted in a political transition after the incumbent President Yahya A.J.J. Jammeh was defeated by Adama Barrow, the presidential candidate of a political coalition. The current president embarked on the task to reinforcing democracy by strengthening the role of the people as well as balancing the role of the government branches. For this, the Constitutional Review Commission (CRC) is established by an Act of the National Assembly in June 2018. The Commission's primary functions are to review and analyse the current Constitution, draft a new constitution for the Republic of The Gambia and prepare a report about the new Constitution.

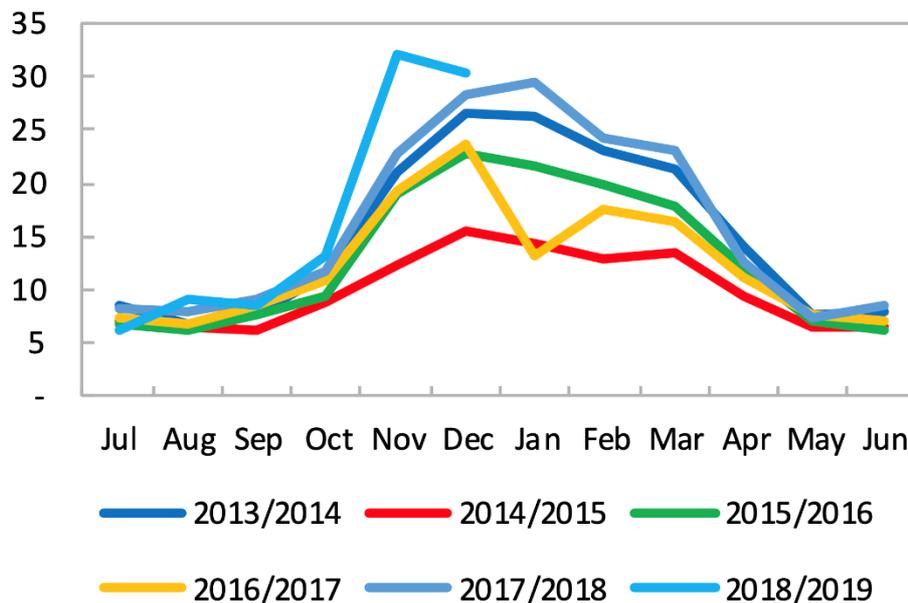
In November 2019, the Commission released the first consultation draft of the constitution[14]. The constitution draft supports science as part of the nation's culture and mandates the state to "recognise the role of science, research and indigenous technologies in the development of the nation" and "promote the intellectual property rights of the people of The Gambia". Likewise, the draft mandates the National Assembly to enact legislation to "recognise and protect the ownership of indigenous seeds and plant varieties, their genetic and diverse characteristics and their use by the communities of The Gambia". The constitution draft also supports free primary and secondary education and mandates the state to make vocational and tertiary education accessible and available to all, while undertaking a process to make them freely available.

Figure 1 - Real GDP growth by sector[15]



Following the 2016 political transition, GDP growth accelerated to 6.6% in 2018 driven by tourism, agriculture and remittances. Multiple shocks, including droughts and the 2014/2015 Ebola crisis in the sub-region, caused some of these sectors to contract in previous years. The Gambia’s agricultural, whose production rise and fall with the level of rainfall, witnessed a slight revival in 2018 and grew by 0.9% compared to the sharp contraction of 4.4% in 2017. As the tourism sector was recovering from the impact of the Ebola crisis (see Figure 2), the political impasse following the December 2016 presidential election took its toll on the 2016/2017 tourism season. Nevertheless, tourism remains the economy’s largest foreign exchange earner; the number of tourists touched a record high and increased by 26% in 2018 compared to 2017. Remittances from Gambian migrants abroad are another significant source of foreign exchange, amounting in 2018 to 12.49% of the GDP.

Figure 2 - Tourist arrivals (thousands of individuals) [15]

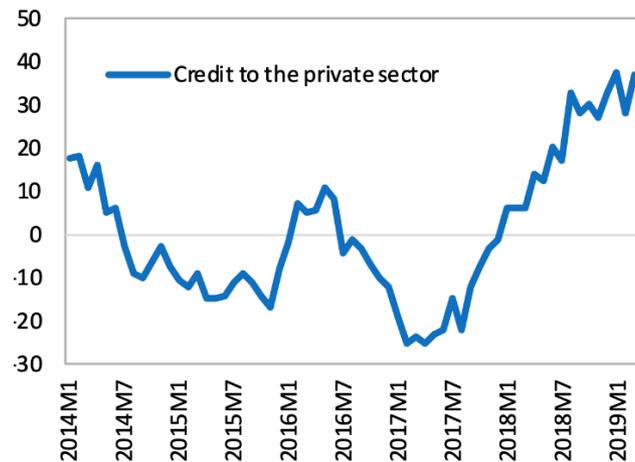


According to the share in The Gambia's exports, the principal partners are Mali (54.62%), South Korea (13.01%) and India (7.51%) while for the country's imports the main partners are Côte d'Ivoire (11.46%), United States (9.14%) and Vietnam (6.82%)[16]. The Gambia exports almost uniquely primary agricultural commodities and imports mainly manufactured goods, running a trade deficit with almost all its trading partners. The Gambia is highly dependent on food, and fuel imports widened the current account deficit reaching -4.8 % of GDP in 2018.

The Gambia attracts significant international financial assistance. The net official development assistance (ODA) flows peaked in 2017 at US\$ 278 million, falling slightly in 2018 to US\$ 220 million[17]. The net ODA as a percentage of the GNI for The Gambia in 2018 is at 14.5%, placing the country 16th in the world and 7th in Africa, according to the data gathered by the World Bank[18], suggesting the heavy weight of foreign financial aid for government expending, including development projects. The main donors of gross ODA for The Gambia are International Organisations with US\$ 59 million (average of 2017 and 2018), followed by EU Institutions with US\$ 50 million, and the United Kingdom and the African Development Fund with US\$ 20 million each[19]. Compared to 2017, the highest ODA sectorial distribution shifted in 2018 from infrastructure to governance. In 2018, The governance sector received 23.12%, followed by the communication sector with 12.61%, the energy sector with 10.97% and the productive sectors with 6.73%[12].

One significant economic challenge in The Gambia is the public debt (81.8% of GDP in 2018). The debt service consumed more than 53% of revenues between 2016 and 2018, leaving limited fiscal space to finance priority spending. Moreover, the high public debt and limited fiscal space kept poverty stagnant (48.4% in 2010 and 48.7% in 2015) and unemployment high (35.2% in 2018). Measures for fiscal consolidation have helped to reduce fiscal deficit to 4.1% of GDP in 2019, through budget support loans and grants as well as expensive domestic borrowing. Nevertheless, the domestic borrowing crowded out the private sector from access to finance, limiting resources the necessary funding to expand their businesses. According to Figure 3, by the end of 2017, the growth of credit to the private sector was at 3% with a strong rebound in 2018, growing by 32%[20].

Figure 3 - Growth in credits from the private sector(percentage change)[15]



The Gambia's private sector is active, but it operates below potential. The private sector mostly concentrates in services in the tourism and agribusiness sectors, and it is characterised by a few medium-sized formal companies and a multitude of micro and small businesses, most of the latter operating in the informal sector. About 97% of businesses have less than five employees (formal or informal sector); small firms (5 to 9 employees) make up 2.2% of the private sector; while medium and large firms comprise less than 1% of firms.

The business environment faces a myriad of challenges in attracting investors and achieve potential. As per data from the World Bank Doing Business Report 2020[21], Gambian firms face several challenges in entering and conducting business. For example, burdensome licensing procedures, administrative complexities and high registration costs are critical hurdles to business environment; high tax rates and bureaucratic tax administration also may hinder the business environment; unreliable electricity is a barrier for industrial development and national competitiveness; the local financial market remains underdeveloped, despite the legal reforms; and the disparity between skills imparted by the training institutions and the skills demanded by industry and commerce, and the economy at large. The government is committed to encouraging national investment and attracting foreign direct investment; hence improvements have been implemented to facilitate starting a business by eliminating the requirement to obtain a company seal and to paying taxes by decreasing the corporate income tax rate and the turnover tax rate, amongst others. Nevertheless, the world is improving faster than the country hence the change in the Doing Business ranking from 145<sup>th</sup> in 2017 to 150<sup>th</sup> in 2020 report.

### 2.3. Education, Employment and Skills

The Government of Gambia has been allocating a substantive amount of funding to the education sector for the last several years to improve country competitiveness and especially opportunities for youth and women. However, maintaining the globally recommended allocation of 20% of the national budget to education has not been consistently met. From 2008 to 2016, government expenditure on education ranged between 18% and 10%[22].

The Government has implemented a free education policy and increased access to education, achieving gender parity at the preschool, primary, and secondary levels. The completion rate in 2019 for Lower Primary Education is 88%, but only 59% for Upper Basic Education and 41% for Senior Secondary Education, with significant differences across regions[23]. Income poverty inhibits families from attending school when confronted with meeting basic non-fee costs such as uniforms, transportation fares and school materials. Early grade reading scores are low, and learning outcomes vary by region calling the Government to continue the efforts to build and rehabilitate schools, provide instructional materials, update curriculums, and accelerate reforms at teacher training institutions for government action to ramp up Education quality, infrastructure and teaching skills[24].

According to the 2018 Labour Force Survey[25], participation in the labour market is low, with almost 43% of the working-age population not seeking employment. This situation is exacerbated by a rate of 35.2% of unemployment for individuals seeking formal occupation. Moreover, unemployment is more prevalent among women (57.1%) and rural communities (76.6%). The informal sector contributes significantly to The Gambia's economy, particularly in terms of employment by providing economic opportunities to 64% of urban households and 35,4% of rural ones. Employment is driven by the service activities with the category "other services" 26.4% and "Wholesale and retail trade; repair of motor vehicles and motorcycles" 11.4% and Agriculture with 9.2%. Interestingly even in rural areas "other services" is the primary employing industry with 13.8% while Agriculture is the second industry of employment with 13.8%. Finally, it is important to highlight in the urban areas of The Gambia, individuals with vocational certificate (51.6%), diploma (56.1%) or Higher (56.1%) education are most affected by unemployment while in the rural areas the less

educated individuals without schooling (79.9%), only Early childhood education (86.7%) or Primary education (75%) are most affected by unemployment.

The employment statistics, according to education level, suggest skill shortages. Despite the Gambia's improving education outcomes, crucial gaps in skill development remain, especially regarding technical and vocational education and training (TVET). According to a Benchmark exercise conducted by ITC in the Agriculture, Tourism and ICT sectors[26], the business ecosystem in these sectors does not supply the companies with individuals who meet the skill requirements of the firms (average score of 42 out of 100). These skill requirements are usually met through in-house training programmes improving the skill capabilities of the firms (average score of 46 out of 100). In this sense, ICT enterprises report more cooperation with TVET institutions to train their employees compared with the other sectors and more in-house training for their employees, not only through their experienced staff but also through external trainers, foreign experts, universities and online courses. Similarly, Agriculture enterprises engage with experienced staff to provide the majority of the training that is offered or supported by the firms. On the other hand, tourism enterprises of all sizes perform relatively poorly when it comes to offering training programmes to develop their workers' skills.

#### 2.4. ICT infrastructure

The governance of ICT in The Gambia is led by The Ministry of Information and Communication Infrastructure. The government has streamlined ICT development in its development blueprints, namely the National Development Plan (2018-2021), The Gambia Trade Strategy and Industrial Development Policy (2018), The Education Sector Policy (2016-2030), National Science, Technology and Innovation Policy (2015 – 2024) and The Gambian ICT for Development Policy (2018-2028), amongst others. The ICT for Development Policy aims at putting The Gambia on an accelerated developmental path that will transform its economy and society in the emerging technological, information and knowledge age into a knowledge-driven, high-income information society and economy.

The Gambia ranks 144th in the world, according to the 2017 ICT Development Index. Compared with other African nations, The Gambia is placed 16<sup>th</sup> and 6<sup>th</sup> in respect to ECOWAS

countries. The index, and consequently the rank, describes the level of and potential development of ICTs, as well as the extent to which countries can make use of them to enhance growth and development in the context of available capabilities and skills.

Figure 4 - Dimensions of the ICT Development Index 2016-2017 [27]

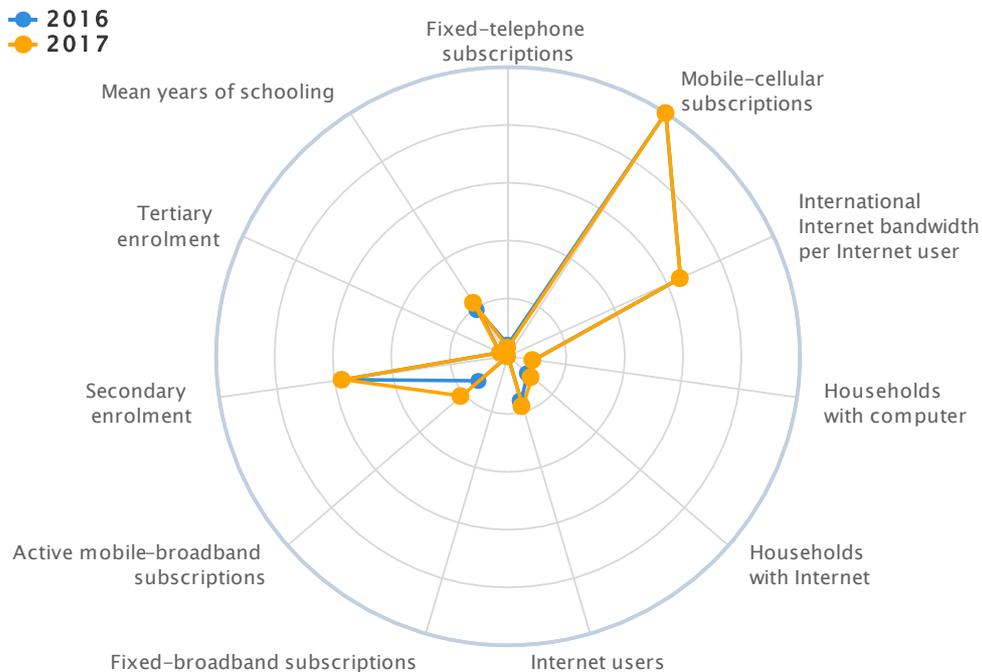


Figure 4 portrays the dimensions incorporated in the index for The Gambia. The country highest dimension is mobile-cellular subscription which has been on the climb since 2011 with 75.8 per 100 inhabitants, reaching 139.5 per 100 inhabitants in 2018[28]. A competitive mobile market arguably drives this substantial growth, with four mobile network operators improving coverage and pricing. Another dimension presenting positive behaviour is International Internet Bandwidth per Internet User after the arrival of the ACE submarine cable in 2011. Despite this positive development, the amount of fixed-broadband subscriptions has been virtual static since from 2014 (0.136 per 100 inhabitants) to 2018 (0.194 per 100 inhabitants)[29]. Some of the interviewees indicated that a possible cause is a difficulty to deploy affordable and accessible fibre optic last-mile solutions that leverage the increased bandwidth capacity and extends the domestic coverage, beyond ADSL, WiMAX, fixed LTE and VSAT technologies. The users of the internet have continuously increased in the country for decades, registering 19.7% of the population in 2017; nevertheless, The Gambia ranked 7<sup>th</sup> amongst the ECOWAS countries[30]. This situation results in limited development

of e-commerce and mobile money hindering the potential of a digital economy. Finally, as discussed in the previous section, The ICT sector is affected by the limited supply of individuals with appropriate skills, as described by the dimensions Mean Years of Schooling, Tertiary Enrolment and Secondary Enrolment.

It is essential to highlight the differences in ICT Development in urban and rural areas. The use of IT and ICT is far lower than in urban areas. Very few businesses have computers and even less internet connection. The demand for ICT services and ICT skills is very low if not inexistent. At first glance, and on a short term, the ground does not seem to be very fertile for the development of the ICT market[31].

## 2.5. Environment and climate change

As previously described, The Gambia is small in size but enjoys a wealth of terrestrial, coastal, marine and wetland habitats and species of local, national, regional and global significance. However, the natural wealth suffers pressures from environmental degradation in rural and urban areas, exacerbated by population growth, non-systematic urban planning. For example, slash-and-burn agriculture and harvesting of wood for fuel have decimated many forests, depriving communities of forest resources and ecosystem services. More than half of The Gambia's inhabitants live in urban areas, and 80% of the urban population resides within 20 km of the Atlantic coast; growing urban populations have strained municipal capacity to control pollution, manage solid waste, and provide sanitation services. Most urban areas have expanded without adequate stormwater management and drainage infrastructure, and suffer substantial losses of life and property during annual rains[32].

The Gambia is among those countries most vulnerable to climate change[33]. This vulnerability is linked to the country's widespread poverty and limited adaptive capacity to deal with the effects of such changes. Limited access to resources to make quick changes to lifestyles, especially concerning food supplies, and low access to risk-spreading mechanisms, render many people highly susceptible to the current and future climatic changes.

More than 98% of agricultural lands in The Gambia are rain-fed, making the sector highly vulnerable to rainfall variability since the yield of some essential crops fluctuates as much as

100% from year to year[33]. Ecosystems will be impacted through the combination of rising temperatures and changing rainfall, mainly in negative ways. The vulnerability of water resources is described by the progressive replacement since 1960 of large areas of freshwater swamps in the western Gambia by salt pans or saltwater marshes, as a result of reduced freshwater inflow from storm runoff. Likewise, this situation affects the fisheries sector with a complete change in the hydrological and salinity balance of the River Gambia's estuary, in turn affecting fish species abundance. The energy sector presents one of the main challenges for The Gambia, and it is highly vulnerable to Climate Change. Rising temperatures combined with decreasing rainfall are likely to cause a decline in standing forest biomass, and hence the renewable volume of fuelwood. Delivery of petroleum products, the second most important source of energy in use, could suffer disruptions in supply related to extreme weather. Electricity supply infrastructure faces decreased thermal efficiency of power lines, and possibly damage to infrastructure since higher temperatures degrade heat exchange efficiency of engines and encourage the use of air-conditioning, resulting in higher fuel consumption and increased greenhouse gas emissions. Sea level is a critical vulnerability. A one-meter rise in sea level would inundate about 8.7% of the Gambia's total land area, which includes over 61% of current mangrove area and over one-third of swampland, while potentially creating new wetlands and mangrove growing areas[33]. Also at risk of inundation is the whole of Barra and over 50% of Banjul including Banjul Port, the country's only deepwater seaport. Furthermore, groundwater in the western Gambia is at risk of increased salinization, while coastal aquifers may become reduced, which would affect fresh water supplies and peri-urban agriculture.

### 3. STI system and policy framework

#### 3.1. STI performance

The Gambia has generally suffered from a lack of reliable data collection systems and statistical data on STI in particular. In 2019 the Ministry of Higher Education, Research, Science and Technology (MOHERST) published for the first time since 2006<sup>2</sup> a study on Science, Technology and Innovation (STI) indicators[34]. With support from the UNESCO Institute from Statistics (UIS) and the Islamic Development Bank (IsDB), the study provides baselines necessary for developing and implementing evidence-based policies to respond to the most urgent socio-economic development needs of the country. The STI survey explores inputs to an Innovation System like R&D Expenditure, R&D Personnel and outputs of this system like enterprise Innovation activities

##### 3.1.1. STI inputs

###### 3.1.1.1. *R&D expenditure*

R&D is part of a class of intangible inputs that also include higher education, and worker training; intangibles that are at least as important sources of long-term economic growth as are physical investments in machinery or other capital investments. Therefore expenditure on R&D is one of the leading input indicators to analyse the performance of an STI System.

The most recent nationwide STI survey in the Gambia was conducted in 2018, and the results were released in 2019 with an accompanying report[34]. For the case of R&D expenditures, the survey collected information from government, private not-for-profit organisations business sector, although with small sample size. Unfortunately, the higher education sector was not covered, despite efforts from the government and evidence of the production of scholarly works by these institutions (see section 3.1.2.1).

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<sup>2</sup> UNESCO Institute of Statistics reports data from 2011 classified as overestimated as well as 2009 and 2008 classified as partial.

Table 1 - GERD as a percentage of GDP and by sector of performance[34]

Gross Domestic Expenditure on Research and Experimental Development (GERD) 2018	GMD 1 315 430 100	0.017 % of GDP <sup>3</sup>
Gross Domestic Expenditure on Research and Experimental Development (GERD) by sector of performance 2018		
Government	GMD 54 865 100	4.17 % of GERD
Private not-for-profit	GMD 1 260 000 000	95.79 % of GERD
Business Sector	GMD 565 000	0.04 % of GERD

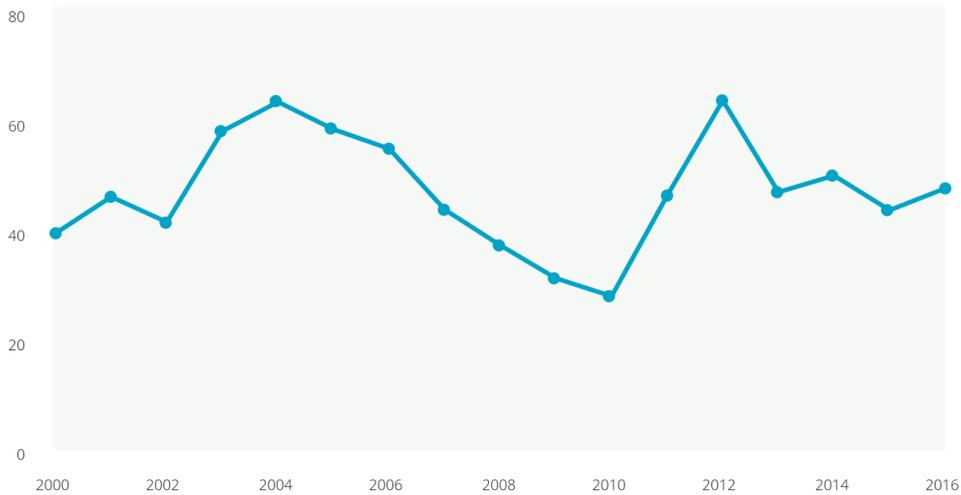
According to Table 1, the GERD of The Gambia (0.017% of the GDP) is distant to the 1% of the GDP recommended in the Science, Technology and Innovation Strategy for Africa 2024[35]. The expenditure on R&D is driven by the private not-for-profit organisations, represented by the Medical Research Council Unit The Gambia, with over 95% of the overall GERD. The business sector expenditure is minimal. Nevertheless, the coverage was of only two entities, which calls for attention when interpreting this number. The government sector expenditure at 4.17% of the GERD is small, especially considering that in not developed countries, the role of the government to drive an STI System tends to be the norm. Despite the unavailability of a GERD breakdown by the source of funding in the STI survey, the report notes that the government expenditure is driven by international sources suggesting an even lower percentage of expenditure from the own government budget.

As previously described, the challenges on the collection of STI indicator, resulting in limited time series of indicators. The best approximation to understand the evolution over time of R&D Expenditure is the use as a proxy of the internationally comparable database on agricultural R&D investments and capacity for developing countries developed by the Agriculture Science and Technology Indicators (ASTI) initiative[36]. The use of this database also allows the triangulate of data to uncover insights and compensate for the impact of limited sample size on the STI survey.

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<sup>3</sup> Given the coverage of the survey, special attention is required at interpreting this figure

Figure 5 - Total agricultural R&D spending in The Gambia(million constant 2011 GMD)[37]



According to Figure 5, R&D spending has been very volatile in the agriculture sector. Levels spiked during 2010–2012 due to the West Africa Agricultural Productivity Program (WAAPP) related activities to enhance the country’s research on rice and other cereals[37]. Thereafter, spending contracted. The implication is that the dependence on foreign funds for the R&D activities in the country may result in variable R&D expenditure and intensity. Moreover, the data suggest that the size of R&D activities in the agriculture sector in 2016 (GMD 47 million 2011 constant prices) is orders of magnitude lower than the value reported in the 2018 STI survey by the Private non-for-profit, what suggests that the activity the Medical Research Council Unit The Gambia is very high compared to other institutions, a situation that requires special attention when consolidating statistics and using these consolidated values for decision making.

Finally, it is important to differentiate financial appropriations and actual expenditure. Although financial appropriations may suggest prioritisation and political will, the highest priority shall be attributed to the real financial effort made by SETI organizations which may provide insights on the capacities in the country for R&D. In this context, according to the 2019 STI Survey Report [34] appropriations of The Gambia government for R&D was at 0.37% of total appropriation, however when compared with the expenditure it only reached 0.04% of total appropriations.

### 3.1.1.2. *STI-related human resources*

Another highly significant subset of STI input indicators measures the human resources devoted to research and experimental development. Policymakers and researchers have increasingly emphasized the importance of skilled people to both knowledge creation and productive innovation. As the economy of nations becomes more sophisticated entering in the spheres of the knowledge economy, the knowledge and skills associated with science and engineering are increasingly more necessary for workers in non-research and innovation jobs as well as for those in occupations traditionally classified as part of the R&D labour force. The planning and formulation of STI policies require the knowledge, especially in LDCs and developing countries, of the total stock of human resources who possess the necessary qualifications to be scientists, engineers and technicians.

#### 3.1.1.2.1. R&D personnel

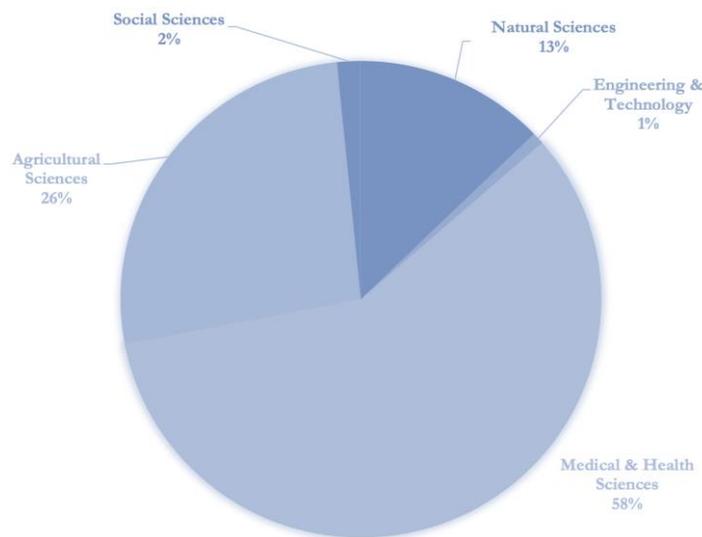
According to Table 1, from the total number of R&D personnel, 8.42% are researchers. Women account for 30% of total R&D personnel and 27% of researchers. The Higher Education sector does not present data on R&D personnel. These figures imply that The Gambia would have approximately 52.6 researchers per million inhabitants, a number below critical mass estimation for the industrialised economy (i.e. 1000/ 1200 FTE researchers per million inhabitants)[38]. Comparing to ECOWAS nations, The Gambia ranks 3<sup>rd</sup> after Senegal and Cote d'Ivoire. The influence of the private-not-for-profit sector is still present in the analysis of this R&D indicator, accounting for 89% of total R&D personnel and 70% of researchers in the country. If only the public sector is considered in this analysis, the country's total number of researchers per million population falls to 14.5. It is difficult to make a comparative rank amongst ECOWAS countries since there is not enough information publicly available to make a comparative with researchers in the government sector; nevertheless, it can be said that the number of researchers per million population is below Mali (29), but above Togo (9.8), Lesotho(8.25) and Senegal (6,75). The rank amongst ECOWAS nations is to be interpreted with care since the normalisation by population punishes countries with a high population that may have higher absolute GERD and number of researchers than The Gambia.

Table 2 - R&D Personnel (FTE) in The Gambia (2018)[34]

R&D Personnel		Researchers			Technician			Other Staff			Total		
Gender		M	F	<u>Total</u>	M	F	<u>Total</u>	M	F	<u>Total</u>	M	F	<u>Total</u>
Sector	Government	27.2	6	<u>33.2</u>	24.4	12.1	<u>36.5</u>	27,3	30	<u>57.3</u>	78.9	48.1	<u>127</u>
	Private	59	27.9	<u>86.9</u>	105	61	<u>166</u>	758	304	<u>1062</u>	922	393	<u>1315</u>
	<b>Total</b>	<b>86.2</b>	<b>33.9</b>	<b><u>120.1</u></b>	<b>129.4</b>	<b>73.1</b>	<b><u>202.5</u></b>	<b>785.3</b>	<b>334</b>	<b><u>1119.3</u></b>	<b>1000.9</b>	<b>441.1</b>	<b><u>1442</u></b>

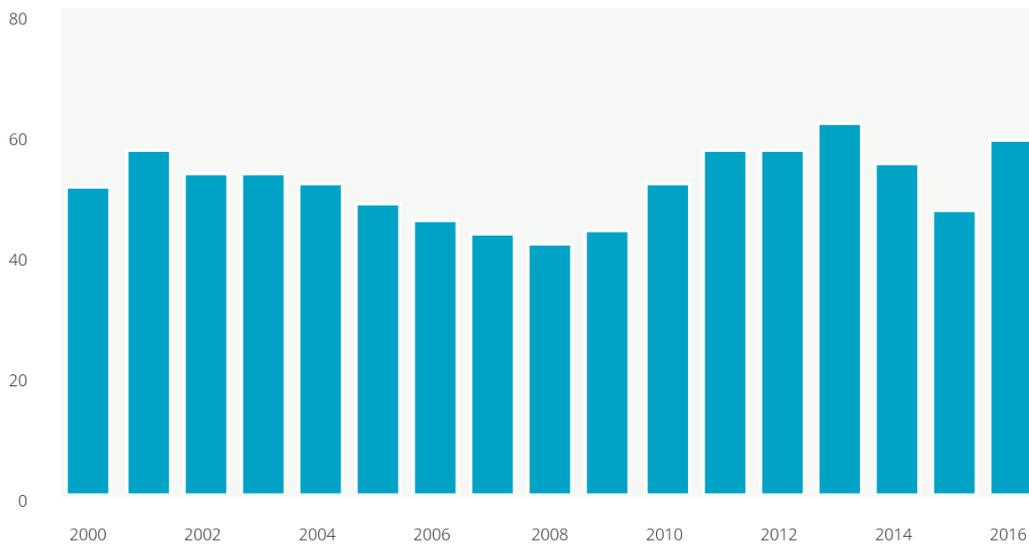
Similar to the analysis in the previous section, the only alternative to review the evolution over time of the R&D Personnel is through the statistics produced by ASTI. Figure 7 presents an oscillating behaviour in the number of Full-Time Equivalent researchers from 2000 to 2016 in a range between 41.7 and 61.8 FTE researchers. Despite the differences in coverage of the 2018 STI Survey and the survey conducted by ASTI, they have one key stakeholder in common: the National Agricultural Research Institute (NARI), the major employer of researchers in the Agriculture sector and one of the main stakeholders in the public sector in the 2108 STI survey. This commonality allows inferring a reduction in the number of researchers since 2016 because ASTI reports 50 FTE researchers in the government sector[37] in 2016 and the 2018 STI Survey reports 33.2 FTE researchers.

Figure 6 - Researchers (HC) by field of science/research and development[34]



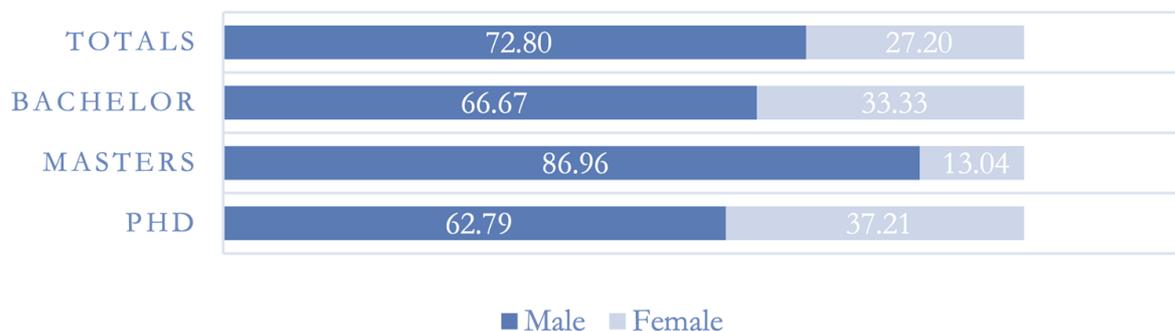
In terms of R&D personnel by field of science, the medical and science fields still account for 50.44% (Figure 6), and the public sector only accounts for 1.61% of the total R&D personnel in these fields. In terms of R&D personnel per FTE, this figure drops for the public sector to 0.81%. This indicates a significantly low human resource from the public sector for the conduct of quality research in the medical and health science fields[34].

Figure 7 - Total researchers (FTEs) in Agriculture [37]



It is of high relevance to explore the qualifications of the R&D personnel in The Gambia to assess the capacities to conduct research in the country. According to the 2018 STI Survey[34], from the total number of researchers, 28.80% hold bachelors degrees, 36.8% hold master’s degrees and only 36.8% hold PhD degrees. However, if the results for government researchers are isolated, we obtain bachelor degree holders at 31.58%; masters 52.63% and PhD 15.79%.

Figure 8 – Highest qualification of Researchers disaggregated by gender[34]



Female researchers represent a smaller proportion of total researchers. Female researchers represent 27.20% of all researchers both in government and in the private sector. In terms of qualifications, female researchers represent 37.21% of all researchers with PhD qualifications (Figure 8). This is above the world average. However, this figure is entirely from the private sector. In government, none of the female researchers has qualifications at the PhD level.

### 3.1.1.2.2. Higher education

The analysis of the human resources with respect to the higher education sector is vital for understanding the barriers to developing a critical mass of scientist, technologists and engineers in The Gambia. The supply of adequate human resources for science and technology depends to a considerable extent on their supply from tertiary and higher education institutions.

Table 3 - Student enrolment by gender and level of study in higher education institutions in 2018 [34]

Gender		Male	Female	Total	Male (%)	Female (%)	Total (%)
Level of Study	ISCED_L8	3	1	<u>4</u>	75	25	<b>0.03</b>
	ISCED_L7	303	64	<u>367</u>	82.56	17.44	<b>2.37</b>
	ISCED_L6	2131	1697	<u>3828</u>	55.67	44.33	<b>24.72</b>
	ISCED_L5	6057	5231	<u>11288</u>	53.66	46.34	<b>72.89</b>
	<b>Total</b>	<b>8494</b>	<b>6993</b>	<b><u>15487</u></b>	<b>54.85</b>	<b>45.15</b>	<b><u>100</u></b>

The data presented in Table 3<sup>4</sup> reveal an important gap in student enrollment for higher levels of education. In 2018 only four students enrolled in PhD courses in Higher Education institutions in The Gambia, this corresponds to 0.03% of total enrolments. Similarly, only 2.37% of students enrolled in Master courses. The situation of Bachelor degrees improves slightly with approximately one-quarter of total enrolments. The majority of students (72.8%) enrol in senior secondary education or vocational education. Remarkably, gender parity has been achieved in terms of gross enrolments at the tertiary and higher education levels. Nevertheless, there is no gender parity in PhD or Masters degrees.

The 2019 STI Survey report revealed that nearly 42% of students applied to study in STEM fields, of this figure, only 27% had been enrolled, indicating a significant gap in enrolment[34]. It is not clear; however, whether the institutions do not have the absorptive capacity to enrol all the applicants or most of the unsuccessful applicants do not meet the admission requirements. In The Gambia, the majority of students prefer to apply to Social Sciences

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<sup>4</sup> These institutions include the American International University of West Africa, University of The Gambia, The Gambia College, and the Gambia Technical Training Institute

degrees (71.17%). Conversely, the current proportion of STEM<sup>5</sup> students in Higher Education Institutions is 26.77%. Gender parity has been only achieved in Medical and Health sector with 50.13% of women enrolments and in Agricultural Science with 45.98% of women enrolment. Natural Sciences, as well as Engineering and Technology, remain unequal with approximately 20% of women enrolment.

Table 4 - STEM Personnel (Lecturers) at Higher Education Institutions by Level of Qualification[34]

Gender		Male	Female	Total	Male (%)	Female (%)	Total (%)
Level of Study	ISCED_L8	36	6	<u>42</u>	85.71	14.29	<b>7.98</b>
	ISCED_L7	198	56	<u>254</u>	77.95	22.05	<b>48.29</b>
	ISCED_L6	136	37	<u>173</u>	78.61	21.39	<b>32.89</b>
	ISCED_L5	23	5	<u>28</u>	82.14	17.86	<b>5.32</b>
	ISCED_L4	27	2	<u>29</u>	93.10	6.9	<b>5.51</b>
	<b>Total</b>	<b>420</b>	<b>106</b>	<b><u>526</u></b>	<b>79.85</b>	<b>20.15</b>	<b><u>100</u></b>

An important aspect to consider when analysis human resources for STI is the institutional capacity for delivery of quality STEM education. In terms of STEM personnel for tutoring in Higher Education Institutions, a total of 558 personnel have been recorded for 2018. Out of this figure, 14.16% are in the natural sciences; 18.10% in engineering and technology; 16.49% in medical and health science fields and 4.48% in agricultural science fields[34]. The total personnel in these fields constitute more than half of all personnel (53.23%) in higher education institutions. Table 4 presents data on the qualifications of lecturers. In this aspect, 43,72% of lecturers have Bachelor's degrees or lower qualifications, while only 7.98% of lecturers are qualified at the PhD level. The data also evidences a lack of women role models since the share of women lecturers is only 20.15% while only 14.29% of them have PhD degrees.

### 3.1.2. STI outputs

The 2019 STI Survey present of The Gambia examines enterprise innovation activities as outputs of its STI System. This section will expand the information provided by this survey by

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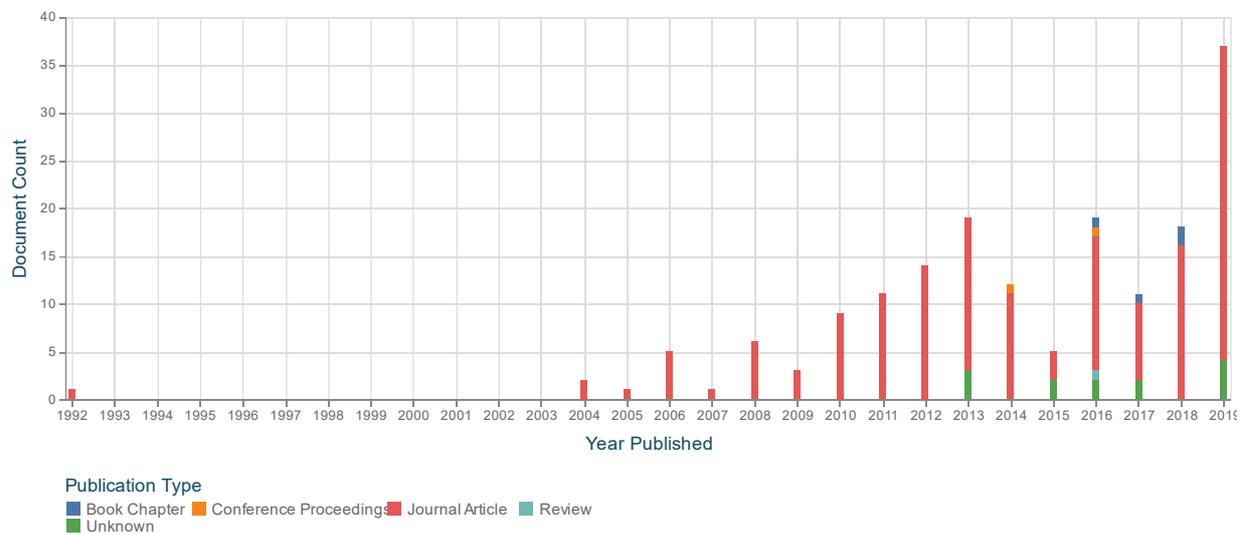
<sup>5</sup> For this study includes natural sciences, engineering, medical and health sciences and agricultural sciences.

a bibliometric study describing the characteristics of scholarly works produced in The Gambia and a review of the patenting behaviour in The Gambia.

### 3.1.2.1. Scholarly works outputs

The bibliometric indicators are essential for assessing the R&D performance and specialisation of R&D performers of countries. As such, this section presents an overview of the scientific publication activity and the level of international co-operation in The Gambia. The analysis was performed on the data from 1990 to 2019 provided by The Lens[39], which incorporates 200 million academic publications.<sup>6</sup> The database provided by The Lens leverages data from sourced from Microsoft Academic, Pubmed, and Crossref. Microsoft is the primary source of data for The Lens; this dataset has been independently analysed and showed high correlation with other bibliometric indexes such as Web of Science or Scopus[40], making The Lens an appropriate instrument to analyse scholarly works in The Gambia.

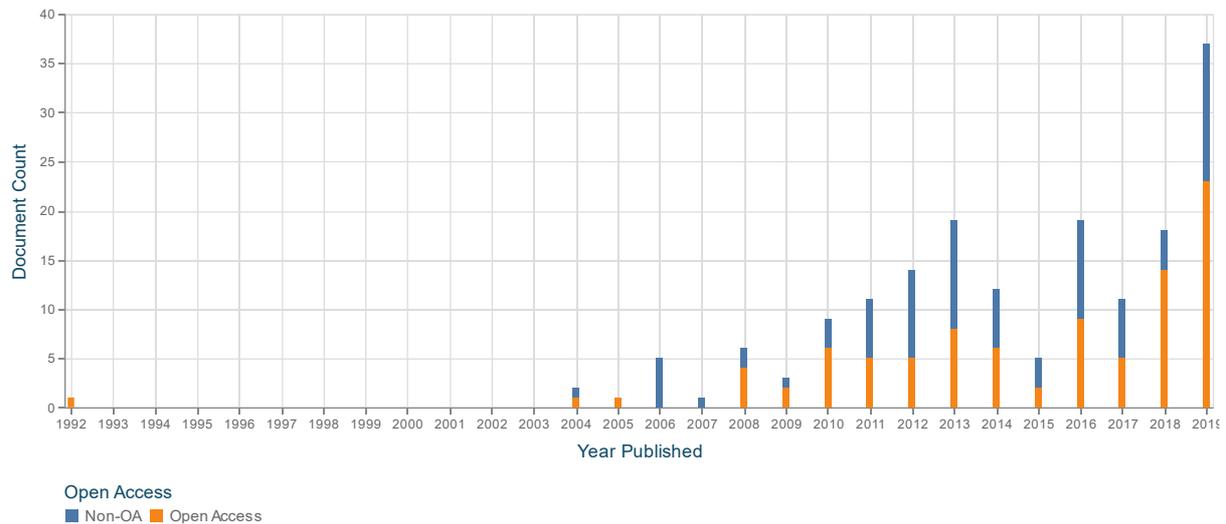
Figure 9 - Number of scholarly works from Institutions in The Gambia from 1990 to 2019[41]



<sup>6</sup> Journal articles, books, book chapters, conference proceedings, conference proceeding articles, and clinical trials.

According to Scimago Lab [42], The Gambia is ranked 30<sup>th</sup> in Africa and 8<sup>th</sup> amongst ECOWAS countries according to scientific publications from 1996 to 2018. Figure 9 presents the behaviour of scholarly works produced by Institutions in The Gambia over time. The trend is overall positive with an approximate 20 times growth in the number of scholarly works from 2004 to 2013. Arguably, the Ebola crisis of 2014-2015 pressured the country, reducing the number of publications during these years, but after the crisis, the number of publications returned almost to the same number of 2014. Despite the growth, in 2019 The Gambia only produced 37 scholarly works, almost ten times less than Senegal in the same period. It is important to highlight that in the last two years The Gambia is producing more Open Access Publications, a trend that in due time will increase access to science (Figure 10).

Figure 10 - Number of Open Access scholarly works from Institutions in The Gambia from 1990 to 2019[41]



Out of the total number of scholarly works extracted from The Lens database for The Gambia, 39% are produced exclusively by Institutions in the country. The remaining works are produced through international collaboration. According to Figure 11, the leading partner is the United Kingdom, with 21.8% of the overall scholarly works, followed by the United States with 13.2%. The leading African partner is Nigeria, with 9.7% of the overall scholarly works, followed by Ghana with 5.4%.

Figure 11 - Top Countries producing scholarly works in The Gambia[41]

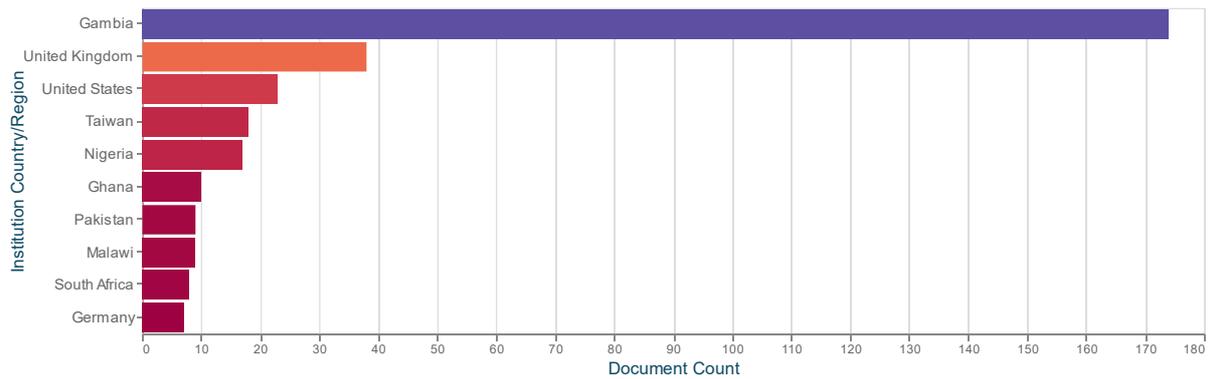
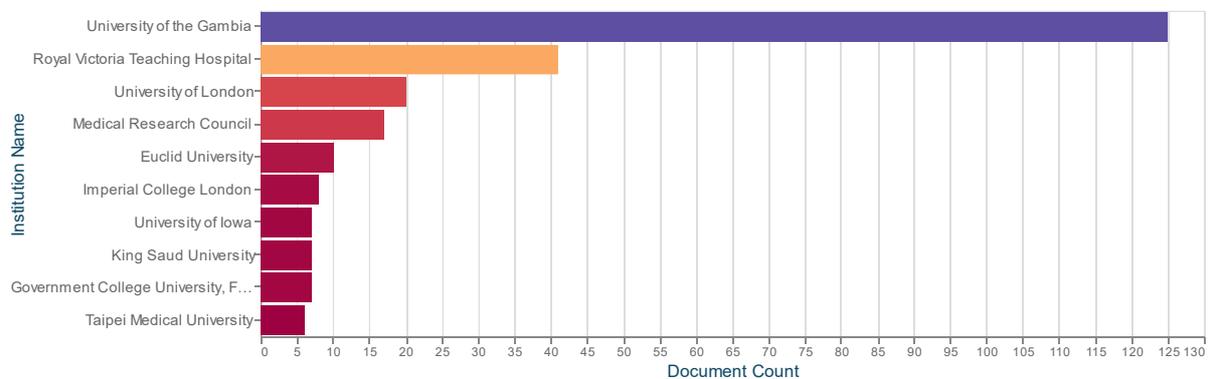


Figure 12 presents the leading institutions producing scholarly works in The Gambia. From the top ten organisations only three are local and one, the Medical Research Council Unit The Gambia, is based in the country but is part of the London School of Hygiene and Tropical Medicine as one of the two research units established in sub-Saharan Africa by the Medical Research Council UK.

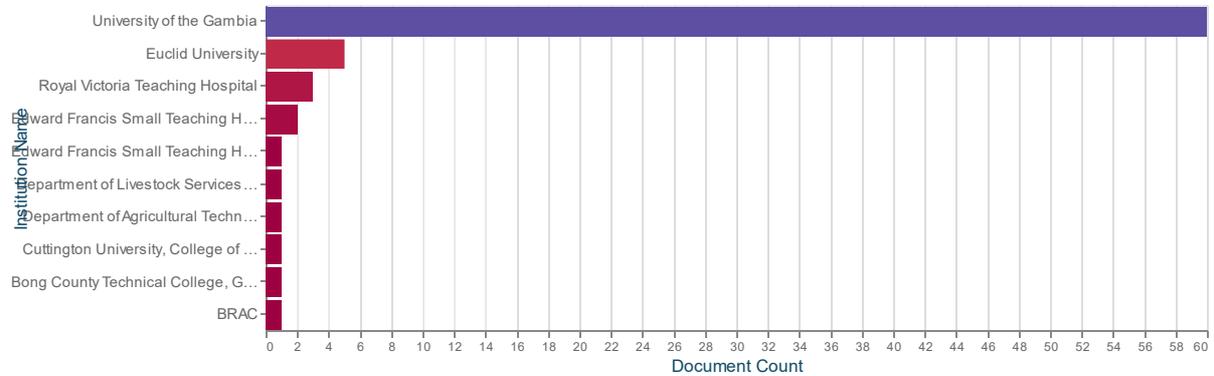
Figure 12 – Top Institutions producing Scholarly Works in The Gambia[41]



The University of The Gambia dominates the production of scholarly works in the country, with 71.8% of documents followed by the Royal Victoria Teaching Hospital with 23.56% (Figure 12). The international organisation with the highest number of scholarly works is the University of London with 11.4% of scholarly works (Figure 12). Interestingly, according to Figure 13 that accounts for publications produced exclusively by local organisations, the amount of scholarly works produced by the Royal Victoria Teaching Hospital falls considerably to 7.3% of its original value. This situation suggests a high dependence on international cooperation for the production of scholarly works. Extending the analysis of this situation, identified that the production is driven by the University of London (34.14%), the Medical

Research Council (31.7%) and the Wellcome Trust Centre for Human Genetics and Imperial College London (17% each).

Figure 13 - Top Institutions publishing scholarly works without international collaboration[41]



The average number of citations of an organisation is an approximation to the quality and impact of the scholarly works it produces. According to Figure 14, the quality of the publications produced in The Gambia is driven by international organisations, mainly the Medical Research Council with 60.5 citations, followed by University of London with 57.9 citations and Imperial College London with 34.8 citations. The first local institution is the Royal Victoria Teaching Hospital with 29.3 citations. As previously described, this value is heavily influenced by international collaboration; considering scholarly works without international collaboration, the average number of citations for this organisation falls to seven. The University of Gambia has only 7.6 citations, almost eight times less than the Medical Research Council.

Figure 14 - Top Institution by average citations[41]

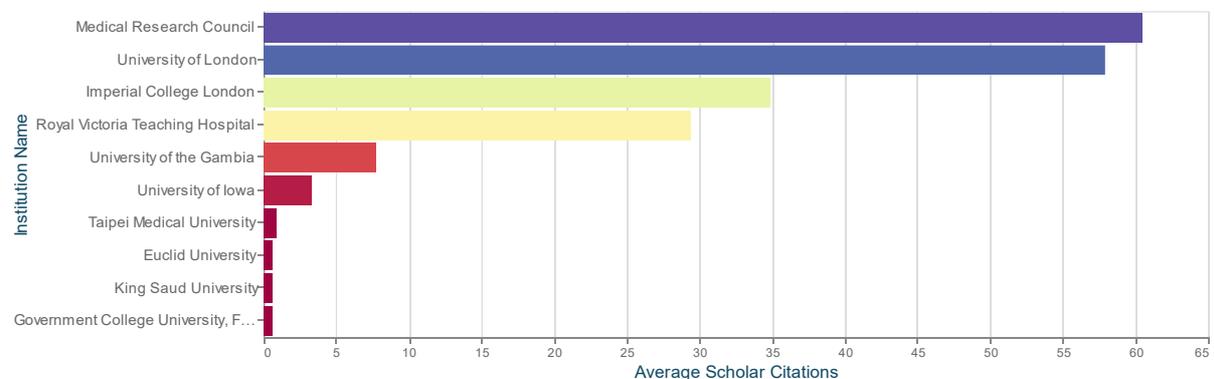
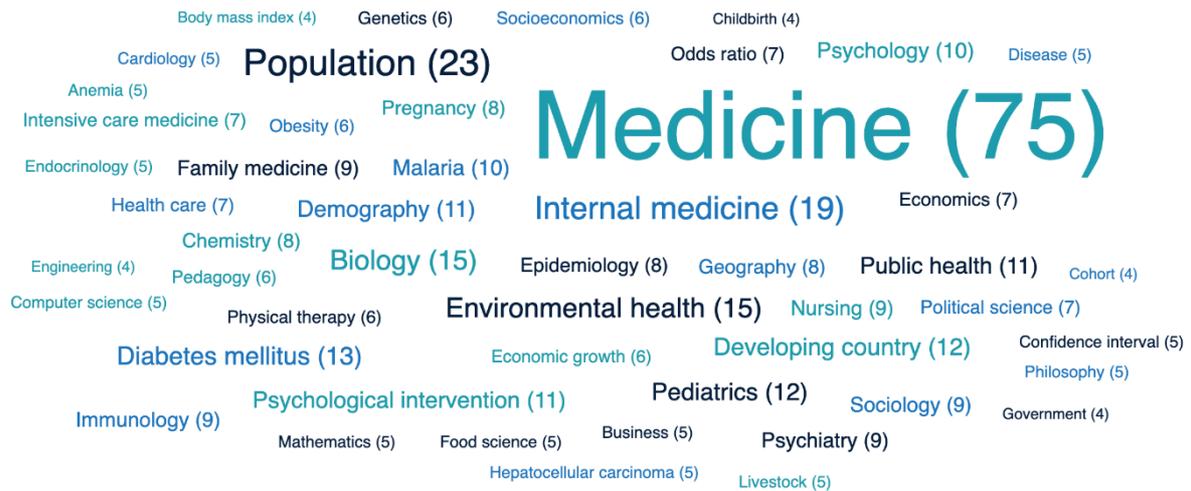


Figure 15 illustrates through a word cloud the top fields of study according to the number of scholarly works in The Gambia. The dominating field is medicine, biomedicine and health-related sciences. More in-depth analysis reveals that the field of study with higher impact scholarly works are related to Malaria, Psychological Intervention, Paediatrics, Immunology and Epidemiology.

Figure 15 - Top Fields of Study of scholarly works in The Gambia[41]



### 3.1.2.1. Innovation activities

The National STI Survey Report 2019 Edition includes an Innovation survey that explores the rate and trend of innovation in The Gambia and amongst industries and enterprises between 2015 – 2017[34]. Data was collected from a sample of medium and large (including extra-large) enterprises of the list of registered members of The Gambia Chamber of Commerce and Industry (GCCl) as of December 2018. Most of the enterprises participating in the survey are mainly engaged in retailing, banking, and service provision with little participation in the manufacturing sector. The results of this survey shall be interpreted with care since it had a non-response rate of over 50%, potentially incorporating no-response bias, which for this case, may suggest that only companies with some capability to innovate had the capacity to fill the survey.

Table 5 - Innovation-active enterprises<sup>[34]</sup>

Type of Innovation		Product Innovation	Process Innovation	Product and Process Innovation	Abandoned or ongoing innovation activities only	Subtotal
Size Class	Medium	5	7	0	4	<u>16</u>
	Large	9	8	0	11	<u>28</u>
	<b>Total</b>	<b>14</b>	<b>15</b>	<b>0</b>	<b>15</b>	<b><u>44</u></b>

Requires meeting with MOHERST to clarify the results in the STI Survey

### 3.1.2.1. Patent outputs

Patent statistics are used to analyse changes in the amount and direction of inventive output, in particular. Besides, paring patent information with other statistical data presented in this report allows the identification of correlations between the evolution of industries and other long-term economic indicators. Unfortunately, The Gambia does not use Patenting consistently as IP protection instrument, represented in a small number of patent documents to shed light on the relative efficiency of company-financed and government-financed industrial R&D and the contribution of individual firms to particular areas of innovative activity. Nevertheless, in the following paragraphs, some interesting insights will be described.

The analysis of patents in The Gambia was conducted with information extracted from Espacenet [43], which provides access to over 110 million patent documents worldwide. From 1990 to 2019, only 13 families of patents documents<sup>7</sup> were found where an inventor or applicant had as residence in The Gambia (see Annex 2). All of these patent documents correspond to patent applications with the implication that no patent has been granted in the jurisdictions covered by Espacenet. All patent documents are associated with the medical, biomedical or health fields.

All the patent documents have one inventor with residence in The Gambia. However, approximately 30% of the patent documents do not contain an applicant with residency in the country; a situation that suggests that the rights of these patent applications remain

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<sup>7</sup> A patent family is a collection of patent applications covering the same or similar technical content.

outside The Gambia. The previously described influence of the Medical Council Research Unit The Gambia in the scientific scene of the country is confirmed by the fact that all applicants or inventors have an association with this institution. Interestingly, the bibliographic information suggests that the patent document applications were registered as individuals rather than as an institution, which is relevant, especially in the case of patent applicants regarding the control of the patent rights.

Further research for patents was conducted in the African Regional Intellectual Property Organisation (ARIPO)[44] resulting in zero patents registered directly with this organisation and three national patent documents (see Annex 3) in the medical or health fields registered in The Gambia from 2000 to 2019[45]. All the applicants of these national patent documents are international companies.

### 3.2. STI policies

The Gambia STI Policy describes a ten-year (2015 – 2024) programme to enhance the development and use of STI to improve the quality of life for all Gambians. The policy document is developed based on the nation's Vision 2020 and Programme for Accelerated Growth and Employment (PAGE), development strategy documents preceding The Gambia National Development Plan (2018-2021).

The vision of the policy is “to create and enhance a scientifically cultured society that contributes to the realization of a knowledge-based economy to support and improve the quality of life”; while the mission is “to build and strengthen national capacity and competencies in STI that will enhance the attainment of economic development and national competitiveness”. In this sense, the policy document broke the ten years programme into three parts according to the time horizon of its objectives.

The first stage and therefore, short-term objectives aim at developing the human capacity, infrastructure and awareness for STI in the country. The objectives are:

- Train personnel in the management, dissemination and implementation of the policy;
- Strengthen scientific research capacity to develop STI;
- Set up a comprehensive central database on STI to serve all sectors of the economy;

- Provide modern and appropriate ICT infrastructure;
- Strengthen data collection and analytical capacity;
- Set up a data bank with appropriate data management facilities and resources;
- Promote awareness and participation in STI to increase the number of students offering STI-related areas at all levels (both formal and non-formal) of the education system;
- Set adequate standards to strengthen the delivery of quality STI.

The second stage involves medium-term objectives focused on the skills and infrastructure necessary to produce local knowledge. The objectives are:

- Enhance collaboration nationally and internationally to foster STI knowledge transfer, adaption and diffusion;
- Develop and strengthen capacity for STI by producing a trained and skilled population competent to transform the nation into a knowledge-based economy; Further, develop and strengthen research capacity and dissemination of scientific findings;
- develop technological and indigenous knowledge through innovative links with industries, to add value to the country's products and services;
- Establish the legal and regulatory framework that ensures effective use of STI for national development with adherence to set standards.

The last stage and associated long-term objectives are associated with the transformation of local knowledge into innovations that add value to the economy and improves the wellbeing of the Gambians. The Objectives are:

- Further strengthen scientific research as a means to spur innovation and entrepreneurship especially among the youth and women to enhance employability, among others;
- Strengthen the incorporation of indigenous technology and traditional medicine in the application of STI in the day-to-day living of the citizens;
- Transfer, adapt and assimilate appropriate technologies;

- Create and sustain a knowledge-based economy in which the citizens can effectively apply scientific and technological knowledge and skills in resolving socio-economic problems;
- Modernize agriculture and other national industries through STI to create quality products and services for sustained economic growth;
- Use STI to modernize agriculture and create quality products and services for sustained economic growth.

The implementation of this policy was envisioned through a set of pillars that would establish the base for an STI system. The pillars are:

### **Education and Training:**

Develop a critical mass of STI personnel through improvements in the education system at all levels. Focus on mainstreaming entrepreneurship and strengthening infrastructure as well as the quantity and qualifications of teachers. Promote linkages with the economy to develop individuals with skills needed in the market.

### **Elaboration of Indicators and Data Management Research and Development**

Develop institutional and human capacity necessary to gather and analyse STI indicators for decisionmaking, monitoring, benchmarking and evaluation.

### **Research and Development**

Promote actively the creation and dissemination of knowledge prioritized in the sectoral priorities of the country, through an increase of funding, creating of coordinating agency and support the development of a critical mass of researchers.

### **Information and Communication Technologies STI Infrastructure**

Increase the accessibility of ICT tools and mainstream the use of ICT across all activities in the country emphasizing the use of ICT for increase efficiency, improved education and R&D.

## **STI Infrastructure**

Create and sustain proactive programmes to ensure the availability of the required STI infrastructure, such as metrology, standardization, testing and quality infrastructure; science laboratories; intellectual property rights; centres of excellence; and centres for the development of indigenous knowledge.

## **Legal and Regulatory Framework**

Develop frameworks to design and enforce regulatory instruments for environmental protection; protection of researchers, scientists and industrial workers; protection of intellectual property; and alignment with international standards.

## **Science, Technology and Society**

Promote the appropriation of science by society through science popularization instruments.

## **STI Governance**

Establish a viable STI governance framework with accompanying supporting and coordinating government bodies to facilitate effective policy implementation, improved transparency, accountability, entrepreneurship, safe and appropriate use of STI by government, industry, society and all other stakeholders.

## **Funding and Sustainability**

Increase STI budget allocations with sustainable programmes to fund STI programmes, research and development. Provide fiscal and other incentives as well as mentoring and business development services support to high-tech start-ups and high growth firms.

An integral part of this policy incorporates sectoral policies and strategies that guided the way in which STI will provide the solution to the most pressing challenges of The Gambia. The priority sectors defined in this policy are medicine and public health; trade and industry, innovation and entrepreneurship; energy; agriculture, the environment and natural

resources; transportation; national security; sports and recreation; tourism and recreation; tourism and hospitality; and youth and innovation.

In addition to the STI Policy, there are direct and indirect references to research, technology and innovation in the majority of the national policy and strategy documents. A brief summary of selected high-level documents with STI elements is given below in order to provide an overview of the current policy framework in the country.

### **Education policy 2016 -2030[46]**

The policy provides provisions for responsive, relevant and quality education for all Gambians in order to reduce poverty. The policy guides the development of the tertiary and higher education system to provide relevant, sustainable and high-quality education and research to support the human resource needs for national development. Research is one crucial component addressed directly in the policy and aims at the development of governmental bodies to lead its development together with the Ministry of Higher Education, Research and Technology.

### **The Gambia Trade Strategy and Industrial Development Policy (2018)[47]**

The objective of the policy to strengthen and develop new competitive advantages across sectors of the economy with the aim of boosting employment, wealth creation and economic growth. The policy has various crosscutting issues, amongst them Innovation, Technology Transfer, R&D requesting budgetary provision for its development; and skills upgrading through vocational training programmes to address the needs of the market.

### **National Employment Policy and Implementation Plan (2019-2024)[48]**

The overall goal of the policy is to promote full, productive, decent and freely chosen employment which will eradicate poverty and reduce income inequality. STI is mainstreamed in this policy, calling for specific strategies for technology dissemination and adaptation as a means to implement Pro-employment macroeconomic policies. Likewise, the policy guides in the industrialisation process lead by the agriculture sector, including as one of the strategies the promotion of agricultural research to enhance farm production. Finally, a central part of

this policy is the promotion of skills development and employability through the linkage of education and vocational training centres to the industry to adapt to its dynamics.

#### **The Gambia ICT for Development (ICT4D) Policy Statement (2018- 2020)[49]**

The overall goal of the Gambian ICT4D process is to facilitate the accelerated development of the nation's economy through the development, deployment and the exploitation of ICTs within the various sectors of the economy and society. One of the main strategies included in this policy is to "Promoting Cutting-Edge Research, R&D and Science Technology and Innovation (STI) Systems & Products to facilitate rapid Socio-economic Development in the Knowledge and Technological age.

#### **National Entrepreneurship Policy[50]**

The general objective of the policy is to improve the conditions for enterprise creation and growth while addressing legal, social and regulatory barriers for equitable and effective economic participation. The emphasis is on women and youth, including groups prone to migration. Likewise, the policy calls for a focus on technology and innovation advances, finance and capacity-building, education and skill development and the promotion of an entrepreneurial spirit at a national level. In direct relation with STI, the policy sets as critical activity the facilitation of technology exchange and innovation through the establishment of incubators, adapting public procurement rules to SMEs and establishment of rural tech hubs.

#### **The National Biodiversity Strategy and Action Plan (2015 – 2020) [6]**

The mission of the document is to set the guidelines for creating a society that sees its self as an integral part of nature, recognizes different life forms, sustainably uses natural resources and maintains for posterity a nurturing and dynamic world rich in biodiversity. STI is considered an integral part of throughout the target defined in the action plan, including target 19 that states that by 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the understanding of consequences of its loss, are improved, widely shared and transferred, and applied. In this sense, the policy states the urgent need to generate new knowledge and compilation of

existing information which will help to identify threats to biodiversity and determine priorities based on status, trends and values for conservation and sustainable use.

### **Gender and Women Empowerment Policy 2010-2020[51]**

The formulation of the policy provides guidance for the achievement of gender equality and equity in the country and through its implementation plan, sets indicators and a framework to assist sectoral departments, partners, and other stakeholders to mainstream gender from a rights-based approach in their planning and programme as well as implementation processes in order to achieve gender equality as provided in the Constitution of The Gambia and other relevant international instruments that the country has ratified. In relation to STI, the policy includes a strategic objective is to encourage girls and boys to study mathematics, science and technical subjects.

### **National Climate Change Policy of The Gambia[33]**

The policy guides the actions of The Gambia to achieve a climate-resilient society, through systems and strategies that mainstream climate change, disaster risk reduction, gender and environmental management, for sustainable social, political and economic development. The policy highlights the need for the development of research infrastructures to strengthen the culture of research in the country and answer to the data constraints that hinder the development of robust and localised climate change responses. Likewise, the document promotes the adaptation and dissemination of technologies to develop appropriate adaptation and mitigation approaches and climate-resilient infrastructure for long-term economic benefits.

### **Gambia National Agricultural Investment Plan (GNAIP)[52]**

The central objective of this plan is increased food and nutritional security and household incomes. This will be achieved through increased production and productivity in the Agriculture and Natural Resources sector, based on sustainable management of natural resources, commercialization and active participation of the private sector. This strategic document promotes STI as a critical aspect for the delivery of its mission, mainstream research and development across the programmes described in the document. More

specifically, the plan emphasises the need to Strengthening National Operator Support Services and Structures for improved research on agro-processing technologies, knowledge exchange and extension services.

### **The National Health Policy (2012- 2020)**

The policy has a direct and straightforward goal, reduce morbidity and mortality to contribute significantly to the quality of life in the population. STI has a central goal in this policy as one of the main instruments for evidence-based decision making. In this sense, the objective is the improvement of data collection practices and availability of reliable health information; and strengthen research in Health Systems. The policy also promotes the development of a government body to coordinate all research done in the health sector

#### 3.3. Policy-Making practices and policy cycle

The national policies and plans in The Gambia are prepared in a participatory manner with the involvement of various relevant stakeholders. Although there is no comprehensive document formalising the procedure for the development of policies and policy instruments, the main stages of the cycle, as described by UNESCO GO-SPIN[1], are:

#### **Agenda setting**

With respect to the strategic direction that the STI policies and policy instruments, the office of the president and the cabinet provides overarching strategic guidance as it is stipulated in the National Development Plan. Regarding specific aspects related to STI, the agenda-setting procedure is championed by the Ministry of Higher Education, Research, Science and Technology (MoHERST). Although in the national STI policy calls for a National Council for STI, this is not yet in place; nevertheless, this function is undertaken by interministerial committees created Adhoc for individual programmes or initiatives.

#### **Policy formulation**

As previously describer, in The Gambia, SETI policy formulation is usually a consultative process led by the Directorate of Science, Technology and Research within the Ministry of

Higher Education, Research, Science and Technology. Owing to the cross-cutting nature of research, innovation and scientific and technological services, other line ministries contribute to the formulation of the national SETI policy, such as the Ministry of Agriculture; Ministry of Basic and Secondary Education; Ministry of Environment, Climate Change and Forestry; Ministry of Finance and Economic Affairs; Ministry of Information, Communications and Infrastructure; Ministry of Health; Ministry of Higher Education, Research, Science and Technology; Ministry of Lands & Regional Government; Ministry of Petroleum; and Energy and Ministry of Trade, Industry, Regional Integration and Employment, amongst others.

### **Decision-making**

In The Gambia, the policies are reviewed at different levels before adoption. After the completion of the policy formulation, the leader of the process sends the document for Cabinet approval. After securing cabinet approval, the document is sent to the house of parliament for approval. Finally, the Office of the President of the Republic approves the policy.

### **Policy implementation**

Implementation covers research and innovation and the provision of scientific and technological services by the appropriate units. Owing to the cross-cutting nature of SETI activities, the implementation plans are the responsibility of the line ministries, such as Ministry of Basic and Secondary Education that is implementing programmes such as using technologies to teach STEM subjects; The Ministry of Information, Communication and Infrastructure is also implementing ICT related programmes, e.g. connect government ministries/departments/agencies to the internet. In addition, the Ministry of Agriculture equally is implementing numerous programmes meant to boost productivity and value addition in the agriculture sector.

### **Policy evaluation**

The National Assembly has the oversight mandate over the actions of the government; however, clear roles and tools for systematic monitoring and evaluation of policies and policy instruments need to be promoted.

### 3.4. Actors of the STI system

The STI system of The Gambia has not yet been fully formed. The country does not have an oversight body for STI policy-making and implementation. As noted before, although included both in the National STI Policy or the Education Sector, the National Council for STI or Research has not been created. The STI related roles are distributed across different ministries and other government agencies.

The following organisations are the key actors of the national research and innovation system, according to the categorisation defined by UNESCO GO-SPIN[48]:

#### **Policy Planning and Promotion Level**

The actors in the policy planning level are those government bodies in charge of planning, budgeting, decision-making and interministerial coordination; while those in the policy promotion level are those directly involved in the promotion, financing and coordination of research, innovation and scientific and technological services in the various sectors of the economy and in society. In many cases, several government bodies have responsibilities at both levels, which is a common situation for line ministries.

The organisations that are mainly involved in the policy planning level are:

- The Office of the President of The Gambia
- The Cabinet of The Gambia
- Directorate of Science, Technology and Research of the Ministry of Higher Education, Research, Science and Technology
- Ministry of Finance and Economic Affairs

Although most line ministries have a role in the development of STI related policies and policy instruments, during the interviews the need to have an inter-ministerial system to coordinate these activities was highlighted, since most coordination activities are established by the body hosting the initiative, according to its own requirements or guidelines.

As mentioned in the policy formulation stage of the policymaking cycle described in the previous section, most ministries include STI related activities or departments; therefore, an active role in the policy promotion level. According to the interviews and the budget overview of 2019[53], the central organisations working in the policy promotion level are:

- Ministry of Agriculture
- Ministry of Basic and Secondary Education
- Ministry of Environment, Climate Change and Forestry
- Ministry of Finance and Economic Affairs
- Ministry of Health
- Ministry of Higher Education, Research, Science and Technology
- Ministry of Information, Communications and Infrastructure
- Ministry of Lands & Regional Government
- Ministry of Trade, Industry, Regional Integration and Employment

As mentioned in the section for STI Inputs, the investment on STI from own national resources is low. The majority of funds available for STI come in the form of grants from international donors, associated with specific programmes or initiatives which in turn are managed by the corresponding line ministry. This situation limits the resources available for the creation of government bodies focused on the promotion of STI related advancements through the creation of policy instruments.

An example of this situation was captured during the interviews where key government officials of the STI sector in The Gambia highlighted the need to create an STI agency to lead the promotion and coordination of STI activities across the Country. This agency is not yet established, despite being supported in slightly different ways, across policy documents in The Gambia, such as the Education Sector Policy, the STI Policy and at a sectoral level the Health Policy.

## Implementation Level

This operational level concerns the actual performance of scientific research, technological development and innovation. The main actors at this level are:

- The University of The Gambia (UTG) was established in 1999 and has since then been training at degree levels in the areas of STEM, Agriculture and Health.
- The American International University, West Africa (AIU / WA) is a private university that runs courses and programmes in Medicine and ICT.
- The National Agricultural Research Institute (NARI) was established in 1993 by an Act of Parliament to address growing demands of agricultural produces in The through research and development.
- The Gambia College which trains at certificate and diploma levels in the areas of STEM for teacher training, nursing, public health and agriculture.
- The Gambia Technical Training Institute (GTTI) was established to provide vocational training in electrical and electronics engineering, automotive, welding, architecture, and information and communications technology. The institute trains up to higher national diploma levels.
- Management Development Institute, TVET centre that provides Advanced diploma and diploma certificates across management and IT fields.
- Gambia Telecommunications and Multimedia Institute (GTMI), TVET centre focused on essential IT skills.
- Various private TVET centres such as QuantumNet Institute of Technology; Smart Technologies; Microtech Institute of Multimedia & Technology; Nifty School of Computer Technology; amongst others.
- The National Public Health Laboratory (NPHL) has been set up as the only national public health laboratory that supports the government in the laboratory investigation of tropical diseases in The Gambia.
- Royal Victoria Teaching Hospital is the leading referral hospital in The Gambia and is the principal teaching hospital to train Gambians to become doctors.
- The Medical Research Council, Unit The Gambia (MRCG) works in research on biomedical, public health, and epidemiology. The centre is an affiliate of the UK

Medical Research Council and has been instrumental for vaccine trials and studies relating to tropical diseases.

- West African Livestock Innovation Centre (WALIC), former International Trypanotolerance Centre (ITC), has the mission to unlock the potential of West Africa's ruminant livestock sector through innovative partnerships and knowledge-based solutions that empower stakeholders along value chains.
- Centre for Innovation Against Malaria (CIAM) is a research institute specialising in public health issues such as malaria, HIV / Aids & related diseases such as TB and anaemia. The centre also carries out evaluation and monitoring of large scale nationwide programmes in the region of West Africa as well as provide technical support.
- Educational Research Network for Central Africa (ENWARCA) in The Gambia conducts research in several areas such as TVET, curriculum development, teacher, training, girls' education, financing and management of education, quality of education, early childhood, development, and higher education.
- The Gambia Economic and Social Development Research Institute (GESRIC) is established under The University of The Gambia to research economic and social issues in relation to The Gambia's development aspirations.

From the previous list of actors conducting STI activities, it is essential to highlight that there are very few public actors in the capacity to conduct research on health. The University of The Gambia does not have laboratories to conduct health research, and the vast majority of initiatives in the health sector are conducted by The Medical Research Council, Unit The Gambia. Therefore, the interviews expressed the urgent need for developing local capacity in The Gambia to conduct research in the health sector, including the creation of a local health research centre and strengthen already existing institutions.

### **Scientific and Technological Services Level**

The actors in this level represent a mixed group of organisations that support in a broad way, the undertaking of STI activities. The type of support can be in the form of a collection of STI data and information, testing, standardization, metrology and quality control, activities

related to patents and licenses, as well as the production of scientific publications. The main public actors at this level are:

- The National Accreditation and Quality Assurance Authority (NAQAA) was established in 2016 to license, accredit, and ensure quality in tertiary and higher education institutions. It also undertakes research on Labour Market issues on Tertiary and Higher Education.
- The Intellectual Property (IP) Office is established under the Ministry of Justice of The Gambia, with the aim of handling issues relating to how patents, utility models are protected under the IP regime.
- The National Council for Arts & Culture (NCAC) is responsible for the registration of intellectual property works such as film, books, music products; to fight piracy; and to sensitize the public on copyright issues.
- The Food Safety and Quality Authority (FSQA) provides standards in relation to food preparation and handling to ensure food safety and quality.
- The Public Utility and Regulatory Authority (PURA) was established to provide regulatory functions for telecommunication and utility service in water and energy service through provision for licenses, guidelines, tariffs, and closure orders.
- The Gambia Standards Bureau (GSB) is established to regulate measurement standards in all goods and services.
- The Gambia Investment and Export Promotion Agency (GIEPA) is the government arm responsible for the provision of the regulatory framework for the promotion of investment and export. The agency provides several services to support business development through training, advocacy, and facilitating finance access.
- The National Environment Agency (NEA) has been established to provide the regulatory framework, monitoring and environmental impact assessments. The agency positions The Gambia fittingly into international Protocols and Treaties relating to the protection of the environment and climate change.
- The National Enterprise Development Initiative (NEDI) was established by the government in 2004 with the primary purpose of providing support to the youth and women through enterprise development, as a means to sustainable employment creation and better livelihood.

The scientific and technological services provided by the government are complemented by private organisations and NGOs that leverage resources from international organisations to support entrepreneurship. The main non-public actors are:

- Social Development Fund is an organisation that delivers financial and non-financial services to intermediaries that offer access to financial services for the economically active poor to support entrepreneurship.
- Start-Up Incubator Gambia is an organisation that provides incubator, accelerator, access to finance, capacity building and coworking services for young and aspiring entrepreneurs in any sector of the economy such as agriculture (35% of start-ups), fashion (55% of start-ups), hospitality (15% of start-ups) and renewable energy (15% of start-ups), amongst others.
- YepAfrica is a national youth organisation within the framework of the National Youth Council, supporting entrepreneurs from the ideation stage of their business through training courses on business plan development, marketing and talent development.
- The Global Youth Innovative Network (GYIN) is an international youth network supported by the Rome based International Fund for Agricultural Development (IFAD) with the aims to contribute to the reduction of poverty among poor rural youth in The Gambia through exposure to opportunities and business prospects, innovation, and knowledge. The network specialises on rural development and focuses on Entrepreneurship, Agribusiness, Leadership, Communication and Information Technology, Community Outreach Programmes.
- Jokkolabs Banjul<sup>8</sup> is an Open innovation ecosystem and a virtual cluster for a social change based on an organic entrepreneur community and a network of innovation centres.
- Information Technology Association of The Gambia (ITAG) is an NGO founded in 2004 with the mission to promote the increased use and development of ICT as part of the country's socio-economic development drive.

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<sup>8</sup> Jokkolabs Banjul is also the host of Google Developers Group Banjul.

- The Gambia Chamber of Commerce and Industry is a business network with the objective of improving the business environment in The Gambia through services for business incubation, capacity building, business advisory services, linkage to funding opportunities and networking.
- The Association of Small Scale Enterprises in Responsible Tourism (ASSERT) is a tourism business advisory service. The organisation offers knowledge services as well as providing various training courses, and micro-financing packages and preferential loan rates to its members.
- The Gambia Youth Chamber of Commerce is a business network that supports business development of young entrepreneurs through agribusiness training, fundraising and capacity building on business development.
- The Gambia Angel Investors Network is bringing together between 10 and 15 local and diaspora based investors who have committed to providing funding to between 8 and 12 early and growth stage start-ups in the Gambia each year. The network aims to provide ticket sizes of between US 20,000 to US 300,000[54].

### 3.5. Operational STI policy instruments

The Gambia has a reduced number of policy instruments for the promotion of an effective STI system. Most of these instruments have been implemented with the technical and financial support of international organisations, limiting the sustainability over time of these instruments. Although there is evidence of the efforts from international organisations to align their programmes with national strategic documents, the dependency on international organisations has the consequence of relying on the development agenda of these organisations for the region or country.

During the interviews, one of the main areas for improvement is the design and implementation of policy instruments. For the past few decades, special attention was given to the development of STI Policies across Africa, including The Gambia. Nevertheless, the mechanisms for the implementation of these policies have not received equal attention. Therefore it is crucial to develop the capacity to not only design implementation mechanisms that are contextualised to the reality of the country but also the capacity for its management

over time. This capacity is an essential supporting factor for raising funds; well-designed instruments with a robust implementation and management strategy will ensure higher impact and therefore would be more attractive to development funders like Multilateral Development Banks.

The main operational policy instruments in The Gambia are:

Extend information on: i) The R&D Human Capital development programme; ii) Technology improvement programme for MSMEs; iii) strengthening capacity through cooperation and partnership programmes

### **Ministry of Higher Education, Research, Science and Technology - University of The Gambia Scholarship**

This policy instrument is a scholarship package for Gambians to study at The University of The Gambia. The programme awarded 413 scholarships for the period 2020-2021 across the programmes offered by the university[55]. From all awards, only 20.8% correspond to STEM fields at the Bachelors of Science level. The STEM fields covered by this scholarship are Biology, Chemistry, Civil Engineering, Telecommunication, Environmental Health, Environmental Science, Information Systems, Computer Science, Nursing, Agricultural Science and Medicine. The fields related to health are Nursing and Medicine, with 14.5% of all scholarships awarded.

### **The Africa Centres of Excellence (ACE) Project**

This is a US \$3 million (Loan for US\$ 2 million and grant for US\$ 1 million) project financed by the World Bank. Under this project, since the country did not yet have sufficient capacity to host a Center of Excellence, has decided to partner with ACEs established under the regional initiative to enhance the capacity of its higher education institutions, government agencies and top talents within science, technology, health and agriculture. The services required from ACE partners include faculty mentorship program at ACEs; experienced visiting-faculty lecture series; access to laboratory equipment, services and training at ACEs; scholarships benefiting 144 MSc and PhD Gambian students[56] as well as student exchange programs; training in administration; training in curriculum development and delivery[57].

## **EMPRETEC Project**

Empretec is a capacity-building project for MSMEs, managed and implemented by GIEPA and supported financially by UNDP and technically by UNCTAD. UNDP allocated US\$2 million, and The Gambia government provided US\$ 374 748 for the first three years of the project[58]. The main objective of the programme is to provide business support services to Micro, Small and Medium Size Enterprises (MSMEs) and farmers to unleash their potential for growth. The programme has conducted 21 training sessions across the country, trained 540 entrepreneurs and 160 farmers up to date. We are providing Business advisory services to 331 existing and start-up businesses for this year. The advisory service is provided by 63 advisers spread across the country.

## **The National Enterprise Development Initiative (NEDI)**

The programme as established in 2014 under the office of the vice-president while also reporting to the Ministry of Youth and Sports. The main purpose of the initiative is to empower the Gambian youth and women through the provision of training in business entrepreneurship and sustainability, and funding to operate their businesses activities[50].

## **Tech Hub in The Gambia For Digital Entrepreneurship**

This programme is not operational yet is in the process of establishment. The initiative is headed by the Ministry of Trade, Industry, Regional Integration and Employment (MOTIE) in collaboration with the UNDP and ITC through the Youth Empowerment Project (YEP). The Tech Hub is implemented through a private partner selected through open tender. The Tech Hub expects to link the foster a digital start-up ecosystem by bringing together students, experts, project leaders, entrepreneurs and innovators to foster collaboration, deepen skills and initiate new ventures. The services provided by the Tech Hub are:

- A fab lab and related programmes (e.g. training on 3D printing solutions) which could also include support to robotics, AI integration and prototyping;
- A co-working space including a corner for the freelancers
- Basic ICT training and entrepreneurial skills development programmes

### 3.6. Summary of the legal and regulatory frameworks for STI

A country's legal framework represents a collection of legal processes and legal instruments, which embody a given policy, or parts of it, in the form of a law, decree or policy regulating an area of activity. Formal agreements, contracts and international SETI co-operation treaties may also be included in this category. A legal instrument elaborates a policy by stipulating obligations, rights, rewards and penalties connected with its observance[1].

The SETI legal framework of The Gambia is presented hereafter[4].

#### 3.6.1. Acts and laws pertaining to research and innovation

**Title: Industrial Property Act of 2015**

**Date of Enactment: April 2, 2007**

The Act sets out the issues of unfair competition, Enforcement of Intellectual Property and Related Laws. It covers Industrial Designs, Industrial Property, IP Regulatory Body, Patents (Inventions), Utility Models, Trade Names, Trademarks, Technology Transfer. It clearly spells out the procedures and measures that need to be done in the administration, registration, protection, and enforcement of intellectual property in The Gambia. The Industrial Property Act also indicates how The Gambia relates to regional and international bodies in the protection of intellectual property, i.e. African Regional Intellectual Property Organization (ARIPO) and World Intellectual Property Organization (WIPO). It caters for owners (producers/inventors) and how they could generate royalties and benefit from their creation and inventions.

**Title: National Environment Management (NEMA) Act of 1994**

**Date of Enactment: 24th May 1994**

The act deals with the control and management of the Gambian environment and makes provisions for all matters relating to the protection, litigation and penalties in relation to violations of the environmental laws. The NEMA Act further established the following:

- **Environment Impact Assessment 2014:** This regulation provides for guidelines on the requirements needed for an investor or development of industry in relation to the

direct impact on the environment. It ensures that people and communities are safeguarded and protected for a sustained environment; and

- **Anti-littering Regulations 2007:** To discourage indiscriminate waste dumping as a measure towards implementing the NEMA Act, the Gambian government came up with an antilittering regulation that stopped individuals, households, companies, and government entities from dumping waste indiscriminately. The regulations have indicated fines and penalties to any person or entity that violates the law in accordance with the volume of the damage.

**Title: Tertiary and Higher Education Act 2016**

**Date of Enactment: December 2016.**

The Act has been established to provide an overarching function to the coordination, management, and provision of policy direction for the tertiary and higher education sector in the Gambia. It provides for registration and operational procedures for public and private tertiary institutions and public and private tertiary and higher education institutions. The Act came in to force and repealed the University of The Gambia Act, Gambia College Act, Gambia Technical Training Institute Act, and the Management Development Institute.

**Title: Information Communication Act of 2009**

**Date of Enactment: 29 May 2009**

The Act was developed to provide for the restructuring, development and regulation of the information and communication sector and all other matters connected therewith. It relates to issues on information, communication, and technology in The Gambia. The act specifies the usage of ICT devices and accessories, band-width internet connectivity, and conditions for registration as Internet Service Providers in The Gambia.

**Title: Public Health Act, 2001.**

**Date of Enactment: 2001**

This Act provides a legal basis for the prevention and protection of human and animal health in The Gambia. It stipulates measures and procedures needed to be adopted to ensure that The Gambia becomes a disease-free country. To maintain a healthy population, legal measures on public health is needed to ensure that the environment and people are protected from diseases. The act puts great emphasis on the protection of the environment,

which is the most significant harbour of pollutants and pathogens. To ensure a healthy population, primary, secondary, and tertiary health care facilities have been established and supported to deliver quality health care services to the populace.

**Title: National Agricultural Research Act of 1993**

**Date of Enactment: 18th October 1993.**

This act was established to help improve agricultural research management and to make provisions for matters connected therewith. The Act established the National Agricultural Research Institute with the primary function on agricultural research in The Gambia to promote food self-sufficiency and security. The institute provides new technologies and varieties to farmers to help boost productivity and yield.

**Title: National Accreditation and Quality Assurance Act, 2015**

**Date of Enactment: 2015**

The Act established the National Accreditation and Quality Assurance Authority, with the mandate to issue licenses to training institutions, accredit, and close any tertiary and higher education institutions that do not conform to standards. The Act provides the basis for the ensuring of quality and standards in training by monitoring quality and ensuring standards within the tertiary and higher education sector. The act is supported by a quality assurance framework, registration and accreditation guidelines, and monitoring and supervision guidelines.

**Title: Trade Act 2011**

**Date of Enactment: 2011**

The Trade Act seeks to improve and widen the environment for trade by establishing transparent systems for exports and imports, provide trade infrastructure as well as articulate forward and backward linkages for trade facilitation. It provides for procedures in the buying and selling of goods within and from outside The Gambia. It enhances linkages between all mediums of transporting goods and services to ensure availability, affordability, and accessibility of goods and services to peoples living in The Gambia. The act also provides a legal basis on tariff and tax-related costs associated with buying and selling in The Gambia.

**Title: Fisheries Act 2010**  
**Date of Enactment: 2010**

Provides for measures in ensuring a viable and sustainable natural resource base, which in turn will create real development and growth in the rural economy and thereby improve in every sense the quality of rural life. This is aimed at utilizing The Gambia's fisheries resources as food basket and export. The Gambia being naturally endowed by its location along the Atlantic Ocean and being cut across by the River Gambia into two halves gives it a great potential to fisheries and other pellagic resources. Therefore, it is relevant that such an act is in place to regulate illegal fishing within Gambian borders in a bid to protecting the country's fisheries resources. The sector has a high potential for employment and export in return for foreign exchange for The Gambia.

**Title: Renewable Energy Act**  
**Date of Enactment: 2013**

The act was established to provide the legal, economic and institutional basis to promote the use of renewable energy resources and for connected matters. It provides for regulations relating to the usage of naturally available resources to generate energy in an environmentally friendly and sustainable manner. These resources range from organic components (biogas plants), solar, wind, and water. Since The Gambia is naturally gifted with sources of renewable energy, therefore taking advantage of these resources to provide the needed energy for household, public and industrial development is apt and relevant to protecting the environment, saving costs, and reducing diseases caused by pollutants emanating from heavy fuels. The wind speed along the Atlantic Ocean can support wind turbines that can be used to generate electricity for local industries in the fisheries, agro-based, and tourism sectors.

**Title: Petroleum Amendment Act**  
**Date of Enactment: 2014**

The act aims at accelerating the promotion of petroleum exploration and production activities in The Gambia with a view to generating more data, wealth and create jobs as well as to achieve maximum self-sufficiency in energy by increasing oil and gas production. It provides for conditions of exploration and utilization of naturally available and used petroleum products in The Gambia.

**Title: Statistics Act of The Gambia**  
**Date of Enactment: 20th January 2006.**

The act mandates the Gambia Bureau of Statistics to provide a sustainable, effective and efficient national statistical system for The Gambia. This is done through the collection, production, and dissemination of integrated, relevant, reliable, and timely statistical information. The act provides for the collection of aggregate data, analysis, reporting of findings to inform sectoral policy developments. The collected data is used for policy and planning by all sectors and development partners in The Gambia.

**Gambia Investment and Export Promotion Agency Act, 2010.**  
**Date of Enactment: 26th May 2010.**

The act came into force and established The Gambia Investment and Export Promotion Agency. It creates export processing zones and the needed conducive environment for investments and enterprise development in The Gambia. It lays the foundation for the required conditions in investing in any sector of development in The Gambia, ranging from services to the production sectors.

**Title: Seeds Act, 2016.**  
**Date of Enactment: December 2016.**

The seeds act provides for the legal basis on which types of seeds are allowed in the Gambia for germination and food production. This is done in accordance with international regulations and ethical and religious considerations of the country. The act provides for quarantine measures for foreign seeds in a bid to protecting native seeds from diseases and other environmental infiltrations.

**The Public Utility and Regulatory Authority Act, 2001.**  
**Date of Enactment: 21st December 2001**

The act has been formulated to provide regulation in information, communication and all utility providers in The Gambia. These ranges from GSM operators, internet service providers, energy suppliers, telecommunications providers, the media houses, amongst others. The act established the Public Utility and Regulatory Authority and mandated it to regulate the telecommunication sector, ensure standards and set tariffs based on agreed and

affordable prices in line with global rates. The act caters for issues relating to unfair competition amongst providers and end-users.

**Title: Mine and Quarries Act**

**Date of Enactment: 2005**

Deals with issues relating to how mining and quarries are identified, used, and managed in The Gambia. The Act highlights the role and ownership of government and communities within the confines of royalties to beneficiaries. This is supported by guidelines on how mining is done and operated in The Gambia. The exploitation of natural resources can be significantly enhanced by providing prerequisite protocols that need to be followed to harness it in a viable and environmentally friendly ecosystem.

**Title: Petroleum (Exploration, Development and Production Act), 2009**

**Date of Enactment: 2009**

This act identifies procedures involved in exploring, extracting petroleum, as well as developing and producing petroleum petroleum-related products in The Gambia. It maps out the steps involved in dealing with petroleum products either by naturally drilling techniques or other productions.

**Title: Hazardous Chemicals and Pesticide (Persistent Organic Pollutants Protection), Regulations, 2004.**

**Date of Enactment: 2004**

This regulation highlights procedures involved in the production, importation, and distribution of hazardous chemicals in The Gambia. The provision provides for annexes of prohibited hazardous chemicals in line with international standards and gazette at the agency responsible for environmental protection. The provision empowers Environment Inspectors in borders and entry points to refuse the entry into The Gambia any prohibited hazardous chemical gazette in the annexes.

**Title: National Tobacco Control Act, 2016**

**Date of Enactment: 30th December 2016.**

The Act provides the right to a tobacco-free society in The Gambia. It puts in place the prohibition of smoking in public places, workplaces, and public transport. The Act controls

the demand for tobacco and tobacco-related products and seeks to implement the World Health Organization Framework on Tobacco control and related matters. It provides for a comprehensive ban in The Gambia on tobacco advertisement, promotion, and sponsorship.

**Title: Medicines Control Act, 2014**

**Date of Enactment: 2014**

The act is envisaged to adequately address the weakness in the control of the importation, manufacture, storage and export of medicines and other medical supplies in The Gambia. This will help support in the curbing of counterfeit drugs and the sale of drugs by unlicensed personnel. The Bill established the Medicines Control to undertake the oversight function of implementation.

**Title: Merchant Shipping and Marine Pollution Bill, 2013**

**Date of Enactment: 17th April 2013**

The act seeks to establish and introduce a comprehensive and modern maritime regime that will regulate shipping and other maritime activities to ensure the safety and security of life and property in Gambian waters. The act came at a time when measures are needed to protect the Gambian waters from vessel pollutants and other carriers.

**Title: Forestry Act, 2014**

**Date of Enactment: 2014**

The act is established to provide for the maintenance and development of the forest resources of The Gambia with a view to enhancing the contribution of Forestry to the socio-economic development of The Gambia and for matters connected therewith. This act provides for protection measures and penalties relating to the exploitation of forest cover in The Gambia.

3.6.2. Main IP Laws: enacted by the Legislature

- Industrial Property Act, 1989 (2007)
- Copyright Act, 2004 (2004)

### 3.6.3. Intellectual Property Regulations

- Industrial Property Regulations 2010 (2010)

### 3.6.4. Intellectual property treaty membership

#### **WIPO-Administered Treaties (Entry into force of the Treaty for the Contracting Party)**

- Summary Table of Membership of the World Intellectual Property Organization (WIPO) and the Treaties Administered by WIPO, plus UPOV, WTO and UN
- Patent Law Treaty
- Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks (December 18, 2015)
- Patent Cooperation Treaty (December 9, 1997)
- Berne Convention for the Protection of Literary and Artistic Works (March 7, 1993)
- Paris Convention for the Protection of Industrial Property (January 21, 1992)
- Convention Establishing the World Intellectual Property Organization (December 10, 1980)

#### **IP-related Multilateral Treaties (Entry into force of the Treaty for the Contracting Party)**

- Convention on the Rights of Persons with Disabilities (August 5, 2015)
- Optional Protocol to the Convention on the Rights of Persons with Disabilities (August 5, 2015)
- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (October 12, 2014)
- Convention relating to the Status of Stateless Persons (September 29, 2014)
- Convention for the Safeguarding of the Intangible Cultural Heritage (August 26, 2011)
- Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005 (August 26, 2011)
- WHO Framework Convention on Tobacco Control (December 17, 2007)
- Stockholm Convention on Persistent Organic Pollutants (July 27, 2006)

- Kyoto Protocol to the United Nations Framework Convention on Climate Change (February 16, 2005)
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity (September 7, 2004)
- United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa(December 26, 1996)
- World Trade Organization (WTO) - Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) (1994) (October 23, 1996)
- Agreement establishing the World Trade Organization (WTO) (September 23, 1996)
- United Nations Convention on the Law of the Sea (November 16, 1994)
- Convention on Biological Diversity (September 8, 1994)
- United Nations Framework Convention on Climate Change (September 8, 1994)
- Protocol (I) Additional to the Geneva Conventions of 12 August 1949, and relating to the protection of victims of international armed conflicts (July 12, 1989)
- Protocol (II) Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (July 12, 1989)
- Convention concerning the Protection of the World Cultural and Natural Heritage (October 1, 1987)
- International Covenant on Economic, Social and Cultural Rights (March 29, 1979)
- Convention on International Civil Aviation (June 12, 1977)
- Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (February 18, 1965)
- Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (February 18, 1965)
- Convention (III) relative to the Treatment of Prisoners of War (February 18, 1965)
- Convention (IV) relative to the Protection of Civilian Persons in Time of War (February 18, 1965)

#### **IP Regional Treaties (Entry into force of the Treaty for the Contracting Party)**

- Charter for African Cultural Renaissance

- Harare Protocol on Patents and Industrial Designs Within the Framework of the African Regional Industrial Property Organization (ARIPO) (January 16, 1986)
- Lusaka Agreement on the Creation of the African Regional Intellectual Property Organization (ARIPO) (February 15, 1978)
- Regional Economic Integration Treaties (Entry into force of the Treaty for the Contracting Party)
- Constitutive Act of the African Union (May 26, 2001)
- Economic Community of West African States (ECOWAS) (August 26, 1997)
- Abuja Treaty Establishing the African Economic Community (AEC) (May 12, 1994)
- The Georgetown Agreement (formally establishing the African, Caribbean and Pacific Group of States, the "ACP Group"), since 1975 (ACP) (February 12, 1976)

## 4. STI SWOT analysis

In this section, an analysis of the STI-related strengths, weaknesses, opportunities and threats (SWOT) for The GambiaBhutan is presented. The STI SWOT analysis of The Gambia is based on the findings of the National Consultation Workshop conducted in Banjul on 27 November 2019 using a participatory approach. It also draws on the findings from the information and data presented in the preceding sections.

### 4.1. Strengths

- **The explicit political will to improve governance and governability in The Gambia.** The development of a National Development Plan, the new Constitution and the numerous sectoral policies are evidence of the efforts to provide greater clarity and focus for government action. The National Development Plan makes explicit the link between the SDGs and The Gambia actions for inclusive and sustainable socio-economic growth. Moreover, STI related fields are present in most of the strategic policy documents promoting the development of R&D to provide answers to the country's most pressing needs as well as enhancement of Education systems at all levels as means to address the needs of the labour market and drive employment.
- **The positive long-term trends in human development indicators.** The Human Development Index has evolved positively and continuously from 0.333 in 1990 to 0.460 in 2017, an increase of 38.2%. This evolution represents the improvements of the country in a long and healthy life, access to knowledge and a decent standard of living.
- **Rich biodiversity.** Although small in size, The Gambia harbours a wealth of terrestrial, coastal, marine and wetland habitats and species of local, national and regional significance. There is a growing recognition in The Gambia that, biological diversity is a global asset of tremendous value to present and future generations. Therefore there is increased awareness on the need for technologies that answer to climate change mitigation strategies.

- **The strong commitment towards the development of ICT across the nation.** The benefits of ICT as one of the main enablers of growth, connecting people and businesses locally and internationally are widely supported.
- **The Leadership of the Ministry of Higher Education, Research, Science and Technology on the development of STI Policy.** The efforts of the Directorate of Science, Technology and Research to conduct STI ecosystem mapping exercises, STI surveys and analysis on the gender perspective in STEM are efforts that promote evidence-based decision making, one of the main pillars for a robust STI system.
- **Entrepreneurship gaining momentum.** The government of The Gambia has taken measures to increase the contribution of Micro, Small and Medium Enterprises to the growth and performance of the economy in critical areas such as job creation, equity and access to markets

#### 4.1. Weaknesses

- **Need to diversify the economy.** The Gambia exhibits a non-diversified small economy that depends highly on funds from International Development Aid to fund its development agenda. The Gambia could reduce this dependence and expand the economy perspectives by leveraging STI to empower its population and increase value-added to local products a key long-term lever for economic growth and prosperity.
- **Need to establish a coordinating and oversight body and develop the STI governance system.** The plethora of STI strategic priorities present in the STI Policy dilutes its effectiveness. Although coordination mechanisms are present in the country, these are Ad hoc. The Gambia needs to create a government body for the prioritization and coordination of STI policy-making and implementation. This type of institution is necessary to enhance the communication and cooperation between line ministries as well as other actors of an STI system, and to eliminate duplications and overlaps of roles and responsibilities among different institutions. Although the government is aware of this need and it is mentioned in various policy documents, it could not yet establish it.

- **Need to create a national STI funding agency and provide sufficient resources to finance STI projects.** The absence of a dedicated national agency to design and implement support programmes and the lack of adequate funds to finance STI are major weaknesses prohibiting the accelerated sustainable development of the country.
- **Need to develop human capacity to design and manage policy instruments.** The stakeholders in the Gambia recognise that the myriad of policy documents need to be reinforced with capacity for policy implementation and enforcement. Therefore the country requires enhanced knowledge, skills and capabilities on STI policy-making and design and management of policy implementation mechanisms. In addition, the competencies and skills of the researchers and entrepreneurs should be developed on research and innovation project design and implementation.
- **Need to develop STI human resources:** There is a need to increase both the number and the qualifications of the human resources to create and maintain a critical mass of researchers and STEM graduates who can carry out continuous research and innovation activities. Likewise, in order to create and grow innovation-driven enterprises, it is essential that these human resources address the needs of the Gambian industry. It is also necessary to fight brain-drain with the promotion of role models, development of the scientific community and decent working conditions.
- **Need to enhance the infrastructure for scientific research and innovation.** The actors of the STI system require tools to conduct research, such as lab equipment for research in health agriculture and other sectors. Moreover, quality control and certification pieces of equipment are necessary to comply with international standards that facilitate access to export markets to local industry and reduces costs. This infrastructure is essential for the collection of scientific data necessary not only for research but also for evidence-based policymaking. Likewise, it is important to have a robust infrastructure for basic services such as water or energy to support industry productivity.

## 4.2. Opportunities

- **A world-class scientific organization such as the Medical Research Council Unit The Gambia operates in the country.** There is a general appreciation of the positive role that this organization plays in the country as well as the potential of beneficial spillovers from its presence and operation in The Gambia. In addition, there is a general understanding of the need to strengthen the STI system to better benefit from this organization.
- **Donor coordination for STI.** The Gambia has the opportunity to leverage the vast presence of International Organisations in the country to attract more funding and technical assistance to support STI as a means for the achievement of the 2030 Agenda for Sustainable Development.
- **Mobilise the diaspora.** Well-educated Entrepreneurs and researchers from The Gambia are present around the world in environments where STI systems are well developed. Therefore, it is important to establish a dynamic network of diaspora and engage them in the STI-focused activities in the country.
- **ICT and emergent technologies.** The developments in ICT bring opportunities to various sectors such as education and health, especially to the most remote rural areas. Technologies such as Artificial Intelligence, Internet of Things or 3D printing offers the greatest opportunities to create new businesses and revenues as well as to address societal and environmental challenges.

## 4.3. Threats

- **Adverse effects of climate change.** The economic activities in The Gambia are very vulnerable to extreme climatic events, and the growing population and socio-economic development may exacerbate the country's vulnerability. The implication is that effective use of STI Policy interventions is needed to mitigate potential disasters by building capacity and by promoting the use of appropriate technologies.
- **Regional and international competition may limit growth.** Over time, The Gambia is likely to face more intense competition from other neighbouring countries with similar natural resources but with the capacity to add value to these resources. The

development of STI policies and its sound implementation provides the opportunity to leapfrog development for accessing and competing in foreign markets.

- **Reliance on international NGOs, enterprise or consultants to implement development projects.** The development of policies, as well as the implementation of development projects, tend to have conditions that are difficult to meet by local enterprises or experts. The experience of new emerging economies indicates that they were able to transform the reality of their countries only when policies and policy implementation instruments were designed and executed with the active participation of local partners. Governments should ensure that the processes and requirements ensure deliveries of quality while providing equal opportunities to foreign and local NGOs, enterprises or consultants.

## 5. Assessment of Technology Needs

Literature review:

Technology transfer is seen to play a critical role in the global response to the challenge of climate change. Technology transfer is a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/education institutions. The broad and inclusive term “transfer” encompasses diffusion of technologies and technology cooperation across and within countries. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with indigenous technologies (Bert Metz et al, 2001).

Technologies identified and technology transfer requirements (GoTG/SNS, 2013) which will also be needed for the implementation of the INDC include:

1. Climate monitoring, forecasting and dissemination techniques and technologies;
2. Energy efficient technologies (High efficiency lighting, Fluorescent lighting technology, Industrial Energy Efficiency Technologies, Fuel Efficiency Technologies);
3. Solar Photovoltaic Technology;
4. Wind Energy (wind mills);
5. Biomass Energy Sources and Technologies (Improved Cook Stoves);
6. Bio-energy Technology for the Transport sector;
7. Waste Management Technologies (Landfill methane capture and Composting technologies);
8. Irrigation Techniques and Technologies (Surface Irrigation Systems, Sprinkler irrigation systems, Drip Irrigation);
9. Crop Types and Cultivars (Deep-rooted, salt-tolerant tree/grass species, Flood tolerant crop species);
10. Post harvest, food processing and preservation techniques and technologies (Drying food preservation, Food preservation freezing, Vacuum packing Food preservation, Canning and bottling food preservation);

11. Rain water harvesting and Water Treatment technologies; Aquaculture; and Coastal Protection Technologies (Groynes, Sea walls, Offshore breakwaters and revetments).

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## 6. Annexes

### 6.1. Annex 1

#### **Institutions Visited**

- Gambia Chamber of Commerce
- Gambia Investment and Export Promotion Agency
- Insist Global
- International Trade Centre
- Ministry of Environment, Climate Change and Forestry
- Ministry of Finance and Economics
- Ministry of Health
- Ministry of Higher Education, Research, Science and Technology
- Ministry of Trade, Industry, Regional Integration and Employment
- Start-up Incubator
- UN Resident Coordinator

6.2. Annex 2

**Patent documents where inventor or applicant is resident in The Gambia**

Title	Inventors	Applicants	Publication number	Earliest priority	Earliest publication
<b>Treatment of freshly-caught fish - in which stock prep. from fish offal and powdered shell fish is used to coat frozen fish portions before packing</b>	BATISSE JEAN-CLAUDE [GM] SLAVICH PIERPAOLO [GM]	AROMA PATENT & LICENSING AP & [NL]	<a href="#">DE4110608A1</a>	02/04/1991	08/10/1992
<b>GENERATION AND USE OF NEW TYPES OF DENDRITIC CELLS</b>	GOLDMAN MICHEL [BE] ISMAILI JAMILA [GM]	GOLDMAN MICHEL [BE] ISMAILI JAMILA [GM] UNIV BRUXELLES [BE]	<a href="#">WO03038072A1</a>	31/10/2001	08/05/2003
<b>EPITOPES</b>	KLEIN MICHEL ROBERT [GM]	GLAXO GROUP LTD [GB] KLEIN MICHEL ROBERT [GM]	<a href="#">WO0170764A2</a>	20/03/2000	27/09/2001
<b>VACCINE AGAINST MYCOBACTERIUM INFECTION BASED ON EPITOPES OF AG85 COMPLEX</b>	KLEIN MICHEL ROBERT [GM]	GLAXO GROUP LTD [GB] KLEIN MICHEL ROBERT [GM]	<a href="#">WO0170991A1</a>	20/03/2000	27/09/2001

<b>MALARIA PEPTIDES</b>	WHITTLE HILTON CARTER [GM] [GM] AIDOO MICHAEL [GB] ALLSOPP CATHERINE [GB] ELIZABETH MA [GB] HILL ADRIAN VIVIAN SINTON [GB] [GB] LALVANI AJIT [GB] PLEBANSKI MAGDALENA [GB] WHITTLE HILTON CARTER [GB]	WHITTLE HILTON CARTER [GM] AIDOO MICHAEL [GB] ALLSOPP CATHERINE ELIZABETH MA [GB] HILL ADRIAN VIVIAN SINTON [GB] ISIS INNOVATION [GB] LALVANI AJIT [GB] PLEBANSKI MAGDALENA [GB] WHITTLE HILTON CARTER [GB]	<a href="#">WO9526982A2</a>	31/03/1994	12/10/1995
<b>METHODS AND REAGENTS FOR VACCINATION WHICH GENERATE A CD8 T CELL IMMUNE RESPONSE</b>	BLANCHARD TOM [GM] GILBERT SARAH CATHERINE [GB] HANKE TOMAS [GB] HILL ADRIAN VIVIAN SINTON [GB] [GB] MCMICHAEL ANDREW JAMES [GB] PLEBANSKI MAGDALENA [GB] SCHNEIDER JOERG [GB] SMITH GEOFFREY LILLEY [GB]	BLANCHARD TOM [GM] GILBERT SARAH CATHERINE [GB] HANKE TOMAS [GB] HILL ADRIAN VIVIAN SINTON [GB] ISIS INNOVATION [GB] MCMICHAEL ANDREW JAMES [GB] PLEBANSKI MAGDALENA [GB] SCHNEIDER JOERG [GB] SMITH GEOFFREY LILLEY [GB]	<a href="#">WO9856919A2</a>	09/06/1997	17/12/1998

<b>PEPTIDES OF AN ANTIGEN, CAPABLE OF RECOGNITION BY OR INDUCTION OF CYTOTOXIC T LYMPHOCYTES, AND METHOD OF THEIR IDENTIFICATION</b>	WHITTLE HILTON CARTER [GM] ELVIN JOHN [GB] GOTCH FRANCES MARGARET [GB] HILL ADRIAN VIVIAN SINTON [GB] MCMICHAEL ANDREW JAMES [GB] WHITTLE HILTON CARTER [GB]	ELVIN JOHN [GB] GOTCH FRANCES MARGARET [GB] HILL ADRIAN VIVIAN SINTON [GB] MCMICHAEL ANDREW JAMES [GB] WHITTLE HILTON CARTER [GM] ISIS INNOVATION [GB]	<a href="#">WO9320103A2</a>	03/04/1992	14/10/1993
<b>MATERIALS AND METHODS RELATING TO THE IDENTIFICATION OF A POLYMORPHISM ASSOCIATED WITH DISEASE SUSCEPTIBILITY</b>	ALI SULEMAN [GB] BELLAMY RICHARD [GB] HILL ADRIAN [GB] ROY SUCHISMITA [GB] RUWENDE CYRIL [US] THURSZ MARK [GB] WHITTLE HILTON [GM]	ALI SULEMAN [GB] BELLAMY RICHARD [GB] HILL ADRIAN [GB] ISIS INNOVATION [GB] ROY SUCHISMITA [GB] RUWENDE CYRIL [US] THURSZ MARK [GB] WHITTLE HILTON [GM]	<a href="#">WO9732998A2</a>	08/03/1996	12/09/1997
<b>MALARIA VACCINES</b>	CONWAY DAVID J [GM] TETTEH KEVIN K A [GB]	CONWAY DAVID J [GM] LONDON SCHOOL HYGIENE & TROPICAL MEDICINE [GB] TETTEH KEVIN K A [GB]	<a href="#">WO2006126029A2</a>	27/05/2005	30/11/2006

<b>APPARATUS AND METHODS RELATING TO DISPENSATION FROM BEVERAGE MACHINES</b>	HANSEN NICK ANDREW [GB] NORTON MARK [GM]	HANSEN NICK ANDREW [GB] NORTON MARK [GM]	<a href="#">US2013230627A1</a>	18/11/2010	23/05/2012
<b>LIPOCALIN-2 AS A BIOMARKER FOR PNEUMOCOCCAL INFECTION STATUS AND USES THEREOF</b>	CASALS-PASCUAL CLIMENT [GB] HOWIE STEPHEN [GM]	ISIS INNOVATION [GB]	<a href="#">EP2870478A1</a>	05/07/2012	09/01/2014
<b>BIOMARKERS FOR TUBERCULOSIS</b>	SUTHERLAND JAYNE [GM]	MEDICAL RES COUNCIL [GB]	<a href="#">WO2015040377A1</a>	17/09/2013	26/03/2015
<b>METHOD FOR PREDICTING PROGRESSION TO ACTIVE TUBERCULOSIS DISEASE</b>	KAUFMANN STEFAN H E [DE] SCRIBA THOMAS [ZA] SULIMAN SARA [US] SUTHERLAND JAYNE [GM] THOMPSON ETHAN [US] WALZL GERHARD [ZA] ZAK DANIEL [US]	MAX PLANCK GESELLSCHAFT [DE] SEATTLE CHILDREN'S HOSPITAL DOING BUSINESS AS SEATTLE CHILDREN'S RES INSTITUTE [US] UNITED KINGDOM RES AND INNOVATION [GB] UNIV CAPE TOWN [ZA] UNIV STELLENBOSCH [ZA]	<a href="#">WO2019175803A1</a>	13/03/2018	19/09/2019

### 6.3. Annex 3

#### National patent documents in The Gambia

Title	Inventor	Applicant	Registration Number	Registration Date
<b>PIPERDINES FOR USE AS OREXIN RECEPTOR ANTAGONISTS</b>	KEVIN THEWLIS GEOFFREY STEMP NORBERT CHRISTOPHER JOHNSON LESILE CLIVE	SMITHKLINE BEECHAM P.L.C.	P200812	2008.04.12
<b>Reboxetine for treating peripheral neuropathy</b>	Ahmed, Saeeduddin Cetera, Pasquale Wong, Erik H.F. McArthur, Robert Taylor, Duncan P. Bigerson, Lars Marshall, Robert Clyde	Pharmacia & Upjohn Company LLC	P200819	2008.09.16
<b>1, 2, 2, 4 - TETRASUBSTITUTED INDOLE FOR THE TREATMENT OF RESPIRATORY DISEASES</b>	ROGER BONNERT RUKHSANA RASUL	ASTRAZENECA AB	P20122	2012.03.12