

Assessing the needs of the research system in Uganda



Report for the SRIA programme

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**“Assessing the needs of the research system in
Uganda. Report for the SRIA programme.”**

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Executive Summary

This report provides a high-level assessment of Uganda's research and innovation system and key research organisations. It seeks to identify the main challenges to research capacity strengthening and some priority areas for intervention in order to support decision-making at DFID and among Ugandan partners. The study does not seek to explore issues such as the historical causes of the current situation or the role of the media and other political actors which, albeit important, fall outside the scope of this investigation. Findings in this report are based on quantitative and qualitative data collected through desk-based research and informant interviews. Over 100 indicators are used to assess the country's research environment and political economy context, research production and research diffusion performance. Some of the qualitative findings are based on the views of a small but balanced number of stakeholders and should be verified through further research.

A. Needs Assessment for Uganda

Research environment. With a GDP per capita of USD643, Uganda is the poorest of the countries considered in this study and one of the poorest in the world. Over 41% of the population lives below the poverty line, with a large rural population, low internet penetration and low technology readiness. According to the World Bank, the country has low political stability and limited academic freedom, while the government's ability to implement policy is also low. Despite these challenges, the government has embraced science and technology as a growth driver and has developed credible policies and a solid institutional framework for science and technology – with the notable contribution of the Uganda National Council for Science and Technology, the National Agricultural Research Organisation and the National Health research Organisation. A lack of funding, the excessive prescriptiveness of the research permit system (see below) and insufficient implementation capacity have limited the effect of such policies and the development of the national research system.

Research production. The number of universities in Uganda has grown rapidly in recent years, but most of them have scarce research capacity. Research production is limited by a severe lack of funding, which affects both the ability to undertake research and the decision to embark on a research career in the first place. Adjusted by population, the number of researchers in Uganda is 75% lower than the African average and the gross expenditure in research and development (GERD) is among the lowest in the continent – just 0.17% of the GDP in 2014. Moreover, a national research permit system that requires all research projects to apply for a research permit and pay a substantial fee upfront, creates barriers to entry for new research projects. Conversely, the country has examples of high-quality research being undertaken by reputable institutions such as Makerere University and the Uganda Cancer Institute. Other positive signs are the existence of a National Research Information System and of a national standard for research ethics (the National Guidelines for Research Involving Humans as Research Participants).

Research diffusion. Ugandan research is highly cited and internationally visible, although overall productivity remains low. 84% of published papers are produced as a result of international collaborations, and citations level are above the G20 average. By contrast, the government states that knowledge transfer is “the weak link in the technology development chain” despite the existence of a

dedicated **Department of Technology Uptake, Commercialization and Enterprise Development**, which provides technical leadership in the implementation and coordination of research uptake activities. Even with the ambition to link research with national priorities, demand for research from the government and the private sector is limited. Knowledge exchange activities are only undertaken by a handful of research organisations, and the links with the private sector and civil society remain undeveloped.

B. Options for research capacity strengthening

Overall, Uganda's research system is well-structured but highly regulated and inadequately funded. In order to support the growth of research in the country, three priorities are identified:

- **Review the research permit system.** UNCST operates a resource-intensive system for granting research permits, which suffers from delays in processing permit applications and results in lost opportunities for researchers. Researchers reportedly look outside of Uganda to undertake their research projects or look for ways to circumnavigate the whole permit process. Although the permit system is an income generator for the UNCST and universities, most researchers cannot afford to pay for the permit. DFID could work with the UNCST to review and potentially reform the research permit system in two ways: by digitalising and simplifying it through investment in IT infrastructure; and by differentiating between permits sought for internationally-funded projects (that would pay the full fee) and national or local research projects (that would be subject to exemptions or discounts).
- **Support the development of research growth centres.** Despite its challenging socio-economic context, Uganda has established research organisations with a global reputation for research excellence. It is already government policy to create new centres of excellence in the form of science parks, international campuses and R&D centres, yet there is little evidence that the policy has made much progress so far. Given the existence of centres of excellence in Uganda, it may be more useful to frame the intervention as focused on the creation of 'research growth' centres. The difference is primarily one of expectation, but could also have important implications for the types of investments made: for instance, within a 'growth' model it may be more legitimate to invest in longer-term research capacity strengthening initiatives across a broad spectrum of research and research support functions, without expectation of immediate high-level research impact. DFID could work with other funders to support the development of research centres performing research in key areas of national priorities through initiative such as **ACE II**. However, such initiatives could be expanded to take into account the broader STI context, collaborations with the private sector and civil society, and the long-term financial sustainability of the research centres.
- **Strengthen knowledge exchange capacity.** Processes and mechanisms to translate research into innovation are still weak in Uganda, but the establishment of government departments dedicated to technology development, uptake and commercialisation creates an opportunity for international donors. Efforts could focus on developing capacity and good practices not just in those departments but also in research organisations where such capacity appears to be largely missing. Both the existing and new centres of research excellence could be the obvious starting point of this work.

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Glossary

Organisations

DIIPM	Department of Innovation and Intellectual Property Management
MoES	Ministry of Education and Sport
MoJCA	Ministry of Justice and Constitutional Affairs
MoSTI	Ministry of Science, Technology and Innovation
UBOS	Uganda Bureau of Statistics
UCI	Ugandan Cancer Institute
UNCST	Uganda National Council for Science and Technology
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEF	World Economic Forum

Other acronyms

FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GERD	Gross domestic Expenditure on Research and Development
IP	Intellectual Property
KE	Knowledge Exchange
NRIMS	National Research Information Management System
NRM	National Resistance Movement
NSTP	National Science and Technology Plan
PPP	Public private partnerships
R&D	Research and development
RMA	Research management and administration
RO	Research office
SDG	Sustainable Development Goal
SGCI	Science Granting Councils Initiative
STI	Science, Technology and Innovation

1. Introduction

This report presents the results of an assessment of Uganda's research needs and it is part of a broader needs assessment of the seven countries in the 'Strengthening Research Institutions in Africa' (SRIA) programme: Ethiopia, Ghana, Kenya, Nigeria, Rwanda, Tanzania and Uganda.

1.1. Structure of the report

The document is divided into two parts. The first part presents a political economy analysis of the country, building on **DFID's guidance**. Section 2 discusses the country's 'structures', or long-term contextual factors that have a direct or indirect effect on the research system. Section 3 looks at the legal and policy framework for research, while section 4 analyses relevant political economy dynamics within the country, specifically looking at relations between public sector bodies, research organisations and individual researchers. The second part of the document assesses research performance in the country. Section 5 explores research production by assessing research inputs, research culture and support, and research outputs. Section 6 assesses research diffusion by looking at actors and networks working on knowledge exchange (KE), and existing KE practices. The last part of the document focuses on the main bottlenecks or constraints affecting the research system and discusses opportunities to strengthen research capacity. It builds on the performance indicators explored in the previous section and considers the overall impact of each indicator on the research system. A full list of indicators and their relative score is contained in Appendix A.

1.2. Methodology

The evidence presented here has been obtained through desk research and informant interviews. Desk research gathered quantitative data from 15 sources (see Appendix E), while qualitative data was obtained from interviews with nine informants, working for research organisations and the Ugandan Government (see Appendix C). Interviews were conducted, recorded, transcribed and analysed using a consistent methodology. Qualitative findings reflect the perceptions of more than one stakeholder, and they have been compared, wherever possible, with available data from published sources. They informed the authors' views on the country performance on each of the indicators listed in Appendix A.

This report has been peer reviewed by the individuals listed in Appendix D and circulated with interviewees for comments and clarifications. Previous versions have been significantly improved in response to the constructive feedback provided by Dr Tom Drake and Dr Alba Smeriglio (DFID), as well as input from DFID staff located in relevant country offices.

1.3. Limitations

The study provides a high-level assessment of the strengths and weaknesses of the Ugandan research system and research organisations. It paints a broad picture of the current situation to inform understanding and action by DFID and others; it does not seek to explore issues such as the historical

causes of the current situation or the role of the media and other political actors which, albeit important, fall outside the scope of this investigation. Some of the qualitative findings are based on the views of a small but balanced number of stakeholders and should be verified through further research.

2. Structures

This section provides an overview of the country's demography and of key political-economic parameters.

2.1. Social and political context

Uganda is a presidential republic ruled by the National Resistance Movement (NRM) led by President Museveni. The party was founded as a liberation movement and has led Uganda since 1986. While elections have been held regularly since the NRM won power, **Freedom House** reports suggest that these have been characterised by violence and the use of force against opposition parties. **Freedom House** gives a negative assessment of political freedoms in Uganda (score 11/40, where 1 is least free and 40 most free). In a context of limited civil liberties (25/40), academic freedom is relatively well-established but its outlook is negative. Academic freedom has been recently undermined by “alleged surveillance of university lectures by security officials, by the need for professors to obtain permission to hold public meetings at universities”, and by the dismissal of 45 Makerere University staff members in December 2018, allegedly to silence government critics. Personal autonomy and individual rights are limited in Uganda (7/16), particularly due to increased surveillance from the Ugandan government in recent years.^a

According to the **World Bank**, Uganda performs poorly on all governance indices. Political stability is beset by violence (percentile ranking 27/100, where 1 indicates lowest performance and 100 highest). Government effectiveness, which includes the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies, is also low (31/100). Both the rule of law (42/100) and regulatory quality, or perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development, (45/100) are below the global average but they perform well relative to other Sub-Saharan African countries. However, corruption in Uganda is perceived to be very high according to Transparency International's **Corruption Perceptions Index**, with the country ranking 149th out of 180 countries. Overall, this paints a difficult picture for national research policy and academic freedom and one of the most challenging among the seven countries considered in the study.

^a Freedom House, Freedom in the World 2019: <https://freedomhouse.org/report/freedom-world/2019/uganda>

2.2. *Economic context*

Uganda has a population of 42.7 million people and has one of the highest population growth rates in the world according to the **National Population Council**. Uganda has GDP per capita of just USD643, the lowest of all countries considered in this study and less than half of the Sub-Saharan average. Using the current World Bank **classifications**,^b Uganda is considered a low income country. Over 41% of its population live in poverty and survive on less than \$1.90 per day, broadly in line with other low-income countries. Uganda has a **Human Development Index** of 0.516, ranking the country 162nd worldwide.

Ugandan GDP is generated predominantly through the primary and tertiary sectors. World Bank data shows that almost 48% of Ugandan GDP comes from the service sector (including tourism, retail and personal services), while approximately 30% of GDP is contributed by agricultural activity alone. The remaining 20% of national income is generated by industry and comprises mining, manufacturing and construction. In line with the high percentage of GDP generated through agricultural activity, the country has a high rural population, with almost three quarters (72%) of the population reported as living in rural areas. Despite this, Uganda's adult literacy rate is 70.1%, much higher than the average for other low-income countries (61%) and the African average (64%).

The percentage of individuals using the internet is low (22%), with less than 1% of the population having fixed-broadband internet subscriptions. The **World Economic Forum** (WEF) also finds that Uganda has a very low technology readiness (2.9/7), which is a composite score looking at the availability and adoption of the latest technology and the development and accessibility of the digital infrastructure. Its capacity to innovate is moderately negative (3.9/7), but higher than many wealthier countries in Sub-Saharan Africa, and in rapid growth. Overall, the WEF assesses country's economy as uncompetitive and ranks it 114th out of 137 countries.

3. Institutions

This section looks at the strength of the national policy framework. Specifically, it considers whether the country has a national research policy or strategy and whether it was updated in the last 10 years. It also looks at the existence of an innovation strategy and of national standards for research quality and practice.

^b Low income countries = \$995 or less; Lower-middle income countries = \$995 - \$3,895; Upper-middle income countries = \$3,896 - \$12,055; high-income countries = \$12,056 or more. In addition, the World Bank identifies further groupings based on their average **GDP per capita**, which are useful reference points for this analysis: Low income = average \$787; Least developed countries = average \$1,072; Lower middle countries = average \$2,209; Middle income = average \$5,282; Upper middle = average \$8,610; OECD countries = average GDP \$45,721; High income = average \$47,892.

3.1. *National policy for research*

Uganda's research policy is codified in a number of documents. Uganda's **Vision 2040** incorporates science, technology and innovation (STI) as a fundamental pillar of the Ugandan economy. Vision 2040 aims to expand the productive potential of the economy by enhancing research and development (R&D) activities, and increasing the use of research and innovation products and in the priority areas of agriculture, tourism, oil and gas, industrial production, financial services and digital technology. Additionally, Vision 2040 proposes a human resource development strategy that invests in higher education and attracts top rated universities to establish campuses, and large multinationals in the oil and gas and technology sectors to create R&D centres in the country. The strategy further states that the Government will support innovation financing by introducing subsidies and tax incentives to stimulate research and development in the public and private sectors.

Uganda also has a **National STI Policy**, published in 2009 and a **National STI Plan for 2012-2018**. The STI Policy identifies challenges to STI, such as fragmentation of powers and responsibilities across ministries, lack of coordination of research activities in STI organisations, lack of funding, limited research infrastructure and administration capacity, and limited human resources. It then set out to create an enabling policy environment for STI by: financing R&D training, increasing R&D funding from 0.28% to 1% of the GDP, improving intellectual property protection, establishing and maintaining national R&D facilities and science parks. In order to support the achievement of its ambitious objectives, the government published a National Science and Technology Plan (NSTP). The Plan shows a detailed awareness of the necessary steps involved in developing a framework for STI, and it introduces four strategic activities to develop an STI framework: strengthening coordination, performance monitoring and evaluation; establishing a critical mass of scientists and technicians; developing an appropriate institutional framework for supporting the technology value chain; and ensuring appropriate and adequate investment in STI development.

Finally, in 2016 the Ugandan National Commission for Science and Technology (**UNCST**) published the **Revised Research Policy and Guidelines** establishing a national coordinated framework for research oversight. The document sets out the guidelines which all research projects carried out in Uganda must follow if they are to be authorized by UNCST, as well as the process that researchers need to follow in order to receive a permit to conduct research. Researchers are required to submit a research protocol, research ethics approval, proof of affiliation and pay a fee of USD300 dollars. The document also grants UNCST the right to have access to research data and research premises at all times, as well as to terminate, suspend or revoke a research permit. Similarly, the draft **National Health Policy** gives comparable funding, monitoring and coordination powers to the National Health Research Organisation.

Overall, Uganda has a very robust and comprehensive policy framework for STI and research which clearly links research activities with national priorities and establishes mechanisms of control of coordination of research activities. On paper, regulatory quality in the research sector is among the highest among the seven countries considered in this study. However, excessive policy prescriptiveness may create rigidity in the system and hamper, rather than facilitate, research production. In particular, the research permit system creates a financial and bureaucratic burden for

researchers that is likely to discourage less well-funded research activities. Moreover, the permit system creates the potential for government interference in scientific inquiry and academic freedom.

3.2. *National institutions for research*

Uganda's National Science, Technology and Innovation Policy establishes a governance structure for STI including the following institutions for research:

- **Ministry of Science, Technology, Innovation (MoSTI):** formulates STI policy, plans and programmes related to STI; identifies national STI priorities; coordinates, implements and evaluates STI programmes and supports public-private partnerships on STI. In practice, most of these functions are delegated to the Uganda National Council for Science and Technology.
- **Ministry of Education and Sport (MoES):** responsible for strengthening STI education at all levels of the Ugandan education system with the aim of producing an STI literate society. The Ministry's Department of Higher Education monitors the functioning and operations of Uganda's public and private universities through the **Uganda National Council for Higher Education**.
- **Uganda National Council for Science and Technology (UNCST):** a semi-autonomous organisation under the authority of MoSTI tasked with incorporating science and technology in national development processes. UNCST performs an advisory function for the Government on STI policy; issues permits to all R&D projects to be carried out in the country; manages national research funding; and provides technical support in matters relating to IP.
- **National Agricultural Research Organisation (NARO):** a semi-autonomous organisation under the Ministry of Agriculture, tasked with funding agricultural research, setting national research priorities in agriculture, coordinating the formulation of relevant policy, monitoring and evaluating agricultural research projects.
- **National Health Research Organisation (NHRO):** a semi-autonomous government organisation that coordinates health research, sets research priorities, strengthens health research capacity, promotes research information sharing, promotes research ethics, supports knowledge translation, and strengthens partnerships and collaboration in health research.

UNCST is the central institution responsible for implementing research policy in the country. With a staff of circa 50 people, its functions include research funding, coordination, monitoring and evaluation of research activities. The Council was established in the 1970s as a research council, and it claims to have significant "convening power" because it has historically controlled the research budget. MoSTI is the policymaking body with a mandate to oversee STI policy, provide policy guidance and coordinate activities across sectors. Although UNCST is a semi-autonomous organisation, it is unclear what level of autonomy from government it enjoys in practice. Similarly, NARO and NHRO appear to be, effectively, the gateways for research policy and research funding in the country, and they appear to work very much in coordination with the government. This centralized institutional setup appears to have the advantage of clarity and coordination of activities and could create the

conditions for effective international interventions if there is government support for such interventions. However, it does not solve the problems of limited government effectiveness discussed above.

4. Agents

4.1. *Stakeholder mapping*

The research system in Uganda is dominated by public sector organisations that control funding, and policy development and implementation. At the ministerial level – where policy, strategies and research priorities are set - operates a network of semi-autonomous public sector organisations that have full power to implement and monitor the policy. The main national actors are the MOSTI and UNCST, NARO and NHRO.

Research organisations operate within this centralised institutional framework. Uganda has a total of 52 universities, of which nine are **public**. The largest universities are public and fully owned by the Government. Among them, Makerere University has a central role as one of the most highly ranked universities in the continent (see Section 5.1 C). Uganda also hosts 43 **privately funded** universities but their research contribution appears limited compared to that of public universities. The country hosts a further 33 science-related vocational and **technical institutes**, 20 active R&D institutes, two technical colleges, two national museums, one functional public library and five private laboratories. Public research institutes are well connected to government and bear significant influence in the decision-making process. For example, the Uganda Cancer Institute is a publicly funded research organisation that conducts high-quality international research and helps shape policy at the Ministry of Health.

Although Uganda's research is dominated by publicly funded research organisations, the government has established strong relationships with international organisations such as the World Bank, that have a presence in Uganda and produce policy-related research. By contrast, private think tanks and research institutes appear to have a limited role in the national landscape and little influence on government policies. Appendix B lists active stakeholders identified through this research.

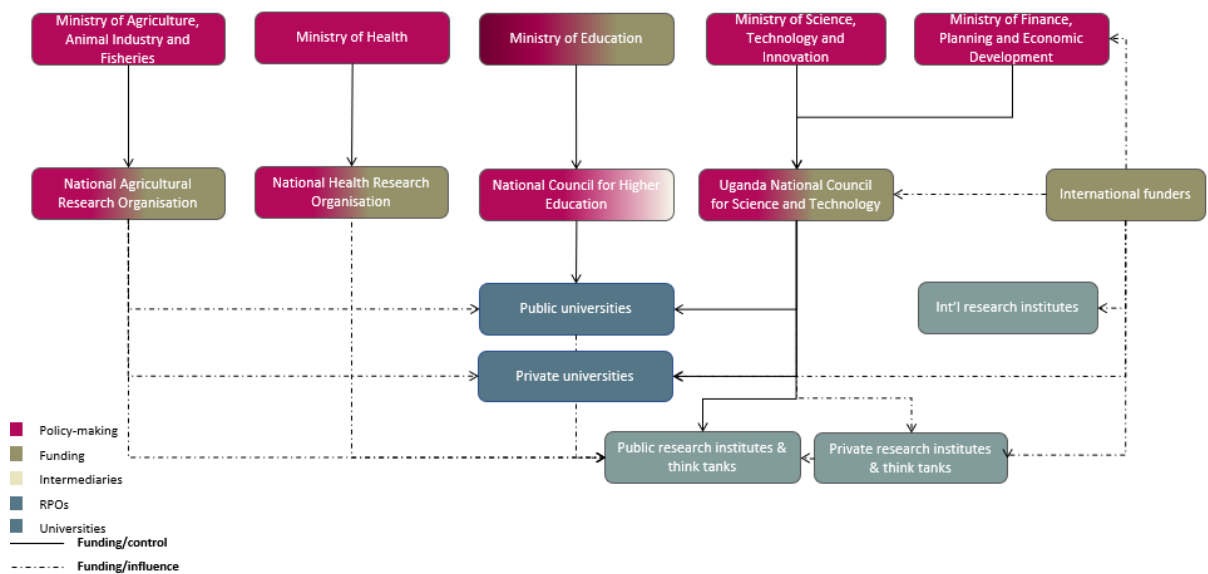
4.2. *Relations and interdependencies*

Ugandan Government ministries are responsible for the formulation of research policy in Uganda. The Ministry of Science, Technology and Innovation (MoSTI) is responsible for developing the country's research policies in line with the National Plan for Science, Technology and Innovation, and provides guidance for coordination, priorities-setting and policy development. However, much of the policy implementation and monitoring is performed by the UNCST, which is also the country's primary research funder and operates under the authority of the Ministry of Finance, Planning and Economic Development. A somewhat similar setup is in place for sectoral research in health and agriculture, where NHRO and NARO coordinate policy implementation and funding for research projects in health and agriculture respectively, under the authority of the relevant Ministry.

The National STI policy is also aligned to the country’s National Development plan (see section 3.1). The Ugandan Government mandates the UNCST to coordinate and implement the research policy for STI. Health research in Uganda is also linked to the country’s National Development Plan and ministries rely on findings from publicly-funded research institutes to inform policy development. For instance, the Ugandan Cancer Institute informs the Ministry of Health on policy development. Perhaps naturally, academia seems more disconnected from government than research institutes, but the government seeks to keep a firm grip on the research conducted in the country and its alignment to national priorities.

The consultation indicated that a high level forum on research, science and innovation has recently been established which includes UK stakeholders (DFID, UKRI, UK High Commission, Medical Research Council) and Ugandan national research stakeholders (Ministry, UNCST, National Council for Higher Education, Agricultural Research Organisation, National Health Research Organisation and Uganda Industrial Research Organisation). The forum is co-chaired by the UK High Commissioner of Uganda and the Minister of STI and it aims to address issues such as aligning UK and Uganda research priorities, identifying ways in which STI can solve societal challenges and support growth, and exploring new strategic partners and look at how UK-funded research can support knowledge systems for private sector development.

Figure 1. Stakeholder relationships in Uganda’s research system



5. Research production

This section discusses the factors necessary for research production within a national system. It considers three components of a research system:

- Research inputs, or the tangible assets that are directly connected with research production: human resources, financial resources and infrastructure.
- Research culture and support, or the enabling environment for research.

- Research outputs, including the products of research and the incentives for producing research.

5.1. *Research inputs*

A. *Human capital*

Uganda has a low number of researchers relative to its population according to UNESCO. The country hosts 41.5 R&D personnel per million inhabitants, compared to over 1,000 per million in neighbouring Kenya and over 120 per million in Ethiopia and Ghana. The proportion of researchers (26.5 per million) is also significantly lower compared to the average reported for Africa (95.1 researchers per million). In 2014, UNESCO data reported that 45.5% of Ugandan researchers were employed in higher education (rising drastically from 25% in 2010) and a further 44% of researchers were employed in the Ugandan Government. The remaining 10% of researchers were employed in the business and non-profit sectors. In terms of researcher gender, only 28% of Ugandan researchers are female – below the African average of 31% but above most of the countries considered in this study. According to UNESCO, in 2014, 30.5% of Ugandan researchers were qualified to PhD level or equivalent, only above Ethiopia and Kenya among the countries considered in this study.

Overall, research does not appear an attractive career option for Ugandan nationals. Aside from the barriers and frustration created by the research permit system (see below), Ugandan researchers have limited career options and low salaries. This is the case in public universities, private universities and research institutes alike. For example, researchers at the Uganda Cancer Institute are not salaried and must secure their own budgets through research proposals.

B. *Research funding*

There is some uncertainty concerning the level of research funding in Uganda. UNESCO data from 2014 indicated Uganda had a **Gross domestic Expenditure in Research and Development** (GERD) of 0.17% of GDP, which is less than half of the African average (0.42%) and the lowest amount among the seven countries considered in this study. By contrast, the National STI Plan indicated that the country's R&D spending in 2009/2010 was 0.6% of GDP: this is better than the UNESCO data and in line with the other SRIA countries, but still considerably lower than the 1% target outlined in the **African Union's Ten Year Plan**. A significant proportion of GERD in Uganda is performed by the Government (47%) and higher education (46%) while the non-profit sector and business enterprise contributes only 3% and 4% respectively. This indicates that Uganda has a centralized research system with a significant role for government-funded research institutes and limited activities from private actors. Over half (57%) of GERD in Uganda is financed by international sources.

Research funding is disbursed by the Uganda National Council for Science and Technology, which has recently implemented a **Grants Management System** to effectively and efficiently monitor the progress of research projects that they have invested in. Grants are awarded based on research

objectives meeting the objectives of the National STI Plan. To receive research funding, projects must demonstrate their contribution to Ugandan GDP, employment generation, government revenue, trade competitiveness and efficient service delivery. It supports research projects in the fields of Agriculture and Allied Sciences, Industry and Engineering, Environment and Natural Resource Management, Health and Nutrition, Information and Communications Technology on an annual basis. It is unclear to what extent UNCST coordinates its funding activities with the National Agricultural Research Organisation and the National Health Research Organisation, who also have a research funding role. The Ministry of Science, Technology and Innovation is seeking to coordinate research activities around national priorities.

C. Research organisations

Uganda has a complex network of research performing organisations. As discussed in section 4.1, it has a total of 52 universities, of which nine are public and 43 are privately funded. The World Economic Forum gives Ugandan institutions a low rating and ranks them 91st out of 137 countries. Three of Uganda's universities appear in Scimago's Institutions Rankings but none rank among the world's top 500 universities. Uganda's Makerere University ranks the highest of all Ugandan institutions considered on Scimago at 646th out of 3,471 higher education institutions. The Ministry of Education monitors the functioning and operations of Uganda's public and private universities.

The research landscape is dominated by Makerere University, one of the largest and most respected universities in Sub-Saharan Africa. The largest universities are public and fully owned by the Ugandan Government but private donations, usually from wealthy individuals, are an important source of funding for the sector. Public universities receive a mixture of public, private and international funds and are the most research intensive. The establishment of private universities was authorised by the Ugandan Government in 1998, and their growth has been supported by international organisations such as the World Bank and the International Monetary Fund through dedicated funding for university education. Today, private universities also rely on funding from wealthy individuals and alumni.

Uganda hosts a further 33 science-related vocational and technical institutes, 20 active R&D institutes, two technical colleges, two national museums, one functional public library and five private laboratories. Public research institutes are well connected to government and bear significant influence in the decision-making process. For example, the Uganda Cancer Institute (UCI) is a publicly-funded research organisation that conducts high-quality international research and helps shape policy at the Ministry of Health. The East African Health Research Commission has created a regional model of centres of excellence, designating UCI as the research hub for cancer. This gives Uganda regional responsibility for developing and resourcing cancer research, with accountability to the other five nation members of the East African Community.

5.2. Research culture and support services

A. Research culture

The consultation found little evidence that a system of incentives and support for research is in place in Uganda. Interviewees indicated that the country's main research funder (UNCST) is insufficiently resourced. This creates several disincentives for research. Firstly, the opportunities to receive research

funding are limited because the funding is highly competitive, poorly administered and often insufficient to undertake long-term research. Secondly, UNCST charges researchers a fee of USD300 to process their research permit application, a sum that is several times greater than their monthly salary. Finally, the lack of funding and a permit system vulnerable to abuse cause delays in the application process and making it an onerous process that further deters researchers from applying.

These appear to be major barriers to the development of a research culture in the country and create incentives for motivated researchers to seek to pursue a research career not just in wealthier Northern countries but also in other African nations. In other cases, where researchers do remain in Uganda, interviewees indicated that a substantial number of researchers choose to circumnavigate the licensing process and conduct research independently. Although against the law, the practice of circumventing the research permit system seems well-established, resulting in many researchers having autonomy in managing their own research budgets and therefore setting their own priorities.

More perhaps could be done to support and incentivise researchers in Uganda. For example, within the UNCST, interviewees report that a new online research management system has given researchers a better oversight of research generation and has made work within the organisation more efficient and effective. Investment in IT could therefore help to reduce the burden on UNCST in dealing with applications, although there appear to be fundamental problems with the financial burden placed by the application fee at the onset of a research project. While not financially attractive, it has been suggested that the model used at the Uganda Cancer Institute (where researchers pay their salaries from their research grant income) spurs researchers and the organisation to secure international funding, and encourages them to produce quality research. Finally, UNCST acknowledged that much emphasis is currently placed on research outputs in the form of publications and not enough on IP protection and commercialisation. They are trying to shift the mindset of “publish or perish” and are looking at incentive mechanisms for researchers that have been granted patents. Recent funding calls have been encouraging public-private partnerships and the development of enterprises and IP.

B. Capacity building

Improving the quality of science and engineering graduates has been an area of focus for international donors. For example, between 2006 and 2013, a USD33.35 million programme funded by the World Bank called the **Millenium Science Initiative** was rolled out to support capacity building in science, technology and innovation in Uganda. The programme focused on improving the quality of science and engineering graduates to enhance STI growth in relevant areas. Yet in 2014, Uganda had a total of just 314 researchers educated to PhD level, out of a total researcher population of less than 1,000. Although, no data since 2014 has been recorded. There appear to be few clear incentives for young people to pursue a career in research, which has limited the available talent pool. For instance, the Uganda Cancer Institute struggles to attract researchers because, according to interviewees at the UCI, cancer research is not considered an attractive discipline for early career academics. The country’s National STI Plan outlines initiatives to address research capacity issues through the development of focused researcher training programmes in higher education, but the consultation process did not unveil any national research capacity strengthening (RCS) activity currently in operation.

C. Research support and administration

Interviewees stated that most Ugandan universities do not have dedicated research management functions. However, larger universities and public research institutes do provide such support. An example of the latter is the UCI which employs ten research managers and administrators that are largely responsible for grant management. The University of Makerere has established a research management and administration function (RMA) drawing on overheads from various grants and building the team over time. Nothing has been developed using UNCST funds.

The absence of research support is an important limiting factor for universities competing to secure public research funding and for researchers themselves, given the onerous process to obtain research permits and produce evidence of compliance with the National Research Guidelines.

D. Digital infrastructure and data

Approximately 22% of the Ugandan population have **access to the internet** according to the World Economic Forum. This is below the African average of 37% and ranks the country as 115th out of 137 countries worldwide. About 33% of the population are reported to have mobile internet subscriptions whereas, in contrast, the proportion of the population with fixed-broadband internet descriptions is below 1%. There is room for improvement with regards to digital infrastructure in Uganda. With average internet speeds of 5.5 kilobytes per second, Uganda is not currently well-placed for data-intensive research.

The Ministry for Information and Communications Technology has recently established a national repository for research, and various committees at institutional levels are working to ensure that research data is fed from institutional repositories to the national one. Research organisations have so far tended to maintain their own repositories in specialist subject areas. The government has launched the National Research Information Management System (**NRIMS**), an online platform that supports research regulation and ethics in clinical research. The Ugandan Cancer Institute maintains a regional repository for cancer research that is accessed by research organisations across five countries in East Africa.

5.3. Research output and evaluation

A. Research publications

Uganda's production of academic literature is relatively low in comparison to other Sub-Saharan countries considered in this study. According to **Scimago**, Uganda produced 1,837 research publications in 2018, or just 44 publications per million people per year, equating to 2.39% of the total output of African research. Uganda ranks only above only Tanzania (33 publications per million people) and Ethiopia (33 publications per million) among the countries considered in this study. In 2018, 48.61% of research outputs were open access according to Scimago.

The quality of scientific publications in Uganda is relatively low. In terms of Uganda's h-index which is a measurement of both productivity and citation impact of scientific publications, the country ranks above Tanzania, Ethiopia and Ghana with a ranking of 77 out of 239 countries according to Scimago. The number of citations per publication has been high over the last decade at almost 18 citations per

paper. International exposure of Ugandan research is high as approximately 84% of research outputs were a result of international collaborations. However, only one Ugandan journal is listed in Scopus.

B. Research evaluation & ethics

It is a requirement of the National Guidelines for Research Involving Humans as Research Participants that all research ethics committees operating in Uganda are accredited by the UNCST. There are **24 research organisations** currently accredited under the committee. The UNCST has developed a methodology to measure research performance through the Science Granting Councils Initiative (SGCI) and the consultation process found that there are plans within the UNCST to adapt this methodology to become a long-term quality review process for Ugandan research. How this will be implemented in practice remains uncertain.

There are no formalised incentives, financial or non-financial, for research in Uganda. Researchers at the UCI for example are not salaried and research is both funded and coordinated by individuals.

6. Research diffusion

This section focuses on the stakeholders and practices underpinning the diffusion of scientific research in the country.

6.1. Actors and networks

C. National users of research

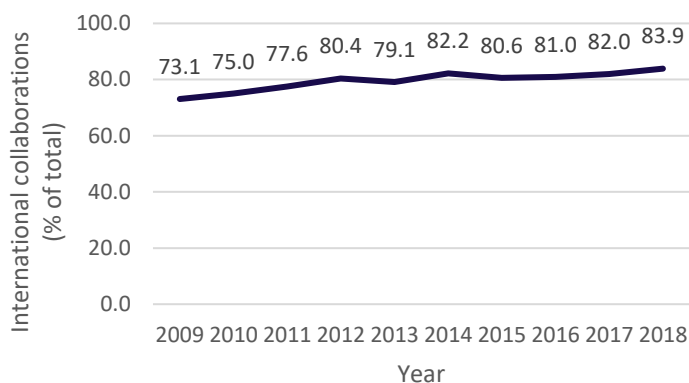
According to data from the World Economic Forum, Uganda's companies have a moderate ability to absorb technology to modernise production (score 4 out of 7), to attract and manage foreign direct investments and technology transfer (4.2/7), both showing a positive trend over the past five years. This capacity to make use of latest technologies and to modernise the production and distribution of goods and services is one of the priorities identified by the government to accelerate development and a key responsibility of the **Department of Technology Development**.

Public sector procurement of technology in Uganda is relatively low (score 3.5 out of 7), indicating a limited role played by the government in stimulating technology development in the country. By contrast, the consultation highlighted that the government is open to use research information and products coming from public research institutes and, to an extent, international donors and research organisations with a permanent presence in the country, such as the International Growth Centre. However, interviewees reported that limited research literacy - i.e. the ability to access, interpret and critically evaluate research literature and findings - hinders the Government's ability to devise and implement evidence-based policy which is informed by research. It is unclear how much influence the research has in practice, but traces of this influence can be seen, among others, in the National STI policy and plan, and in the research quality guidelines used by UNCST.

D. International exposure

International exposure is measured by assessing the percentage of Ugandan papers that fall under the 10% most-cited papers in a given field of research and considering the number of international collaborations. According to Scimago, between 2008 and 2012, 13% of Ugandan research papers were among the 10% most-cited papers in their respective fields of research. The G20 average is 10.2%. Over 80% of papers in Uganda resulted from international collaborations in 2018, a figure which has been increasing steadily since 2007. In Uganda, international collaborations are primarily conducted with research institutions based in the USA, UK, Kenya, South Africa and Sweden.

Figure 2. International collaborations in scientific publications (% of total).



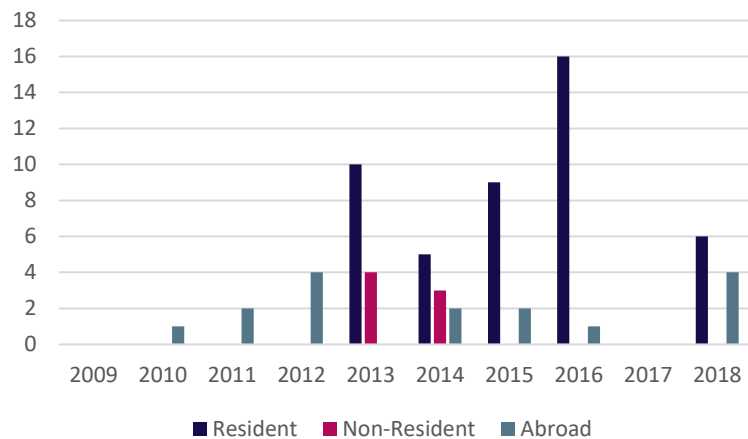
6.2. Knowledge exchange practices

A. Intellectual property

The body in charge of intellectual property protection in Uganda is the Uganda Registration Services Bureau (URSB), an office that provides a suite of business services (registration, insolvency and so forth) and operates under the Ministry of Justice and Constitutional Affairs. Moreover, the Ministry of Science, Technology and Innovation oversees a Department of Innovation and Intellectual Property Management (DIIPM) which was established to coordinate the implementation of IP policies. Currently, Uganda has no national policy for IP but a document is currently being drafted for publication in 2020. Interviews found that this policy will include the provision for the establishment of a specialist IP office. For Ugandan research organisations, difficulties in protecting IP are recognised as a significant risk. The consultation highlighted the example of a major treatment developed by the Ugandan Cancer Institute that was not protected. Allegedly, the process was subsequently adopted by the US and Canadian research centers, who went on to register the IP themselves and then licensed the treatment.

According to **WIPO** data, Ugandan residents have made no patent applications domestically or abroad since 2017 and only 6 applications in 2018. Moreover, no industrial design applications had been filed in the country until 2018 (to compare, Rwanda has had 68 in 2018 while Nigeria had 1,174 applications the same year). The country ranks 108th out of 119 countries in terms of the number of patent applications made through the **Patent Cooperation Treaty** according to the World Economic Forum. This places Uganda above Nigeria and Ethiopia. Uganda is a member of the African Regional Intellectual Property Organisation (**ARIPO**).

Figure 3. Number of patents filed in Uganda.



B. Knowledge exchange support and administration

The National Science, Technology and Innovation Plan highlights technology transfer as the “weak link in the technology development chain”. Uganda scores 3.6/7 for university-industry collaborations according to the **World Economic Forum**, despite having put in place an institutional set up dedicated to knowledge exchange and technology transfer. The **Department of Technology Development** (operating under MoSTI) was established to provide strategic technical leadership in the implementation and coordination of technology development, acquisition, transfer and adaptation. The Ministry also oversees the **Department of Technology Uptake, Commercialization and Enterprise Development**, which provides technical leadership in the implementation and coordination of research uptake. Moreover, UNCST provides financial support for spin-out activities with a long-term ambition of engaging the private sector in R&D.

The consultation revealed, however, that similar capacity does not exist in research organisations. Universities lack technology transfer offices and often operate in isolation from the government and other universities.

7. Needs assessment

This section summarises the overall score of each component of the research system using a 7-point scale (see Appendix A). Research system component scores are calculated as an average of all indicator scores within it (see Table 4). All research system components are assigned a component ID (see Table 1). The aim of this exercise is to show which components are most deficient. However, there is no exact equivalence between a low score for one component and identification of needs since different components have a different impact on the system. Section 8 discusses other considerations that influence the choice of priorities for action, such as the feasibility of interventions.

Uganda is a low-income country whose research system, in many respects, outperforms its challenging economic and political environment. Scoring 3.2/7, the socio-political context presents a negative picture (RSC1). Uganda enjoys limited political freedoms, including an erosion of academic freedom. High levels of perceived corruption, political instability and low government effectiveness are especially concerning, while regulatory quality and the rule of law remain below average. However, research and STI policies appear comprehensively drafted and are accompanied by plans that set out credible strategies and a stark recognition of the challenges facing the country. Economically, Uganda has one of the lowest GDP per capita in Sub-Saharan Africa, almost half of the population lives below the poverty line and the Human Development Index places the country almost at the bottom of a global ranking. However, its underdeveloped economy (RSC2, 1.9/7) is fairly diversified and literacy rates are relatively high and, while the country's technological readiness is extremely low, its capacity to innovate shows some promise.

Uganda's research system is guided by an impressive set of policies covering research and STI (RSC3, 5.9/7). The policies show a good understanding of the importance of supporting STI as a growth driver, of the problems faced by the country and of potential solutions. The policies are supported through a well-structured institutional framework that places great emphasis on coordination and the role of the government in implementing and monitoring policy. However, institutional performance is hampered by the lack of funding and by onerous bureaucratic processes leading to a score of 3.5/7 (RSC4). The country has seen a rapid growth in the number of universities since the government authorised the establishment of private institutions, but the latter are mostly concerned with higher education. Research production is the domain of a handful of public universities and publicly-funded research institutes (RSC8, 3.3/7).

Research production appears to be primarily hampered by two structural problems: lack of funding (RSC7, 1.8/7) and a stifling environment that limits academic freedom and places undue burdens on the researchers. In particular, the research permit system appears to undermine the government objective of stimulating research and is driving some researchers to operate outside of government supervision – but potentially also outside of the law. The combination of these factors contribute to the scarcity of researchers in Uganda and to the brain drain problem (RSC6, 1.8/7). Uganda has a low number of publications for its size, reflecting the very low number of researchers in the country. However, its publications have a very high number of citations and, therefore, international visibility. This may be explained by the fact that the country hosts a few centres of research excellence, such as the University of Makerere and the Uganda Cancer Institute, has a decent research communication infrastructure and a very high number of international research collaborations. The positive message is that good research practice exists in Uganda, but it appears to be the remit of a few organisations.

With regards to knowledge diffusion, the picture is also mixed. The government has established an institutional framework for the protection of intellectual property, but its effectiveness appears low (RSC17, 3.5/7). Demand for research from the government and the private sector is limited, indicated by an average score for users of national research of 3.8/7 (RSC15). Knowledge exchange and commercialisation activities are only undertaken by a handful of research organisations, and the links with the private sector and civil society are underdeveloped (RSC18, 3.8/7) despite this being an area of priority for the government.

Table 1. Scoring of research system components

Section	Research system component	Score	Component ID
National context	Social and political context	3.2	RSC1
	Economic context	1.9	RSC2
	Total	2.6	-
Policy and institutional framework	National policy for research	5.9	RSC3
	National institutions for research	3.5	RSC4
	Stakeholder composition & relationships	4.2	RSC5
	Total	4.5	-
Research inputs	Human capital	1.8	RSC6
	Research funding	2.8	RSC7
	Research organisations	3.3	RSC8
	Total	2.6	-
Research culture and support	Research culture	4.0	RSC9
	Capacity building	2.0	RSC10
	Research support	3.0	RSC11
	Infrastructure and data	4.0	RSC12
	Total	3.3	-
Research outputs and evaluation	Research publications	4.5	RSC13
	Research evaluation	3.5	RSC14
	Total	4.0	-
Knowledge exchange (KE) actors and networks	National users of research	3.8	RSC15
	International exposure	5.5	RSC16
	Total	4.6	-
KE practices	Intellectual property	3.5	RSC17
	KE support and administration	3.8	RSC18
	Total	3.9	-

8. Recommendations

8.1. *Identification of priorities*

This section identifies options for research capacity strengthening in Uganda by looking at the worst-performing indicators and considering their overall impact on the research system and their tractability, or the feasibility of external interventions in that area. Three areas appear important:

- **Review the research permit system.** UNCST operates a resource-intensive system for granting research permits, which suffers from delays in processing permit applications and results in lost opportunities for researchers. Researchers reportedly look outside of Uganda to undertake their research projects or look for ways to circumnavigate the whole permit process. Although the permit system is an income generator for the UNCST and universities, most researchers cannot afford to pay for the permit. DFID could work with the UNCST to review and potentially reform the research permit system in two ways: by digitalising and simplifying it through investment in

IT infrastructure; and by differentiating between permits sought for internationally-funded projects (that would pay the full fee) and national or local research projects (that would be subject to exemptions or discounts).

- **Support the development of research growth centres.** Despite its challenging socio-economic context, Uganda has established research organisations with a global reputation for research excellence. Current government policy supports the creation of new centres of excellence in the form of science parks, international campuses and R&D centres, yet there is little evidence that the policy has made much progress so far. Given the existence of centres of excellence in Uganda, it may be more useful to frame the intervention as focused on the creation of ‘research growth’ centres. The difference is primarily one of expectation, but could also have important implications for the types of investments made: for instance, within a ‘growth’ model it may be more legitimate to invest in longer-term research capacity strengthening initiatives across a broad spectrum of research and research support functions, without expectation of immediate high level research impact. DFID could work with other funders to support the development of research centres performing research in key areas of national priorities through initiative such as **ACE II**. However, such initiatives could be expanded to take into account the broader STI context, collaborations with the private sector and civil society, and the long-term financial sustainability of the research centres.
- **Strengthen knowledge exchange capacity.** Processes and mechanisms to translate research into innovation are still weak in Uganda, but the establishment of government departments dedicated to technology development, uptake and commercialisation creates an opportunity for international donors. Efforts could focus on developing capacity and good practices not just in those departments but also in research organisations where such capacity appears to be largely missing. Both the existing and new centres of research excellence could be the obvious starting point of this work.

8.2. Conclusions

The needs assessment has shown that Uganda has a well-developed research policy and institutional framework, but that limits to civil liberties and widespread poverty create difficult political and economic contexts for research. The Ugandan government is firmly at the centre of the research system. Partnering with UNCSTI and MoSTI, as the recently convened Forum of UK donors appears to be doing, would be key to the effectiveness of interventions. Building relationships at the Ministries of Health and Agriculture would also be important to strengthen research capacity in their respective disciplines. However, the main problems affecting Uganda’s research systems are difficult to address and will require long-term engagement. Among them, issues of academic freedom and the management of research permits are the areas of most conspicuous interest, but also some of the hardest to address.

At the same time, DFID has the opportunity to work with key research organisations. NARO and NHRO have significant influence over research projects and research capacity in agriculture and health respectively. The University of Makerere has an established track record of managing research funding but also a stifling effect on the university system, where its size and dominance appear to limit the

growth of younger, smaller, less resourced universities. Given the economic situation of the country, DFID would need to carefully consider whether investing in centres of research growth would be the best use of resources for creating sustainable research. These centres develop research in key areas of national priorities and engage in knowledge exchange activities with relevant actors, producing measurable results in the short term.

Finally, interviewees stressed the importance of international donors expanding their long-term presence in the country and working extensively with local stakeholders that are able to unpick the complexities of working in the Ugandan research system.

Appendix A – Full list of indicators and scores

Table 2. How to read the scales

	1	2	3	4	5	6	7
Qualitative indicators	Very poor	Poor	Somewhat poor	Neither poor not good	Somewhat good	Good	Very good
Quantitative indicators	Very low	Low	Below average	Average	Above average	High	Very high

Table 3. Score conversion table

Data type	Description	Score conversion
Absolute country rank	Country ranks are converted to scores by dividing the total number of countries ranked in seven groups of equal size and then positioning the country in one of the seven groups.	Variable based on number of ranked countries
Country scores (1-7)	A number of indicators have already been scored on a 1-7 scale. Decimal numbers will be rounded up or down to their closer whole number.	Maintained (rounded)
Country score (1-16)	Freedom House (FH) scores freedom of expression and belief from 1 to 16. We convert the score to 7, but consider performance of the sub-rating “academic freedom” when rounding up the overall score for freedom of expression.	FH score 1-2 = Needs Assessment score 1; 3-5 =2; 6-7 =4; 8 =5; 9-10 =6; 11-16 =7
Percentile score / percentile rank (1-100)	This scale uses a 1-100 score, generally with 0 indicating the lowest score and 100 the highest (in a few cases, 0 is the best score and 100 the worst). Scores are divided in 7 groups, and the score is given depending on what group a country falls under. Note that percentile score is expressed differently from the percentage value (%) which indicates quantity.	Original score 1-14 = Needs Assessment score 1; 15-28 = 2; 29-43 = 3; 44 – 58 = 4; 59-72 = 5; 73-86 = 6; 87-100 = 7.
University rankings	A score is assigned based on the position in the combined position on the global rankings of the country’s top three universities (sum of individual rankings divided by three).	1-100= 7; 101-300= 6; 301-500= 5; 501-1000= 4; 1001-2000= 3; 2001 -3000 =2; 3001+ =1

Data type	Description	Score conversion
Percentage values	Indicators such as literacy rates, access to internet etc are measured with percentage values (%). For percentage values, scores are given based on a country's performance relative to other countries.	Relative to other countries' performance
Yes/No	Some indicators are scored using a binary system, e.g. whether a country has a or has not a research strategy. Where additional qualitative evidence is available, this will be reflected in the score. Where no additional evidence is available, Yes is equated with the median point of the high rating (6) and No is scored with the median of the low range (2).	When no additional qualitative evidence is available: Yes = 6; No = 2
GERD per capita	We use the 1% African Union target as best outcome (score 7), and modify the score based on the actual GERD. GERD higher than 1% is scored 7.	GERD 0-0.2% = score 1; 0.3-0.5% =2; 0.6-0.8% =3 0.9-1.1% =4; 1.2-1.4% =5; 1.5-1.7% =6; 1.8-2% =7
GERD funding from abroad	The extent to which external funding in R&D is seen positively or negatively depends on many factors. For instance, foreign investment in business R&D is seen as a positive tech transfer opportunity, whilst excessive dependence on foreign funding in HE R&D is rated negatively. Based on existing studies , we take 35% as an optimal value for GERD from abroad for LMICs. Deviation from optimal value is rated negatively.	Deviation (+ or -): 0-5% =7; 6-10% =6; 11-15% =5; 16-20% =4; 21-25% =3; 26-30% =2; <31% =1
GERD performance by sector	We use the following GERD distribution as optimal (based on a slightly modified distribution from the OECD estimate to take into account LMICs unique circumstances): business enterprise = 50%; HE = 25%; government = 15%; non-profit = 10%. Deviation from this distribution is rated negatively.	Total deviation: up to 20% = 7; 21-35% = 6; 36-50 =5; 51-65% =4 66-80 =3; 81-95 =2; <96% =1
Number of journals listed in Scimago	A high number of local journals is positively correlated with research diffusion.	0-5 journals =1; 6-10 =2; 11-20 =3; 21-30 =4; 31-40 =5; 41-50 =6; <50 =7
Country income classification	The World Bank identifies further groupings based on their average GDP per capita : Low income = average \$787; Least developed countries = average \$1,072; Lower middle countries = average \$2,209; Middle income = average \$5,282; Upper middle = average \$8,610; OECD countries = average GDP \$45,721; High income = average \$47,892.	Low income = 1; Least developed = 2; Lower middle = 3; Middle income = 4; Upper middle = 5; High income = 6; Very high income = 7
Poverty	The score is based on the percentage of population living with less than \$1.9/day, using World Bank estimates .	40% or more =1; 25-39% =2 15-25% = 3; 10-15% =4; 9-5% =5; 1-3% =6; less than 1% =7
Urban/rural divide	We assume that there is a positive correlation between the proportion of people living in cities and research. We assume see a proportion of urban v rural dwellers above 60% as optimal, while lower proportions are rated negatively.	1-10%=1; 11-20%=2; 21-30% =3; 31-40% =4 41-50%=5 51-60%=6; >61%=7
Literacy rate	Low literacy is negatively correlated with research. Given the international standards of literacy, we weigh low literacy more heavily than relatively high literacy and only give full score to those countries where almost all the population is literate.	1-20%=1; 21-40%=2; 41-60%=3; 61-75%=4; 76-85%=5; 86-95%=6; 96-100%=7

Table 4. List of country indicators and scores

COMPONENT	INDICATOR	VALUE	SCORE	DETAILS	SOURCE
1. National context (structures)					
1.1 Social and political indicators					
1.1.1 Social and political factors	Working language	English, Kiswahili	-	No direct impact on research performance	[1]
	Total population (millions)	42.7million	-	No direct impact on research performance	[2]
	Urban population (% of total)	23.8%	2	Uganda has a low proportion of urban dwellers	[2]
	Type of government	Democratic	-	No direct impact on research performance	[3]
	Political stability	27/100	2	See table 3. Score goes from 0 (worst) to 100 (best)	[4]
	Rule of law	42/100	3	See table 3. Score goes from 0 (worst) to 100 (best)	[4]
	Regulatory quality	45/100	4	See table 3. Score goes from 0 (worst) to 100 (best)	[4]
	Government effectiveness	46/100	4	See table 3. Score goes from 0 (worst) to 100 (best)	[4]
	Voice and accountability	31/100	3	See table 3. Score goes from 0 (worst) to 100 (best)	[4]
	Corruption (ranking)	149/180	2	See table 3. Ranking goes from 1 (best) to 180 (worst)	[5]
	Access to information	N/A		N/A	
	Freedom of expression	10/16	5	See table 3 and section 2.1	[3]
	Adult literacy rate (% population aged 15+)	70%	4	See table 3	[6]
	Gender Development Index	0.865	-	Women's achievements in health, education and command are much lower than men's, underlying stronger gender inequality than the African average	[7]
1.2 Economic indicators					
1.2.1 Economic development	GDP per capita USD	\$643	1	See table 3.	[8]
	Agriculture, value added (% of GDP)	27.16%	-	No direct impact on research performance	[8]
	Manufacturing, value added (% of GDP)	10.02%	-	No direct impact on research performance	[8]
	Population living in poverty (\$1.9/day)	41.7%	1	See table 3	[8]
1.2.2 Digital infrastructure	Access to internet (ranking)	115/137	2	See table 3	[9]
	Individual using Internet/100 people	21.9	2	Scored under access to internet.	[9]
	Broadband internet subscription/100 people	0.3	1	Scored under access to internet.	[9]
	International internet bandwidth, kb/s per user	5.5	1	See table 3	[9]
	Mobile internet subscriptions/100 pop	33.7	2	See table 3	[9]
1.2.3 Competitiveness	Global Competitiveness Index (ranking 2018)	114/137	2	See table 3	[9]
	Overall technology readiness	2.9/7	2	See table 3	[9]
	Capacity for Innovation	3.9/7	4	See table 3	[9]
	Innovation index (score)	3.3/7	3	See table 3	
2. Enabling environment (institutions)					

Table 4. List of country indicators and scores

COMPONENT	INDICATOR	VALUE	SCORE	DETAILS	SOURCE
2.1 Policy and institutional framework					
2.1.1 National policies	Existence of a national research policy	Yes	6	See section 3.1	Various
	Existence of sector-specific research policies	Yes	6		Interviews
	Research policy updated in the last 10 years	Yes	6		[10]
	Existence of <u>appropriate</u> national standards for research quality and practice	Partly	4	See section 5.3	Interviews
	Existence of an <u>appropriate</u> Strategy for STI	YES	7	See section 3.1	Interviews
	Capacity development is part of the Strategy	YES	6		Interviews
	Country has <u>appropriate</u> indicators tracking R&D	YES	6	See section 5.2	Interviews
2.1.2 National institutions	The country has a ministry or department for research	Partly	4	Minister for STI. See section 3.2	Interviews
	The ministry/department for research is sufficiently resourced	No	2	See section 3.2	Interviews
	The country has one or more national research funders	Yes	6	See section 5.1	Interviews
	The research funders have sufficient financial resources	No	2	See section 5.1	Interviews
	Quality of the research funder management capacity	Below average	3	See section 3.2	Interviews
	The country has a national research ethic body	Partly	4	No dedicated body, but UNCST, NARO and NHRO perform the functions of national ethics committees. See section 5.3	Interviews
3. Stakeholder analysis (agents)					
3.1.1 Stakeholder composition	Clarity of relationships between national actors	Good	6	See section 3.1	Interviews
	Clarity of decision-making and accountability processes	Poor	2	Rules are in place, but their application is limited and processes are onerous and complex.	Interviews
	Level of coordination between government department	Average	4	See section 4.2	Interviews
	Cohesion between policy mechanisms	Above average	5	See section 4	Interviews
	Level of participation in decision-making/standard-setting	Average	4	Public research institutes have some effect on government policy, and so do international funders	Interviews
	Quality of monitoring & enforcement mechanisms (M&E)	Average	4	M&E activities seem to happen preventively (licensing system) and only occasionally happen ex post, but	Interviews

Table 4. List of country indicators and scores

COMPONENT	INDICATOR	VALUE	SCORE	DETAILS	SOURCE	
				mandates and processes are in place and implementation may be due to funding constraints. See section 3.2		
4. Production of research						
4.1 Research inputs						
People and resources needed to produce robust research.						
4.1.1 Human capital	Total R&D personnel per million people (FTE)	41.5	1	See table 3	[11]	
	Researchers per million inhabitants (FTE)	26.5	1	See table 3	[11]	
	Researchers (FTE) - Business enterprise %	4%	3	See table 3	[11]	
	Researchers (FTE) - Government %	44.4%		See table 3	[11]	
	Researchers (FTE) - Higher education %	45.5%		See table 3	[11]	
	Researchers (FTE) - Private non-profit %	6.1%		See table 3	[11]	
	Researchers (FTE) – Female %	28.1%		1	See table 3	[11]
	Researchers (FTE) with ISCED 8	30.5%	3	See table 3	[11]	
4.1.2 Funding	GERD per capita (%GDP)	0.17%	1	See table 3	[11]	
	GERD per researcher FTE (in current 000 PPP\$)	\$111	2		[11]	
	GERD financed by abroad (% total)	57.3%	6	See table 3	[10]	
	GERD performed by	business (% total)	4.3%	2	See table 3	[11]
		gov (% total)	47.09%			[11]
HE (% total)		45.99%	[11]			
private non-profit (% total)	2.58%	[11]				
4.1.3 Research organisations	Average quality of research organisations	91/137	3	See table 3	[9]	
	Global ranking of Makerere University	646/3471	4	See table 3	[12]	
	Global ranking of Makerere University College of Health Sciences	681/3471		See table 3	[12]	
	Global ranking of Mbarara University of Science and Technology	695/3471		See table 3	[12]	
4.2 Research culture and support services						
Set of cultural rules and principles, activities and interactions supporting the production of research						
4.2.1 Research culture	Perceptions of the utility of research	Average	4	See sections 3.1 and 5.1	Various	
	Time allocated to research	NA	NA	See section 5.2	Interviews	
4.2.2 Capacity building	Local availability of specialized research and training services	Poor	2	The consultation has not identified any specialized research training service	Interview	

Table 4. List of country indicators and scores

COMPONENT	INDICATOR	VALUE	SCORE	DETAILS	SOURCE
	Funding for Research Capacity Strengthening	Poor	2	See section 5.2	Interviews
	% HEI with PhD programmes	NA	NA	N/A	-
4.2.3 Research support and administration	Level of access to proposal writing support	Below average	3	Makerere University and large research institutes have research management staff, but most universities don't. See section 5.2	Interviews
	Existence of institutional policies				Interviews
	Quality of administrative support				
4.2.4 Infrastructure and data	Is there a central repository for research data?	Good	6	Uganda has a national repository and institutional repositories are common. See section 5.2	Interviews
	Quality of research infrastructure	Poor	2	The broader research infrastructure is underfunded and underdeveloped outside of a handful of centers of excellence. See section 5.2	Interviews
4.3 Research output and evaluation					
Products of scientific research (publications and patents) and incentives for producing research					
4.3.1 Research publications	Total # of publications (2018)	1,837	-	Not scored, depends on population size	[13]
	Publications per million people (2018)	44	2		
	Total # of citable publications	1,601	-	Not scored, dependent on population size	[13]
	Citations per publication (1996-2018)	17.95	-	Scored by citation per publication ranking	[13]
	Citations per publication ranking (1996-2018)	56/236	6	See table 3	[13]
	H index ranking	77/239	6	See table 3	[13]
	# Journals listed in SciMago	1	1	See table 3	[13]
	Scimago country ranking 2018	87/239	5	See table 3	[13]
% of the total output for Africa	2.39	-	Not scored.	[13]	
4.3.4 Research evaluation	Existence of national mechanisms for research quality evaluation	Yes	6	See section 5.3	Interviews
	Quality of incentives for research production	Very poor	1	Powerful disincentives hamper research. See section 5.2	Interviews
5. Diffusion of research					
5.1 Actors and networks					
National users of research and international research partners					
5.1.1 National users of research	Firm Level Technology absorption	4/7	4	See section 6.2	[9]
	FDI and Technology Transfer	4.2/7	4	See section 6.2	[9]
	Gov't procurement of technology products	3.5/7	3	See section 6.1	[9]
	Government use of research information/products	Average	4	See section 6.1	Interviews
5.1.2 International	Percentage of papers in 10% most-cited papers	13%	6	The G20 average is 10.2%	[14]

Table 4. List of country indicators and scores

COMPONENT	INDICATOR	VALUE	SCORE	DETAILS	SOURCE
exposure	(2008–2012)				
	International collaboration 2018 (% of total)	83.89%	5	See section 6.1	[13]
	Main foreign partners	USA, UK, Kenya, South Africa, Sweden	3/5 Northern		[13]
5.2 Knowledge exchange practices					
Activities and structures supporting the exchange of research-based knowledge					
5.2.1 Intellectual property	Country has a body in charge of intellectual property protection	YES	5	Limited effectiveness. See section 6.2	[15]
	Country is member of a regional IP organisation	YES	5	See section 6.2	[15]
	Number of patents applications per million people (global ranking)	108/119	1	See table 3	[9]
	Number of patents applications per million people (African ranking)	14/21	3	Score based on global ranking	[9]
5.2.3 Knowledge exchange support and administration	Country has joined a regional initiative for the promotion of STI	YES	6	See section 6.1	-
	University-Industry collaboration (score)	3.6/7	3	See section 6.2	[9]
	University-Industry collaboration (ranking)	52/137	5	See table 3.	[9]
	Existence of <u>appropriate</u> institutional policies for KE	No	2	See section 6.2	Interviews
	Quality of incentives for research diffusion	Below average	3	See section 5.3, 6.1 and 6.2.	Interviews
	Existence of commercial office	No	2	See section 6.2	Interviews

Appendix B - Uganda stakeholder table

Non-exhaustive list of the MAIN research stakeholders in the country.

Role	Uganda		International	
	Public	Private	Public	Private
Policymakers	<ul style="list-style-type: none"> Ministry of Agriculture, Animal Industry and Fisheries Ministry of Health Ministry of Education and Sport Ministry of Finance, Planning and Economic Development Ministry of Science, Technology and Innovation 			
Research funders	<ul style="list-style-type: none"> Uganda National Council for Science and Technology 		<ul style="list-style-type: none"> Chinese Embassy Department for International Development European Union German Development Agency International Center for Research on Women International Development Research Centre Institute of Development Studies International Monetary Fund Korea International Cooperation Agency 	<ul style="list-style-type: none"> Bill and Melinda Gates Foundation Carnegie Foundation Global Greengrants Fund <p>Wellcome Trust</p>

			<ul style="list-style-type: none"> • Mastercard Foundation • Swedish International Development Agency • United Nations Development Fund • USAID <p>World Bank</p>	
Intermediaries	<ul style="list-style-type: none"> • National Council for Higher Education • National Agricultural Research Organisation • National Health Research Organisation • Partners in Population and Development in Africa 		<ul style="list-style-type: none"> • Center for Development Innovation Wageningen UR 	
Universities	<ul style="list-style-type: none"> • 9x public universities 	<ul style="list-style-type: none"> • 43x private universities 		
Research performing organisations and think tanks	<ul style="list-style-type: none"> • Centre for Basic Research • Economic Policy Research Centre • Fisheries Resources Research Institute • Joint Clinical Research Centre • Kawanda Agricultural Research Institute • Kituo Cha Katiba-East African Centre for Constitutional Development • Makerere Institute of Social Research • Makerere University College of Health Sciences • Medical research Council • Ministry of Education & Sports 	<ul style="list-style-type: none"> • Development Research and Training • Economic Policy Research Centre • The Youth Think Tank 	<ul style="list-style-type: none"> • International Think Tank Initiative 	

	<ul style="list-style-type: none"> • Namulonge Agricultural & Animal Production Research Institute • National Agriculture Research Organisation • National Chemotherapeutic Organisation • Uganda Cancer Institute • Uganda Industrial Research Institute • Uganda Institute of Information & Communications Technology • Uganda National Council for Science & Technology (UNCST) • Uganda Virus Research Institute 			
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Appendix C - Interviewees

Name	Organisation
Dr Jackson Orem	Uganda Cancer Institute
Hellen Opolot	Uganda National Council for Science and Technology
Ismail Barugahara	Uganda National Council for Science and Technology
Dr Peter Ndemere	Uganda National Council for Science and Technology
Ronald Jjagwe	Uganda National Council for Science and Technology
Hebert Kamusiime	Associates Research Trust
Edith Wakida	Mbarara University of Science & Technology
Jakob Rauschendorfer	International Growth Centre
Nicole Ntungire	International Growth Centre

Appendix D – Peer reviewers

Name	Organisation
Ajoy Datta	On Think Tanks
Justin Pulford	Liverpool School of Tropical Medicine
Robin Drennan	The University of the Witwatersrand

Appendix E – Key data sources

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