Science and technology for development in Sub-Saharan Africa: Key topics, challenges and opportunities

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SciDev.Net Learning Series

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Bringing science and global development together
through news and analysis

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Yulye Jessica Romo Ramos
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Summary

SciDev.Net's focus groups in Sub-Saharan Africa (SSA) are part of a global programme that aims to understand regional needs and contexts for science and technology (S&T) in development. The programme started in 2012 in South East Asia and the Pacific, and reports are available online at http://www.scidev.net/global/content/learning-series.html

This report is relevant to many stakeholders, particularly those interested in research uptake for policy and development, as it highlights the key areas of interest in S&T for development, and barriers and gaps in the use of S&T evidence. It also provides suggestions for how communications about S&T can be improved.

Chapter 1 outlines details of the process used in this research. The countries and organisations we engaged with were selected in consultation with our local contractors, our Sub-Saharan Africa regional coordinator and SciDev.Net's senior management team. The focus countries are Ethiopia, Kenya and South Africa. The two-day focus groups had about 12 participants per event, who were drawn mainly from the following sectors:

- Policy
- Academic and research community
- Science communicators
- Civil society.

The report has been reviewed by participants and an independent consultant for quality assurance.

Chapter 2 provides a profile of each country and presents a comparative analysis situating them in regional and global contexts. Participants acknowledge that there are many similarities in priorities and challenges at regional and global levels, but some differences emerged:

- Limited access to information and technology
- Limited human, financial and infrastructural resources
- Weak legal and regulatory frameworks.

Each is studied in detail in the chapter and reflections about science communication are presented.

Chapter 3 provides detailed insights on the role of governments and international funders in creating and sustaining an enabling environment for research, innovation and use of evidence for policy and development (uptake). It also details the type of education and research that is more conducive to uptake and innovation.

Chapter 4 analyses how science communication and effective knowledge management advance the use of S&T for policy and development. This chapter also provides insights on preferred channels to find and disseminate S&T information per sector, although traditional media such as newspapers and TV are widely used by all to find S&T information (with varied levels of effectiveness). Participants felt that professional language and jargon often acts as a barrier to strategies aimed at bridging the gap between sectors, but that best practice recommendations on science communication can help resolve these issues.

Chapter 5 presents key S&T topics in development that emerged from our discussions in the three countries. These include:

- Health
- Agriculture
- Environment
- Education
- Technology and innovation
- Energy and infrastructure.

All these topics are interrelated in one way or another. Access and quality are common issues across all themes, and women and rural populations are a concern owing to their particularly limited access.

Chapter 6 summarises the capacity building needs of policymakers, academics, researchers, and journalists.

Chapter 7 offers a set of recommendations about how to improve S&T for development. From the focus group discussions three clear strategic visions emerged:

- A desire to use S&T to meet basic needs and ease the burden of daily activities — improved health, food security, and access to technology, energy, information, etc.
- Using S&T to create value-added products and services that could provide a competitive advantage and increase opportunities for economic and social growth
- Sustainability and inequality — to reduce reliance on natural resources and tackle issues related to climate change and inequality.

For these recommendations to be recognised, participants say there is a need to strengthen the links between research, policy and the media with a focus on adaptation and local relevance, as opposed to importing solutions, and on knowledge management to increase use. They feel it is crucial to adopt innovative approaches to research, science communication and policymaking, including partnership building to tackle complex issues and multidisciplinary research.

For this to occur the role and capacity of different actors to make changes needs to increase. This includes:

- Improvements in the science communication capacity of journalists, academics and researchers
- Better capacity of policymakers to use S&T information
- An improved environment for use.

Within this process a focus on gender relations and the role of women, young people and other marginalised groups such as the rural poor are important.

This report also recommends developing strategies aimed at connecting ‘silos’ and generating multidisciplinary and multisectorial partnerships that might be more effective when aiming to increase use of S&T for development.

Chapter 1: Methodology

SciDev.Net's focus groups in Sub-Saharan Africa (SSA) are part of a global research programme that aims to understand the needs of developing countries and enabling contexts that allow science and technology (S&T) to have a positive impact on equitable and sustainable development and poverty reduction. The programme started in 2012 in South East Asia and the Pacific, and reports are available online at http://www.scidev.net/global/content/learning-series.html

We use the findings to guide and prioritise the key S&T topics for our editorial, and also for developing training programmes. They also help us serve our various regional audiences. A secondary goal is to recruit people for our regional advisory groups (RAGs), which help us with long-term engagement with key audiences (particularly policy and development practitioners) and with quality assurance for our work.

Focus group process

SciDev.Net's monitoring and evaluation (M&E) coordinator designed the focus group programme based on wide consultations with our staff. The main research questions we raise during the focus groups are:

1. The S&T topics most relevant for development purposes according to a participant's opinion or experience.
2. Whether there are regional gender-related topics in S&T for development
3. If there are new areas of research, science communication and science policy
4. The appropriateness of formats used for S&T communications according to different audience needs
5. Comparing the value of SciDev.Net's regional, global and topic-specific coverage
6. Preferred formats and technology platforms for accessing S&T information by sector
7. Capacity building and science communication training for all groups.

The focus groups are designed to stimulate dialogue across stakeholders working in different sectors (policy, development, media, academic and research) to uncover similarities and differences in their viewpoints. This is a key component of the methodology as it provides a wide range of experiences and opinions about science outside the academic world, and results in a more holistic, multistakeholder view of how science can be better used for policy and development.

We use different methodologies to maximise participation in the group discussions. For example we start with a brainstorm at a plenary session, after which participants are split into smaller working groups using a World Café approach[1] as well as other interactive activities. The M&E coordinator facilitates these focus group discussions, with the help of contractors in each country who coordinate the logistics and administration.

The contractors help to write down the main ideas during the plenary session and then participants create their own notes when working in groups. The facilitator also takes notes, which serve as a cross-reference when processing the evidence used to write the report. This means that at the end of all focus groups there are comprehensive sets of notes for each focus group, which are then used by the report author to identify themes and ideas.

[1] This is a simple, flexible format for running large groups. Participants start at small discussion tables, and then a majority moves to a different table leaving behind a table host, until all participants visit all tables. For more information see: http://www.theworldcafe.com/method.html

Before publishing the report a draft is sent to all participants, allowing them to revise its content for accuracy and quality insurance. Additionally, an independent professional, in this case Kate Hawkins (director of Pamoja Communications), reviewed the document with a structural and social research focus. The report author receives and integrates any appropriate comments as submitted by participants and the independent reviewer, making changes or adding information as needed.

Participants

The countries were selected in consultation with our Sub-Saharan Africa regional coordinator, Ochieng Ogodo, and the SciDev.Net senior management team. Key considerations include population size, economic development and their relevance and profile in the region. For practical reasons we only screened English-speaking countries for this project. For country profiles see Chapter two.

A wide range of organisations were represented, and we usually only allow one representative per institution. The M&E coordinator worked with each local contractor to create a list of the most prestigious organisations in their country, which was then evaluated with the help of the Sub-Saharan Africa regional coordinator. A final list of organisations was then shared with the local contractors and they were asked to reach, within each one of those organisations, the most senior people to attend our focus groups so we could tap their knowledge and experience.

The two-day focus groups had about 12 participants per event. Participants were drawn from the following sectors:

- Policy (civil servants, policy advisors, policymakers, policy administrators at local and national levels)
- The academic and research community (scientists and researchers, and teachers)
- Science communicators (science journalists, press officers working for science or research organisations)
- Civil society (development practitioners working for non-profit organisations).

The focus groups also provide networking opportunities within the country and across sectors and organisations, so indirectly fostering partnerships in S&T for development. See Annex 1 for a list of participants.

Other sources of information

The report author was invited to a three-day conference in South Africa, marking the halfway point of a five year project, Development Research Uptake in Sub-Saharan Africa (DRUSSA).[2] Conference attendees were mainly high-level managers and research office directors from DRUSSA's 22 member universities from across the region. This provided further information for our findings and analysis.[3]

Other references are included as appropriate in this report.

[2] http://www.drussa.net/

[3] DRUSSA aims to provide direct support to 24 selected universities from Sub-Saharan Africa as they work together to improve research uptake capacity. To find out more about the meeting see: http://www.scidev.net/global/education/scidev-net-at-large/could-african-universities-get-policy-friendly-research.html
DRUSSA 2014 Research Uptake Benchmarking Report. Available here: http://www.drussa.net/getfile.php?id=2439

Limits of the research

The findings outlined in this report are based on a small sample of stakeholders and therefore findings are not necessarily representative of their sectors or countries. What the report does well is:

- Highlight key areas of interest in S&T for development
- Uncover barriers and gaps to the generation and use of S&T evidence
- Suggest how communications about S&T can be improved.

Chapter 2: Situating Ethiopia, Kenya and South Africa in regional and global contexts

This chapter profiles Ethiopia, Kenya and South Africa and presents a comparative analysis of their regional and global contexts. Participants acknowledge that there are many similarities in priorities and challenges between the regional and the global context. But some differences emerged:

- Limited access to information and technology
- Limited human, financial and infrastructural resources
- Weak legal and regulatory frameworks.

Each is studied in detail in this chapter and reflections about science communication are presented.

Country profiles

In 2009 the gross expenditure on R&D (GERD) as a percentage of GDP for developing countries was 1.11 (excluding the least-developed), 0.2 for least-developed countries and 2.32 for developed countries — around 343, 2.1 and 931 in US$ billion purchasing power parity (PPP) respectively. Estimates for researchers per million inhabitants are around 520 for developing countries, 47 for least-developed countries and 3,637 for developed countries. In Africa alone (Sub-Saharan countries not including South Africa and Arab states) GERD in 2009 was about 3.4 (US$ billion PPP) or 0.28% as a % of GDP, and the number of researchers per million habitants was 50 (source: UNESCO Institute for Statistics).[4] So how do Ethiopia, Kenya and South Africa compare with the above figures? The boxes show how. Figures are from the World Bank's World Development Indicators[5] and the UNESCO Institute for Statistics.

Box 1: Country profile – Ethiopia

Ethiopia is situated in East Africa and it is the second most populous country in the continent. It has a population of 94,100,756 (2013), which is mainly rural (82.5% in 2013) and depends heavily on agriculture for survival. The GDP per capita (current US$) is $498 (2013). The proportion of graduates in natural sciences is around 70%[6] and in 2010 gross expenditure on R&D (GERD) as a percentage of GDP was 0.25, around 0.2 in US$ billion PPP, and the estimated number of researchers per million people is around 42. The percentage of female researchers is 7.6.

With no history of colonialism, Ethiopians enjoy a sense of pride and no great experience of racism, which is not shared by others on the continent. Our participants see the government as the backbone of the country and the economy, controlling most major industries and communications in particular. The government maintains strong control over this sector using surveillance.[7] International aid plays an important role in the country. But recent policy changes prohibit non-governmental organisations (NGOs) receiving more than 30% of their funding from foreign sources to get involved in policy matters.[8] This is seen as a move to diminish undesired political intervention from outside governments and international organisations.

[4] UNESCO Institute for Statistics: http://data.uis.unesco.org/#
[5] World Development Indicators: http://data.worldbank.org/data-catalog/world-development-indicators
[6] Ethiopian Ministry of Education (2013). *Education statistics annual abstract, November 2005 E.C. (2012/2013 G.C.)* Ministry of Education, Addis Ababa. http://www.moe.gov.et/English/Resources/Documents/eab05.pdf and Ethiopian Ministry of Education (2008). *Annual intake and enrolment growths and professional and program mix of Ethiopian public higher education: strategy and conversion plan, 2001–2005.*

Box 2: Country profile – Kenya

Kenya is also situated in East Africa and has a population of 44,353,691, of whom 75% are rural (reliance on agriculture for survival is high), with a GDP per capita of US$994. In 2010, gross domestic expenditure on R&D (GERD) as a percentage of GDP was 0.98, around 0.65 in $US billion PPP; the estimate for researchers per million inhabitants is around 227. The percentage of female researchers is 17.8.

Many believe that Kenya has gained prominence thanks to its economic development and geographic advantage. Today Kenya functions as the hub of Africa, with most flights to various parts of the continent connecting there.

Box 3: Country profile – South Africa

South Africa is situated in the south of Africa; it has a population of 52,981,991 (of whom 37% are rural), 21% more than Kenya but 40% fewer than Ethiopia, but its GDP per capita (current US$) of $6,618 is about six times greater than Kenya's and 13 times greater than Ethiopia's. In 2010 gross domestic expenditure on R&D (GERD) as a percentage of GDP was 0.76, just under 4 in $US billion PPP; the estimate for researchers per million inhabitants is around 364. The percentage of female researchers is 40.8.

The country enjoys a relatively good position in research compared with the rest of Africa. Participants from the focus group discussions in South Africa regard the country as having greater political clout than other regional powers, as well as an economy that keeps growing.

How does Sub-Saharan Africa compare with the global context?

We asked participants to reflect on the differences between their country or region and the global context. Analysis of the responses indicates that the 'global' context was generally seen as the global North or the developed world.

Participants acknowledged that there are similar priorities and challenges in the region and the global context. But there are also differences that include:

- Limited access to information and technology
- Limited human, financial and infrastructural resources
- Weak legal and regulatory frameworks.

Reflections on science communication are presented at the end of this chapter, and more details for these thematic areas can be found in the sections below.

It is interesting to note that Ethiopians see that while the region deals with issues related to survival, the global powers focus on political gains. Both Ethiopian and Kenyan participants felt that at the regional level science has fewer demands from the economy and that science is highly industrialised in the global context compared with the regional level.

Limited access to information and technology

Participants in all countries said that public information in general, but particularly on S&T, is less available than at global level. For example there is a lack of access to the internet and information produced at national or local levels. Accountability and transparency is also hindered by a lack of access to policymakers as sources of information, although South Africans report that science policymakers are a little more accessible than other nations in their region.

Technology transfer from the developed world was seen as a challenge, and also access to technology by certain groups — generally those without financial resources such as the rural poor.

Limited human resources and capacity

Compared with the global context, participants felt that their region had fewer human, financial and infrastructure-related resources — all of which have impacts on S&T and development.

Participants reported that they lack highly skilled and experienced professionals and that those that remain are not well-incentivised — this was linked to brain drain. South Africans feel the country tends to nurture generalists and that more specialists should be developed. This may be linked to education systems in the country. Participants felt that there is more support for research and education abroad than at home, where there is a need for more high-quality teachers who are motivated, rewarded and recognised. Locally, they see a need for science training for teachers with performance monitoring and more mentorship programmes. Researchers in South Africa consider their country is doing well in certain scientific fields, and is leading in Africa, particularly in space science.[9]

Policy stakeholders in Kenya felt that there had been positive changes in the education sector and pointed out that, in the country and in Sub-Saharan Africa, pupil enrolment at all levels has increased,[10] but demand is outstripping resources, and they acknowledged that secondary level dropouts have increased. They highlighted cases where there has been more emphasis on S&T in the curriculum, such as in Rwanda, and where efforts have been made to integrate information and communications technology (ICT) studies into education.

Human resources for science policy were mentioned in South Africa. The lack of a science advisor role within government is thought to be a weakness and improvements in human resources policies are needed — for example on parental leave and gender-issues — similar to those in Europe.

Limited financial resources

A common issue for many countries in the region is limited access to funds for information, technology and infrastructure (such as for transport, ICT and research). In Kenya participants believe there is a failure to make effective use of research facilities, which may be linked to poor training and restricted accessed, and there are poor links between R&D and both the public and private sectors.[11]

In South Africa, researchers complained of inadequate funding for research, and poor accountability for the funding that is received. They noted that researchers in developed countries get funding for 'blue sky' research and enjoy intellectual property rights. With public budgets tightening, both in South Africa and globally, there is also more competition for R&D funds. But South Africa may be at an advantage for international funding owing to more effective investment than other countries in Sub-Saharan Africa.

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[9] http://www.scidev.net/global/technology/feature/astronomy-africa-telescope-education.html
[10] World Bank: World Development Indicators
http://data.worldbank.org/indicator/SE.PRM.ENRR/countries/KE-ZF-XM?display=graph
[11] http://www.scidev.net/global/innovation/news/secrecy-among-kenyan-firms-may-be-impeding-innovation.html

In Kenya, participants believed that there is a huge gap between local innovation and global trends. They link this to the poor investment environment in research and innovation in the region (see country profiles section). Participants in Ethiopia believe that developed countries do a better job of encouraging local innovation than the Ethiopian authorities.

Legal and regulatory frameworks

Legal and regulatory frameworks, for example those related to intellectual property rights, have huge impact on research and innovation.[12] Participants in Kenya and South Africa said that such frameworks could be improved. Enforcement is more effective in the developed world, they said.

Chapter 3 explores the role of the public sector in enabling an environment where S&T works for development.

Science communication outlook

Participants in Ethiopia believe that media professionalism is underdeveloped in the country, with particular gaps in knowledge, specialisation, experience, analytical reporting skills and incentives. There is high staff turnover and technological limitations in comparison with the media in developed countries. As a result they feel that S&T communication has contributed little to development.

Ethiopian participants also say that at regional level there is a traditional way of understanding science — as opposed to an industrialised view — and that science institutions have no effective communications tools, strategy or culture.

In Kenya, participants reported that countries such as Uganda are more positive about science, and believe that the focus on politics over science is most felt in East African countries where there is a lack of local journals and limited access to international journals owing to costs. There could be more investment in science journalists and science communication courses in higher education. In their view the local focus is on communicable diseases. In contrast, reporting in developed countries is on advanced science and there is more focus on placing science in context in order to increase its appeal and relevance.

In part these differences arise from constraints related to technology and financing for science communication, particularly when there is a need for extra funds to cover some stories (to cover transport costs to rural areas, for example). Participants indicated that publishers do not favour science, and policymakers and researchers are unwilling to provide interviews.

According to participants in South Africa, science news capacity is poor compared with developed countries; there are few science writers in South Africa but more than in other African countries. They feel that science policymakers are a little more accessible that in other nations in their region. But there is less publicly available information and data than in developed countries.

[12] http://www.scidev.net/global/innovation/news/secrecy-among-kenyan-firms-may-be-impeding-innovation.html and http://www.scidev.net/global/innovation/scidev-net-at-large/top-tips-for-building-policy-for-innovation.html

Chapter 3: Creating an enabling environment for S&T for development

Enabling conditions concern:

- The role of governments and the international community
- Developing future generations of researchers
- Reforming the academic and research institutions
- Ensuring research addresses real-world problems.

Knowledge management and science communication are also enabling conditions — these are studied in more detail in the Chapter 4, along with preferred communication channels per sector.

The political environment

Governments are pivotal in ensuring that an enabling environment exists for research and its uptake. Some participants believe that application of S&T is dependent on governance. But participants from all three countries said that they do not believe policymakers actually have an interest in S&T or that there are structures to promote S&T in policymaking. There was a sense that even where advice and evidence were given it is not always considered in decision making.

Participants felt that coordinating national efforts, mobilising resources and people, and providing overall direction should be the responsibility of government. Some believe that governments should also drive the commercialisation of research, adding that currently the private sector is better at adopting new technologies. The government can, for example, modify certain regulatory policies to promote applications that are of national interest. In Kenya, participants said this could apply to commercialising kits for hepatitis[13] but current regulations on production are so strict that the costs are prohibitive for local entrepreneurs, and only multinational companies can take advantage of this opportunity.

Within the policy arena, the creation of councils, academies and ministries of S&T are seen as a positive step and an indication that science is high on the political agenda. These government institutions can help collect information for policymaking and provide funding and incentives for research and innovation. For example, the Ethiopian Academy of Sciences awards research prizes provided by the Ministry of Science and Technology. In South Africa, about two-thirds of national funding is disbursed by eight research councils.

In many instances lack of funding is a barrier to research, according to our participants and those attending the DRUSSA conference[14]. For example, in Kenya participants said that their government's funding only goes as far as supporting salaries of research organisations, such as at the Kenya Medical Research Institute (KEMRI), and that a big proportion of financing in this area comes from the private sector and international donors and is targeted toward agricultural work.

In Kenya, as part of Vision 2030, the government has proposed it will build a 'techno city' known as Konza to encourage economic growth.[15] In Ethiopia the aim of the Environmental Climate-Resilient

[13] http://kemri.org/index.php/home-mainmenu-1/1-latest/249-kenya-bridging-research-commercialisation-gap
[14] http://www.scidev.net/global/education/scidev-net-at-large/could-african-universities-get-policy-friendly-research.html
[15] http://www.vision2030.go.ke/cms/vds/Konza_Techno_City_-_Frequently_Asked_Questions.pdf

Green Economy (CRGE) initiative[16] is to achieve middle-income status by 2025 via a green economy. The strategy is also guided by Ethiopia's Growth and Transformation Plan.[17] In both countries, according to our participants, these efforts will have to include a wide range of S&T solutions as well as more collaboration and cross-departmental coordination, connecting silos, reducing duplication and forging innovative multisectorial partnerships.

While the above policies are generally seen as positive by participants, political will and capacity to implement policies are challenges and participants feel that policies do not compare well with, say, those of Brazil and India in medicine, which have resulted in the creation of big global industries.

In South Africa, participants reported that national policies are in conflict; for example, policies include S&T as a means for growth yet these are not underpinned by transformative efforts to increase research and its uptake. They also feel that current politicians are not necessarily positive role models for younger people, as they show that education is not required to be in power (particularly at rural and local levels). For our participants, a culture of science and education is highly desirable within government, and is reflective of their own backgrounds. Governments can have a big influence on education at national level — for example in Kenya the Ministry of Education is retraining teachers to be more capable in science, so that they can in turn help change students' perceptions, particularly those of girls.

A major concern for all participants is that of brain drain,[18] which detracts from educational and research efforts aimed at increasing national capacity. Highly skilled and educated citizens often emigrate because the academic and research market offers comparatively low pay and few opportunities for advancement.

The role of international stakeholders

Participants felt that because S&T is not seen as a funding priority in many settings the S&T agenda is largely driven by foreign funders. These funders, generally from high-income countries, direct resources to areas they believe to be most relevant but they do not always tackle the most pressing local concerns, according to participants.

Participants acknowledge that collaborative projects (between global and local organisations) are needed but are not always unproblematic. They cited instances where there had been conflicts over intellectual property rights and corruption scandals, which create mistrust. For example, in Kenya local researchers worry about foreign professionals coming to the country and then publishing analysis under their own names, giving little or no credit to local input that made such research possible. Additionally, there is a feeling that researchers do not own their own outputs but that their funders/sponsors do. Participants suggest that regulations and policies aimed at safeguarding national knowledge should be put in place to avoid this. More transparency and awareness-raising in countries receiving funds could help international donors demonstrate how their funds are being used to the advantage of local people.

Given the power international funders have, it is no surprise participants feel that researchers tend to listen to donors more closely than local partners. Funders do tend to support research that offers opportunities to increase local relevance and uptake, which participants say is useful. But many participants believe these goals are not realised, being mostly useful during the bid stage and do not

[16] Climate-Resilient Green Economy (CRGE) initiative (2011). Available at: http://www.undp.org/content/dam/ethiopia/docs/Ethiopia%20CRGE.pdf
[17] http://www.mofed.gov.et/English/Resources/Documents/GTP%20English2.pdf
[18] See Maharaj, B. The African brain drain: causes, costs and consequences. In: S. Sahoo and B.K. Pattanaik eds. (2014). *Global Diasporas and Development*. Springer India, 121–138. Available here: http://www.springer.com/social+sciences/population+studies/book/978-81-322-1046-7

necessarily deliver in practice. Another trend that participants mentioned concerns gender, which they say is effective in securing funds but does not necessarily translate into gender-sensitive research.

Participants said that promotion for academics is linked to publishing research in international journals, and policymakers favour such journal articles as they see them as trustworthy. But these journals tend to favour research that is globally relevant and may not be what is required at national or local level (e.g. for tropical diseases). So this incentive for researchers can work against meeting local needs.

In Ethiopia, the influence of donors is a concern and a new law was introduced in 2010 to limit all political activities by non-governmental organisations (NGOs) that get more than 30% of their funds from international sources. This affected a large number of NGOs working in the country and it was justified as a measure to reduce outside political interference.[19]

Developing capable future generations

Education is a big theme for focus group participants when discussing S&T for development. Increasing literacy, particularly science literacy, is a challenge, as is increasing the number of highly-educated people (post-doctoral graduates in particular).[20] A lack of skills results in low levels of research outputs. The quality of education in Sub-Saharan Africa generally is a big issue, and basic infrastructure is lacking in many countries, in particular equipment and facilities.

Outdated curriculums that do not keep up with the fast moving developments in science, and poor teaching methods, were highlighted. In South Africa, a lot of teaching is given in local languages, yet exams are taken in English, which lowers chances for students to excel. It has proved difficult to retrain teachers to teach in English.

Concerns about teaching methods include a heavy reliance on memory and repetitious exercises instead of analytical and critical activities. Participants added that issues concerning science subjects on offer, professional choices/desires, career guidance and entrance requirements need to be resolved to increase the number of young people opting for science-related careers. Instead, in many countries in Africa, many students enrol in social science subjects. According to our participants, role models can be useful to increase interest in education and science (see also Chapter 4). Role models provide positive examples of professions for young people to follow, allowing them to visualise the types of careers they could have by studying sciences, counteracting negative stereotypes.

Participants also said that educational programmes should develop skills related to innovation and entrepreneurship.

Another area that needs attention is that of science journalism. Most universities do not include it in their journalism curriculums, resulting in lack of skills to cover S&T topics and low numbers of graduates in this area (see also Chapter 4, Science journalists as knowledge brokers). Science communication skills for academics and researchers are also much needed.

[19] http://www.icnl.org/research/journal/vol12iss3/special_3.htm
[20] For more information see SciDev.Net Spotlight: 'Making higher-education count for Africa' at http://www.scidev.net/global/education/spotlight/higher-education-africa.html

Reforming academic and research institutions

The lack of structures and staff for science communication within academic and research institutions has been identified as a major problem, particularly by those organisations taking part in the Development Research Uptake in Sub-Saharan Africa (DRUSSA) project.[21] As part of this research project, SciDev.Net was invited to attend a conference in South Africa[22] on progress made by DRUSSA, where more than 30 senior representatives from 22 member universities from across the region attended, mainly high-level managers and research office directors.

During the event participants reported that communications strategies have been developed to reach a wider audience, partly through new partnerships with non-academics for science communication. But this is not common practice in Africa and more should be done to increase access to information, although the lack of skills for science communication is an obstacle, even for DRUSSA's universities. Some participants said there has been progress by identifying 'champions' among academic and research circles with ability to translate science for a lay audience. If the research cycle is modified (see Chapter 7), for example to include descriptions of impact, it will be easier for academics and researchers to contextualise research outputs in a way that resonates with non-specialist audiences, attracting interest and increasing uptake. Chapter 7 also offers thoughts on reforming human resources management in academic and research institutions to increase engagement with development issues and to shift the focus to impact.

And it is challenging to constantly integrate knowledge into academic curriculums as the speed of advances continues to increase — perhaps the digital age will make this task easier, although marginalised communities still depend heavily on printed materials.

Research that addresses real-world problems

Participants said that research should try to address development issues. S&T should adapt to context, offering low-cost solutions that add value and can generate economic opportunities while taking into consideration climate change (adaptation and mitigation needs) and marginalised and vulnerable groups.

Chapter 7 (recommendations) offers suggestions for planning and conducting research to help increase relevance and effectiveness in terms of policy and development, with a particular focus on adaptation to context, multidisciplinary research, multistakeholder partnerships, and application and commercialisation.

[21] https://www.acu.ac.uk/focus-areas/research-management-uptake/drussa
[22] Could African universities get policy-friendly research? http://www.scidev.net/global/education/scidev-net-at-large/could-african-universities-get-policy-friendly-research.html

Chapter 4: Science communication and knowledge management

Overview

In this chapter we analyse how science communication and effective knowledge management advance the use of S&T for policy and development. We also provide insights on preferred channels to find and disseminate S&T information per sector, although traditional media such as newspapers and TV are widely used by all to find S&T information (with varied levels of effectiveness). Participants said that professional language and jargon often acts as a barrier to bridging gaps between sectors but that best practice for science communication can help resolve this.

A significant barrier to the use of evidence is poor access to information. Availability of evidence for policymaking is key to increasing use, but it remains a challenge. Participants say that data exists but it is highly fragmented or dispersed in a multitude of places. But there are some encouraging projects, for example in Ethiopia, where the Environmental Protection Authority and the Ministry of Science and Technology are setting up databases where science relevant to their mandates can be stored and made more accessible.

Science journalists, think tanks, and knowledge brokers and intermediaries can all play a role in making evidence more accessible. The goal of science communication is to translate complex information into messages that are easier to understand by non-specialist audiences in the hope that this will increase interest and uptake. But many have argued that this type of communication should include an analysis of the socioeconomic implications of research findings and avoid oversimplification. This is important in a world that is more complex and sophisticated when it comes to discoveries and science in general.

Participants from South Africa suggested that science advocacy is an alternative way of increasing interest in S&T. What differentiates science communication from science advocacy is that the former generally supports all S&T and is seen as neutral, whereas the latter tends to take a stance and advocates for a particular topic or research project. One strategy for communication involves 'rock-star science champions' who could increase reach and engagement with S&T, particularly among young people.

Some participants said scientists would put themselves at risk by engaging in science advocacy as they may be seen as biased, but others suggested that high-level members of staff are ideally placed to do so (i.e. chief scientists advocating on behalf of a team or organisation). Policy participants mentioned that it is important for academics and researchers to engage more with policymakers to influence policy, instead of waiting to be engaged. They add that patience and long-term engagement is needed, because the dynamics and complexities of policymaking are very different to the research sector.

In general, transparency and independence are seen as key for influencing policy as well as being able to identify and take advantage of policy moments. Monitoring and evaluating impact can also be useful to increase influence, for profile and reputation-building.

Advanced information and communications technology (ICT) can be positive and negative for information dissemination, communication and advocacy. Participants noted more blogs by researchers, helping them reach non-specialist audiences more easily, but warned that some see blogs as equal to peer reviewed articles. Science communication needs to be managed carefully, especially as some have limited or no access to ICT, mainly marginalised groups.

Science journalists as knowledge brokers

Participants see the media as a knowledge broker that helps bridge the gap between research and policy and between research and the public. In the global review SciDev.Net undertook in 2012 we found that the media is one of the main sources of information for policymakers and there is agreement that the media can influence the policy agenda.[23]

In Kenya, we heard that those who go into science journalism do so because they are passionate about the role, while the rest shy away from it, mainly because of the lack of specialist journalist training in academic programmes and the low interest by the media in publishing S&T stories. Science journalists in our focus groups complained that researchers, particularly those who are government-sponsored, are reluctant to share their findings. But some researchers we talked to mentioned cases where journalists had misconstrued information shared with them, and the researchers were reluctant to speak to journalists again, rather than talking through what went wrong in an attempt to build a better relationship.

Media sector participants suggested that academics and researchers should suggest catchy phrases to help grab attention and answer questions quickly to meet deadlines, which can also help resolve misunderstandings and inaccurate information.

Good data alone is not enough, they said — apart from being easy to understand, information needs to be engaging to attract interest and motivate action. Findings that have local relevance can be particularly valuable.

Another concern is the representation and reach of science journalism. Most journalists live in capital cities, and so tend to report more on urban issues. A lack of transport links to rural areas and a multitude of local languages restricts wider coverage.

And how should journalists approach science advocacy and the reporting of scientific uncertainty? Our media representatives said it is particularly hard to strike a balance between science communication and science advocacy for subjects such as genetically modified foods. But the media has a key role in demystifying scientific debate for the public. Participants also used climate change as an example, suggesting that some organisations were still trying to take advantage of scientific uncertainty to mislead people and stop action, when in fact there is global scientific consensus that humans are the major contributor to climate change.[24] Accurately reporting scientific uncertainty would help the public understand that there is not major disagreement and unreliable data.

Other concerns with science journalism concerns how the gender of the writer can affect the reporting of findings. In Kenya, we heard how an article on a Kenyan soil study focused on speeches made by delegates at a conference and on the prices of commodities, but omitted major findings. A male participant in Kenya mentioned that women journalists tend to focus more on emotional angles or stories instead of facts, which was not contested by any female participants present. Yet this is not necessarily a drawback if these types of stories are more effective at engaging the public, and if women and networks can be reached. After all, it is about building audiences and increasing uptake — whether it is via science communication, science advocacy or via a 'rock star' science champion on social media — as our participants pointed out.

[23] See Romo J. (2012). *SciDev.Net Global Review*. SciDev.Net. Available here: http://www.scidev.net/global/evaluation/learning-series/scidev-net-global-review-2012.html
[24] http://www.ipcc.ch/report/ar5/wg2

Effective formats for finding S&T information

Participants reported that traditional media, including newspapers, newsletters and TV, are generally used by policy stakeholders, academics and researchers to find S&T information. The internet is also used by policymakers although not extensively, and participants said that policymakers have little engagement with social media, unlike media and non-governmental organisation (NGO) participants.

It is not clear whether academics and researchers in Ethiopia and Kenya use the internet as heavily as counterparts in South Africa, as the responses for the latter were very thorough on internet sources and include blogs, Scoop.it, Google, social media (Facebook, Twitter) PubMed, institutional webpages, YouTube TED (technology, entertainment, design) experts. Other sources include scientific journals, conferences and networking events. Traditional media outlets also figure, such as magazines and newsletters, radio and some newspapers. In Ethiopia participants use SMS text messages to receive S&T information.

Research publications are also used to find S&T information by both policymakers and researchers. Policymakers felt that the use of jargon and difficulties in accessing this material are barriers to their use in policymaking. Other common sources for policymakers are government sources, policy briefs, international agencies, advisory groups/councils, conferences and meetings.

Media sector participants scan a larger 'horizon' than the other sectors and cover NGOs, the private sector and universities on top of traditional media outlets. They attend press conferences and read press releases and some scientific journals if they have access, and use the internet, particularly social media, frequently and also contact local citizens and networks for information.

Preferred channels for S&T dissemination

Social media is not a commonly-used channel to disseminate science or science policy information. Mass media, policy round tables and conferences are favoured by policymakers.

Publications in peer reviewed journals are the primary channel used by academics and researchers but social media is increasingly being used — YouTube, Facebook, Twitter and LinkedIn. Other specialist outlets noted by South African research participants include open access sources, institutional websites, ResearchGate and Google Scholar. Other popular activities for this sector include research visits, public lectures at academic institutes such as at national science weeks, open days (in South Africa) and professional conferences. Some research findings do appear on radio, TV and newspapers – in many cases a press conference was organised by institutions for major announcements – and there are specialist magazines as well.

Chapter 5: Key S&T themes for development by country and sector

Major S&T themes for development emerged from our discussions in Ethiopia, Kenya and South Africa: health, agriculture, environment, education, technology and innovation, energy and infrastructure. They are inter-related in one way or another. For example, education can be seen as crucial to increasing agricultural production, conservation and the use of S&T. Access and quality are common issues across all themes, with women and rural populations particularly affected.

Health

A cross-cutting concern is poor access to services, particularly by women and rural populations. A common area of interest in all countries is maternal and child health. Illnesses with high prevalence, and a priority in all countries, include HIV/AIDS and malaria.[25] Health-issues related to alcohol misuse by both men and women are worrisome (and mentioned in Kenya and South Africa), and are thought to increase violence, and foetal alcohol syndrome that affects children's development.

Common issues where the rural population is large, such as in Ethiopia and Kenya, concern preventable diseases, hygiene and nutrition. In Ethiopia, population control is also seen as a priority. Other health challenges are heart disease and diabetes, mentioned as increasing in Kenya. Media participants in Ethiopia indicated that coverage of health issues in the media tends to focus on technologies. In Kenya, media participants reported that some preventable and poverty related diseases get less attention than HIV, cancer and heart disease. A sensitive area is stem cell research, which is controversial among the public. In South Africa, participants expect that nanotechnology and stem cell research will create a new era of personalised medicine.

Table 4: Health-specific trends per sector/country

Country	Public sector	Academic and research	Media
Ethiopia	• Public health • Cancer research and treatment	• None mentioned	• Health technology
Kenya	• HIV/AIDs policy of no new infections • Child and maternal mortality • Adequate access	• Human health • Animal health	• HIV and homosexuality • Malaria, jiggers, cancer • Health extension programme • Drugs

[25] http://data.worldbank.org/indicator/SH.DYN.AIDS.ZS/countries/KE-ZF-XM?display=graph

Country	Public sector	Academic and research	Media
South Africa	• Neo- and antenatal health	• Basic healthcare and nutrition • HIV, tuberculosis, malaria • Stem cell • Non-communicable diseases such as diabetes and cancer • Mental health, drug misuse • Genomics and bioinformatics • Nanotechnology – diagnostic devices	• Vaccine development • HIV/AIDS • Science funding, particularly related to the Millennium Development Goals (MDGs) • Pseudo-science: covers issues such as detoxing, cosmetic procedures and how to prevent certain diseases

Agriculture

Food security and the impact of climate change are common issues. New agricultural technologies and genetically modified organisms were highlighted by media and research participants.

Research linked to climate change includes crops that can adapt to a changing environment. In Ethiopia, participants said there is a need to use technology to modernise the agricultural sector to increase productivity and food security. An example mentioned from China is irrigation technologies used in rooftop farming.

In Kenya, agriculture is seen as the backbone of the economy.

Table 5: Agriculture-specific trends per sector/country

Country	Public sector	Academic and research	Media
Ethiopia	• Food security	• Crops • Livestock • Soil • Water • Climate-smart agriculture	• New technology • Biotechnology
Kenya	• Food sustainability	• Food security • Biofortification of food	• Food security • Climate change, in particular global warming and climate variability • Genetically modified organisms (GMOs)
South Africa	• Food security • Water scarcity	• Food security • Urban agriculture	• New technology • GM foods • New seed varieties • Links with the economy • New ventures • Fisheries and quails • Climate change • Pollution

Environment

Climate change is a recurring theme when discussing the environment; sustainable approaches, mitigation and adaptation strategies were mentioned. Participants highlighted the need to focus on grassroots innovation as a way of tackling climate change. In Ethiopia, climate change is linked to soil degradation, increased floods and droughts. Other environment topics are pollution, water and resources management.

There is a desire to use advanced technologies to improve natural resource management and facilitate development, and also to reduce the heavy dependency on natural resources.

In Ethiopia participants believe that the success of the Ethiopia's Growth and Transformation Plan[26] depends on the proper management of the country's natural resources.

Table 6: Environment-specific trends per sector/country

Country	Public sector	Academic and research	Media
Ethiopia	• Climate-Resilient Green Economy (CRGE) initiative[27] to achieve a middle-income status by 2025 via a green economy	• Conservation • Resource management • Climate change: mitigation, adaptation, climate variability • Water and sanitation	• Agriculture and health issues related to climate change • Pollution • Issues related to resource management such as energy production and their environmental impacts
Kenya	• Sustainable environmental management • Climate change	• Water and sanitation	
South Africa	• Greening the economy • Sustainable use of resources	• Environmental science • Geological resources • Water resources and sanitation • Climate change adaptation and mitigation[28] • Biodiversity	

[26] http://www.mofed.gov.et/English/Resources/Documents/GTP%20English2.pdf
[27] Ethiopia's Climate-Resilient Green Economy (2011). Available here: http://www.undp.org/content/dam/ethiopia/docs/Ethiopia%20CRGE.pdf
[28] Examples include: http://www.csir.co.za/enews/2009_climate/06.html

Education

All countries are concerned with educational quality and access, particularly by rural populations. The main interests at a national level are how to foster high-quality education to increase a country's economic standing and the potential of ICT to support education. Increasing science literacy across the population to promote public understanding and attract more young people to science is also a key challenge and priority.

As discussed in Chapter 5 (capacity building needs per sector), science journalism programmes for journalists are much needed, as is training for researchers to communicate effectively with non-specialist audiences. Enabling policymakers to make use of evidence is a priority that could also be tackled by training.

Table 7: Education-specific trends per sector/country

Country	Public sector	Academic and research	Media
Ethiopia	• Establishment of a science academy • Linking industry with higher education institutions	• None of the groups in any country cited education as a current research topic	• None mentioned
Kenya	• Konza Techno City in Vision 2030[29] (knowledge-base economy, transforming the country into a middle-income state by 2030) • ICT as a key component of education system (e.g. laptops for secondary schools)		• None mentioned
South Africa	• Increase higher education graduates[30]		• Progress on science education target

[29] http://www.vision2030.go.ke/cms/vds/Konza_Techno_City_-_Frequently_Asked_Questions.pdf
[30] http://www.dst.gov.za/index.php/media-room/latest-news/1012-budget-vote-201415

Technology and innovation

Participants prioritised low-cost solutions or products that are adapted to context, while ensuring skills exist or are developed to manage and use these new technologies and innovations effectively.

In all countries we heard about advances in ICT. Its use in education is seen as a way of increasing educational impact. ICT can also facilitate community empowerment and development to help tackle gender issues and increase reach. Other areas for technology for development include agriculture, health and banking.

A current area of work for decision-makers is developing policies that enable innovation and technology management. Apart from work on ICT, researchers in Kenya and South Africa are also working on nanotechnology and biotechnology. In biotechnology, an important subtopic is genetically modified crops (see Agriculture section above).

Table 8: Technology-specific trends per sector/country

Country	Public sector	Academic and research	Media
Ethiopia	• Formation of science and technology council • National ICT policy • Technology park and incubation centre	• IT for core banking, education, communications and network building	• Mobile applications and features
Kenya	• Innovation and technology management • Entrepreneurship and innovation capacity, ICT hubs, technology assessment	• ICT • Nanotechnology • Biotechnology • Green technologies	• ICT and innovation
South Africa	• Consolidation of the Department of Science and Technology (DST)	• ICT: mobile technology, education, telemedicine, apps for development and entrepreneurial activities • Big data • Nanotechnology • Biotechnology, bio-mathematics and biomechanics	

Energy

The focus is on renewable sources and access by rural populations and women.

Table 9: Energy-specific trends per sector/country

Country	Public sector	Academia and research	Media
Ethiopia	• None mentioned	• Wind • Solar • Biogas • Hydropower • Geothermal	• Technologies for wind, hydropower, geothermal
Kenya	• Renewable energy • Rural electrification	• None mentioned	• Renewable energy: wind farms, hydroelectric, solar, energy saving stoves
South Africa	• None mentioned	• Bioenergy • renewable	• Electricity • Power generation

Infrastructure

The focus in infrastructure is on transport facilities to increase access and to provide health, education and market opportunities, particularly for rural populations. Transport infrastructure also impacts on research; for example in Ethiopia, transport and roads are important for collecting data for meteorological research. Infrastructure for research is also needed, such as laboratory facilities.

Table 10: Infrastructure-specific trends per sector/country

Country	Public sector	Academic and research	Media
Ethiopia	• Dam in north-west corner of country[31]	• None mentioned	• None mentioned
Kenya	• Transport: roads and railways		• Transport
South Africa	• None mentioned	• Engineering	• Infrastructure equipment

[31] http://www.undp.org/content/dam/ethiopia/docs/Ethiopia%20CRGE.pdf

Other themes and areas of work

NGO participants said their key areas of focus concern security, gender and community development.

In Kenya, policy stakeholders said a key area of work is on public-private partnerships with the goal of using private investment to support public service delivery.

Researchers in South Africa seem to be the busiest, with a multitude of research areas highlighted during our events, most of which we have included in the above sections, but others are:

- Human sciences for community development via the Human Science Research Council[32]
- Areas of research where the country enjoys a geographic advantage, i.e. Antarctic research, astronomy and palaeontology
- Peace and security — criminal forensics, shipping.

The media in South Africa follows developments in astronomy, physics, engineering and computer science.

[32] http://www.hsrc.ac.za/en

Chapter 6: Capacity building needs per sector

This chapter summarises capacity building needs for policymakers, academics and researchers, and journalists.

Policy stakeholders

In Ethiopia, representatives from the Ministry of Science and Technology and the Environmental Protection Authority discussed the need to develop database skills and data-sharing policies and agreements for government agencies and other organisations such as non-governmental organisations (NGOs). They say there is a need for training on communication techniques to disseminate S&T to the wider public. Other participants suggested that Ethiopia's public sector needs to build capacity to conduct multistakeholder consultations and partnerships, not least to share experiences and lessons learned.

In Kenya, policymakers stressed the need for more workshops, seminars and conferences for knowledge sharing and training on the use of policy briefs. They reported a need for know-how on putting forward more evidence for policymaking, and, suggested strategies that would advance the use of evidence:

- Working with policymakers to change their attitudes towards using more scientific information for decision making
- Narrowing the gap between policy, science and communication functions to improve interaction between the three groups:
    - Policymakers could create spaces for scientists within their own organisations
    - Intervening in the scientific community to build capacity to influence and participate in the policy process
    - Strengthening research institutions so that they are seen as having independence and integrity
- Ensuring policymakers have the capacity to analyse the relevance and quality of evidence for decision-making.

In South Africa, participants said that scientific knowledge within the parliamentary portfolio committees needs to be expanded and linked back to communities, infrastructure and service delivery. Further, a science advisory panel needs to be established for the country. All this might require considerable capacity building.

South Africans also believe there is a need to build social science skills within the science sector, to increase science literacy and to train scientists to communicate science to the wider public. Some research sector participants disagreed with the public remit, insisting that academics and researchers should be left to focus on their scientific competence instead of trying to influence policy. This group suggested the focus should instead be on building capacity within policy institutions for uptake. Participants suggested that perhaps the most effective solution involves a combination of both, such as a current initiative by the South Africa Young Scientist Academy, which is organising exchanges between researchers and policymakers with a 'Breakfast with a scientist' project.[33]

[33] More information: http://www.sayas.org.za/index.php?id=306

Academics and researchers

In Ethiopia, participants felt that the academic and research sector needs support for professional development, better science-related management skills, institutional capacity building and curriculum improvement. Infrastructure also need improvement, including IT facilities, laboratories, instruments, software and supplies for conducting experiments.

In Kenya, research management skills were stressed, and also infrastructure, not least because better facilities attract local and international funding. Science communication skills and the ability to identify and capitalise on policy opportunities were identified as a capacity need. The capacity to identify strategic partnerships and champions is also important, particularly links between the research community, policymakers and private sector.

In South Africa, skills for grant applications were raised, along with more institutional capacity for disseminating information to the wider public. Science communication skills in the academic and research sector are lacking, as well as key skills at postgraduate level. Capability in maths was mentioned and needs to improve among all in the research sector. Participants also believe more science leaders should be developed.

For more see the section in Chapter 7, 'Recommendations for research'.

Media

Participants said there is a need for more training, fellowships and practice on science journalism, and management needs to carry more editorial on S&T news and analysis.

In Kenya, suggestions include having high-quality science training and mentoring by experts with a track record of excellence in science reporting, and specialised training in subject areas such as environment and health reporting. Participants stressed the challenge of contacting sources from remote areas and the need to involve the management of media organisations in capacity building for science communication, particularly for training, benchmarking and communicating science in local languages.

Science communication needs to be on media curriculums at colleges.

Chapter 7: Recommendations

Strategic dimensions for S&T

Studying the responses given to questions about S&T for development, three clear strategic dimensions emerge:

1. A desire to use S&T to attend to basic needs and ease the burden of daily-life activities: better health, food security and access to technology, energy, information, good education and infrastructure. Access and quality are common issues across all themes, with women and rural populations particularly affected.

2. S&T to provide an advantage: facilitating the creation of value-added products and services that could provide a competitive advantage and increase opportunities for economic and social growth.

3. S&T for long-term interests: reducing inequality and reliance on natural resources, tackling climate change issues. Sustainability is key — sustainability of research outputs, policies and approaches to development.

Key activities also emerged as pillars for these strategic dimensions:

- *Strengthening the current weak link between research, policy and media:*
    - Governments to provide the lead and set an enabling political environment
    - A focus on adaptation and on local relevance rather than importing solutions
    - A focus on knowledge management to increase the use of S&T.
- *Innovative approaches to research, science communication and policymaking:*
    - This includes innovative partnership building to tackle complex issues
    - It also needs multidisciplinary research to increase the effectiveness of solutions.
- *Increase the reach and capability of key actors to enable change and impact:*
    - To build science communication capacity for journalists, academics and researchers
    - To build capacity of policymakers to use evidence and create an enabling environment for S&T to have an impact on development
    - A focus on gender relations and the role of women and young people, ensuring rural populations and other marginalised groups are included.

Recommendations for research

Research should try to address development issues, generating low-cost S&T solutions that are adapted to local context, adding value and economic opportunities, while taking into account climate change (adaptation and mitigation) and the needs of marginalised and vulnerable groups. But publishing in international peer-review journals does not contribute greatly to the local body of knowledge and practice — these journals tend to favour global issues with limited local impact and in any case are less accessible to the local S&T community. Organisations such as PEI[34] have suggested that there is a need to establish local science journals to attract more relevant research.

Reform in human resources management at academic and research institutions might be more effective. Career progression could be linked to indicators that relate more to local impact, gearing researchers towards development issues and encouraging them to also consider science communication and innovative partnerships for increased uptake.

What follows are further recommendations for research at two key stages, in line with the idea of a greater focus on use and impact of S&T for policy and development, with particular attention to context, multidisciplinary research, multistakeholder partnerships and application and commercialisation.

Planning stage

One of the main criticisms our participants made of research is the lack of local relevance. To that end, the recommendation is that from the outset researchers should have development impacts as goals. It is possible that such development issues require multidisciplinary research and direct engagement with those ultimately affected. This would ensure that stakeholders' views and needs are taken into consideration, particularly those related to gender and indigenous knowledge. Such efforts will be particularly useful at later research stages for science communication, as research findings will already be conceptualised in a development framework, with impacts identified for particular stakeholders. This will increase local relevance and uptake.

Researchers should also plan for implementation and possibly commercialisation, which might take the form of talks with partners in the private sector from the start, or with non-governmental organisations (NGOs) interested in rolling out local technology. If working directly with indigenous groups, engagement from the outset will also go a long way towards identifying key enabling factors for application. Participants acknowledged that entrepreneurial skills are not always present in academic and research circles and might represent a reputational risk for some institutions.

Some felt this is too far away from the traditional remit of researchers. One participant in Kenya suggested that innovation is the antithesis of research, simply because research creates new knowledge and eventually wealth, whereas innovation uses knowledge directly to produce wealth. Another in Kenya added that attempting to innovate at local levels might offer more opportunity for success, given that there could be untapped skills and knowledge on the ground. Competing with multinational companies in high-tech markets is much harder.

A topic that generated much debate was blue-sky science, such as astronomy. Some could not see the link between such research and development issues. But one participant working in South Africa in astronomy had secured funding to create a new tourist industry for space research, which has also helped raise interest in S&T topics.[35] Currently, astronomy projects are on the agenda in high-level political visits and feature in profiles of South Africa. The challenge to all researchers is to identify links with development needs, and funders should encourage this through their policies.

[34] http://planetearthinstitute.org.uk/what-are-the-barriers-to-scientific-independence-in-africa
[35] http://www.scidev.net/global/technology/feature/astronomy-africa-telescope-education.html

Conducting research

Some participants said that research and innovation are not just created in formal sectors such as universities and private companies. There are other research groups such as associations (e.g. innovation organisations in Ethiopia)[36] and indigenous groups whose knowledge and innovations are not generally part of formal knowledge. An exception is where indigenous knowledge has been applied to medicine by documenting how certain trees and plants are used by local people to cure illnesses — many have since been commercialised.

Indigenous knowledge can also help solve problems in innovative ways or encourage a change of behaviour. For example, in Kenya participants suggested that indigenous discourses on conservation (using deities to justify the balanced use of resources and overall respect for nature) may provide a useful mechanism for messaging on environmental issues. Indigenous people have also been credited with contributing to action on food security issues (i.e. developing crops that are more resilient) and in making accurate climatic predictions. Participants suggested that researchers should engage with these groups in ways that do not only extract knowledge but also ensure credit and benefits are distributed accordingly.

Multidisciplinary research is needed to approach complex development issues, although this can be challenging. It is common in healthcare, where social science has provided answers that natural science could not (e.g. natural sciences provide solutions to diseases yet social sciences help change habits).

Young people, rural populations and gender relations

Young people

Future generations are key to ensuring S&T makes a positive contribution to development. In this report we have touched on issues that affect young people directly, mainly the quality of education, the professional avenues and lives they can lead based on their choice of studies, and the lack of a vibrant labour market that encourages the development of S&T professionals. The private sector can be an important player here, particularly for training and jobs, although NGOs can also offer employment opportunities and should not be forgotten in strategies to employ the next generation of graduates.

Entrepreneurial skills are among those needed for young people, so they can contribute to building the economy by producing locally needed solutions.

Rural populations

There are many issues concerning the rural/urban divide but most of them relate to a lack of access.

Lack of transport separates rural populations and their marginalisation is deepened by an absence from media reporting (see section: Science Journalists as brokers) and general policymaking.

There are many NGOs that engage with rural groups, and also many gender-related projects, yet most science researchers and organisations do not tend to engage with NGOs, despite the fact that they can help identify needs and issues and help with uptake.

[36] http://www.iceaddis.com

Gender relations

Participants identified S&T as being instrumental in improving the status of women and lessening their reproductive and work burdens, and there needs to be more focus on gender-related health, education, energy and agriculture issues. Examples are improved processing and harvesting of food to increase economic opportunities and food security, and solar cooking stoves and electricity to lessen the burden of fetching wood and other resources to meet energy needs.

But women are not just passive recipients of S&T — their involvement in knowledge creation is important. According to participants, an increasing number of small companies and philanthropic organisations are run by women. Information and communications technology (ICT) has been particularly instrumental in addressing women's rights, to the point where it cannot be seen as gender-neutral anymore. Research by the UN/African Union has shown that ICT has mainly benefited women, particularly with increased access to information, training and market opportunities.[37]

Despite more women in education and work, challenges remain. There have been political reforms but cultural and religious practices remain a barrier to change in many settings. Participants explained that many parents still choose boys rather than girls to go into higher education, and land-tenure policies tend to favour men. Educational approaches to S&T are thought to be more successful at attracting boys, particularly for physics and more specialised science subjects.

Common political reforms include quotas for political representation. In Ethiopia, this has resulted in a parliament where 28% are women.[38] Participants said women should play a more active role in promoting such representation. In Kenya, journalists criticised women scientists approached for quotes who declined and deferred the request to a male counterpart. A similar criticism was made about women who are selected to be part of political circles but do not have the confidence or skills to speak in front of male peers or to the public. Participants called on women journalists to help advance women's issues, for example by covering issues that affect women in rural areas, and trying to ensure that news reaches them too.

Gender-bias can be seen in the often male-dominated S&T environments, which discourage women from joining and can even push them out. There is a recognition that there are now more women in academic and research positions, but not yet in management roles. Participants said that those women who are in management tend to be paid less than men. Some participants suggested that there is a need to change the perception that women are not suitable for these posts.

But participants from South Africa said that women scientists are believed to have failed if they pursue science communication or education roles. Gender disparities in the workplace might also be linked to the human resources systems that are in place, where promotion is based on publishing and does not take into account women's daily lives, often as mothers. This is seen by some participants as institutional bias. Participants say that governments should continue to pursue reform to institutionalise equality.

Motherhood seems to be the most important factor contributing to gender disparities in the workplace. Some women in our focus groups suggested that they felt equal until they became mothers — although there was also agreement that all women feel they have to work harder than male counterparts. There are some challenges for men and parenthood. Despite best intentions, one of our male participants felt that children need and want their mother more, which has implications for policies such as paternity leave. Another example from South African participants is if a woman takes her children to work it is seen as if she is not being able to cope — but when a man does so, it is admired. There are cases where

[37] http://www.itu.int/wsis/implementation/2014/forum/inc/doc/outcome/362828V2E.pdf
[38] World Bank Databank.

incentives have been successful in increasing women's engagement in professional areas: participants mentioned that some biology conferences have offered financial support to allow women to afford a babysitter or travel with their children.

Male participants in the Kenyan focus groups criticised the way in which gender issues are often reduced to a focus on women and girls. They explained that men and boys also face challenges, such as alcohol abuse in young men. Participants called for a gender approach to S&T that is dynamic and relational, rather than a focus on women alone, supported by monitoring and evaluation approaches. A danger of a gender intervention for women is that they can be isolated in single-sex exercises and talks, which according to some of our female participants, ends up reinforcing the silos. Informal conversations can be more helpful. Positive women role models who girls can talk to and share experiences with are also good.

Finally, as part of our gender discussion we asked briefly about homosexuality. In South Africa, participants believe it is generally tolerated, but in countries such as Kenya the subject is taboo and still heavily associated with HIV, according to our participants.

Final remarks

If S&T is to have a positive impact on equitable and sustainable development, policies and research should be aligned to the three strategic dimensions discussed at the beginning of this chapter (to attend to basic needs, provide an advantage and for long-term interests), with a focus on young people, rural populations and balanced gender relations.

In general, governments tend to focus on setting an enabling environment, whereas journalists tend to report on issues affecting the wider public (mainly urban issues), while researchers are more concerned with career advancement. But they are all working on the same subject areas, suggesting that strategies aimed at joining up silos and generating multidisciplinary and multisectorial partnerships might be more effective when aiming to increase use of S&T for development.

High-quality science communication and knowledge management are also key to increasing availability and use of evidence, so capacity for these activities should be increased.

Annex 1: Participants

Ethiopia

Name	Gender	Job title	Organisation
Abebe Woldegiworgis	M	Editor	Addis Lisan newspaper
Yitbarek Tibebe Weldesemaet	M	Secretary	Environmental Society of Ethiopia
Lakemariam Yohannes Worku	M	Meteorologist, water resource engineer	National Meteorological Agency
Dereba Muleta	M	Meteorologist	National Meteorological Agency
Mesfin Kebede Desta	M	Researcher	Ethiopian Institute of Agricultural Research
Goitom Kelem	M	Climate researcher	National Meteorological Agency
Yonas Abiye	M	Editor	The Reporter
Yodit Admasu	F	Senior producer	Ethiopian Radio and Television Agency
Dagne Biazen	M	Chief editor	Ethiopian Herald (Ethiopian press agency)
Binyam Tamene	M	Member	Ethiopian Environmental Journalists Association (EEJA)
Thomas Cherenet Asfaw	M	Director, tsetse and trypanosomiasis control and eradication programme	Ministry of Science and Technology

Ethiopia (cont.)

Name	Gender	Job title	Organisation
Bethelhem Getachew	F	Project officer	Forum for Environment
Negash Teklu	M	Executive director	Population, health and environment (PHE) Ethiopia Consortium
Shirega Minuye	M	Consultant	Research and consultancy business
Afework Temtime	M	Programme officer, new technology and innovation section	United Nations Economic Commission of Africa (UNECA)
Dagim Terefe	M	Student of journalism and communication	Addis Ababa University
Masami Nakata	F	Programme specialist for natural science	UNESCO
Berhanu Ayalew	M	Director, public relations and communications directorate	Environmental Protection Authority
Bemnet Yisrak	F	Programme assistant	UNESCO

Kenya

Name	Gender	Job title	Organisation
George Achia	M	Science journalist	Science Africa
Wangari Ndirangu	F	Journalist	Kenya News Agency
Sarah Ooko	F	Science journalist	Africa Science News Service (ASNS) and SciDev.Net
George Ogodo	M	Assistant director, quality assurance and standards	Ministry of Education, Science and Technology
Verenardo Meeme	M	Media trainer	King's College
Gatonye Gathure	M	Senior science editor	The Standard
Robert Karanja	M	1) Senior research officer 2) Director KEMRI & ACADEMIC DIRECTOR – BIOENTREPRENEURSHIP, SBS	1) Kenya Medical Research Institute (KEMRI) 2) Bio-Entrepreneurship Program, Strathmore Business School (SBS)
Berhanu Abegaz	M	Executive director	Africa Academy of Sciences
Cavin Otieno Opiyo	M	Research office administrator	Strathmore University
Paul Baki	M	Director, school of physical sciences and technology	Technical University of Kenya
Edward Ahonobadha	M	Communications manager	Kenya AIDS NGOs Consortium (KANCO)
Duncan Mboya	M	Science journalist	African Woman and Child
Hannington Odame	M	Regional coordinator	East African hub, Future Agricultures Consortium (FAC)

Kenya (cont.)

Name	Gender	Job title	Organisation
Karimi Karemu	F	PhD student	Jomo Kenyatta University of Agriculture and Technology
Martin Obanda	M	Director, research and production	Jomo Kenyatta University of Agriculture and Technology
Isaiah Kase Okuthe	M	Principal renewable energy officer	Ministry of Energy and Petroleum

South Africa

Name	Gender	Job title	Organisation
Elizabeth van der Merwe	F	Chair and senior lecturer	South African Women in Science and Engineering / University of Cape Town
Wiida Fourie Basson	F	Media officer and science writer	University of Stellenbosch
Alison September	F	Senior research officer	University of Cape Town / Medical Research Council
Novosti Buta	M	Maths and science education specialist	Primary Science Programme
Tom Harber	M	Project officer	Development Research Uptake in Sub-Saharan Africa (DRUSSA)
Amanda Weltman	F	Researcher	South African Young Academy of Scientists; University of Cape Town
Liezel Gouws	F	Project manager	Biosafety SA
Lizel Shepherd	F	Programme coordinator	Inyathelo: The South African Institute for Advancement

South Africa (cont.)

Name	Gender	Job title	Organisation
Duncan Alfreds	M	Science editor	Media24
Kevin Govender	M	Director	International Astronomical Union Office of Astronomy for Development
Linda Nordling	F	Editor and columnist	Research Africa / SciDev.Net
Adrian Di Lollo	M	Senior practitioner: parliamentary relations	Council for Scientific and Industrial Research
Karrine Sanders	F	Project manager	Development Research Uptake in Sub-Saharan Africa (DRUSSA)
Cinzia Swart	F	Editor	Science Stars
Carla Sharpe	F	Business development manager	Square Kilometre Array (SKA) South Africa

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The publications in the SciDev.Net Learning Series derive insights from research projects and analysis regarding science communication. The series is part of SciDev.Net's monitoring and evaluation programme and provides valuable knowledge and lessons regarding the mainstreaming of evidence for policymaking, development programmes and when building a culture of science.

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