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Promoting critical knowledge, skills and qualifications for sustainable development in Africa: How to design and implement an effective response through education and training systems

Sub-theme 3

Lifelong acquisition of scientific and technological knowledge and skills for Africa's sustainable development in a globalized world

Impact of Recent Reforms in Science and Technology in Kenya: the case of Public Research Funding

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LIST OF ACRONYMS

AAS	Atomic Absorption Spectrometer
ASTII	African Science Technology and Innovation Indicators
CHE	Commission for Higher Education
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
FY	Financial Year
HEST	Higher Education, Science and Technology
ICT	Information and Communication Technology
JSPS	Japan Society for the Promotion of Science
KIPI	Kenya Intellectual Property Institute
KNBS	Kenya National Bureau of Statistics
MOEST	Ministry of Education Science and Technology
MoHEST	Ministry of Higher Education Science and Technology
NCST	National Council of Science and Technology
NEPAD	New Partnership for Africa Development
OECD	Organization for Economic Co-operation and Development
PhD	Doctor of Philosophy
PIUB	Public Universities Inspection Board
PPP	Purchasing Power Parity
PRF	Public Research Funding
R&D	Research and Development
SSA	Sub-Saharan Africa
ST&I	Science, Technology and Innovation
UNDESA	United Nations Department of Economic and Social Affairs

1 ABSTRACT

1. Public funding for R&D can both engender and stimulate the training needed to support the lifelong learning crucial for this social transformation. In this study, we start with a general evaluation of the reforms that have taken place in the ST&I sector in Kenya since 2003. We then focus on reforms and impacts of Public Research Funding (PRF) on R&D, looking at the impact of the recent reforms in PRF through the following three questions: (i) what is the status quo of the research funding landscape in Kenya; (ii) what is the impact of projects funded by public research funds; and, (iii) does public funding increase the total spending on research or merely displaces funding from other sources? First, an analysis of a 2009 study done under the auspices of the African Science Technology and Innovation Indicators (ASTII) in Kenya revealed three key findings: females are underrepresented in the ST&I sector in Kenya; Government agencies spend the highest share of their funds on research through funding other institutions; and most institutions do not allocate their own funds for research. Second, looking at Kenya Government's funding on research (Public Research Funding-PRF), 75% of the projects funded under the current PRF scheme performed well or fairly, indicating that the immediate outputs (e.g., published collaborative papers and patents registered) are often realized. In contrast, most of the projects that missed out on PRF were never undertaken (85%) while 9% obtained alternative funding and 6% were downscaled to student thesis projects. In sum, these data highlight the crucial role of Government funding in promoting critical local research that would otherwise stand little chance of being executed. Overall, we provide a snapshot of the status and shape of the research arena in Kenya, and hope that this will help in guiding the government on how it could spend its research money.

2 EXECUTIVE SUMMARY

The ST&I space in Kenya

2. Science, Technology and Innovation (ST&I) which are based upon Research and Development (R&D) are known to play a critical role in a country's economic and social development. ST&I drives the social transformation needed as Kenya makes the transition to a globally competitive, knowledge-based economy as outlined in her development blueprint Vision 2030. Public funding for R&D can both engender and stimulate the training needed to sustain the lifelong learning crucial for supporting this social transformation. In Kenya, the importance of STI sector to lifelong learning and social transformation is reflected in the establishment of strong policy and infrastructural support. Indeed, the Policy Framework on Education Training and Research, Policy Paper No.1, 2005 identified technology as a critical form of wealth to our nation.

3. The HEST (Higher Education, Science and Technology) sector in Kenya faces several challenges including insufficient capacity of universities to offer doctorate programs in key areas of science, engineering and medical sciences, little or poor coordination and harmonization between research institutions and industry leading to a mismatch between curriculum and industry needs and limited funding for research (resulting in insufficient or obsolete research equipment, little motivation for researchers etc). Since 2003, several initiatives have been implemented across the Kenyan HEST sector to address some of these challenges, such as increasing the linkages between research and industry, enhancing awareness on IPR in research institutions, drafting of ST&I Bills and increasing government allocation for research purposes.

4. In 2009, under the auspices of the African Science Technology and Innovation Indicators (ASTII) initiative, Kenya completed the first survey of ST&I Indicators since independence. The survey targeted a total of 872 institutions in five key sectors–Higher Education, Government, Business Enterprise, Private Non-Profit and Abroad–of which 487 responded by filling the survey questionnaires. Though it was thus an incomplete sample, those who responded can be considered a random sample of their respective sectors, and hence can be considered representative of the sector. Here, we assess the impact of the recent reforms in the ST&I sector by asking: what is the status quo of the research funding landscape in Kenya (who pays, who undertakes, how is it distributed)? The main findings are summarized into the following four key areas:

R&D Personnel by gender and qualification

5. The ASTII study found that, besides fewer women trained at MSc. and PhD levels, for all five sectors (Higher Education, Government, Business, Private non-Profit and Abroad) combined, only 18% of researchers, 27% of technicians and 23% of managerial staff was female, while the reverse was the case for administrative jobs where nearly 70% were male. Why have fewer females in all research-related occupations except administration? Women are often thought to be at a disadvantage during their doctoral training and early stages of their academic careers, due to a lack of social and professional connections available to most women in academic science and engineering departments. Yet, a recent study revealed that overt discrimination against women might be a thing of the past, stressing that choices, not discrimination, determine success for women scientists. As such, Kenya may learn from this and conduct further research into the choices that women make, why and how they make them. On the one hand, as long as women make the choice and are satisfied with the outcomes, then there is no policy problem. On the other hand, to the extent that these choices are constrained by biology and/or society, and women are dissatisfied with the outcomes, or women's talent is not actualized, then there is a policy issue.

GERD by sector

6. Here, results indicated that the average institution within the Government sector spent nearly Kshs 200m on research compared to only Kshs 7M for Higher Education institutions. When total expenditure across the five sectors was summed, it was estimated that a total of KSh13.65 billion was spent on research in 2007/8 Financial Year (FY). The GDP estimate for Kenya during the same period was Kshs 4679.25 billion, indicating that approximately 0.29% of GDP was spent on research in 2007/8 FY. Though possibly a slight underestimate because the survey was not comprehensive except for the Higher Education sector, it is nonetheless near the calculated average of 0.3% for sub-Saharan Africa. Curiously, the average Government institution spent considerably more money on research than the rest through funding research rather than actually undertaking it. A key policy question here then is: what are the likely causes and implications for the 0.3% research expenditure. Failure of Governments to meet their research funding obligations may have two key implications: first, not filing gaps for critical (national) research that no one else is funding, and second, missing out on the fact that public funding is known to stimulate private funding in R&D. It is clear however that the current public funding falls short of the recommended 1% which is deemed the minimum necessary to sustain critical research.

GERD by source of funding

7. About 38% of the Higher Education sector's GERD came from the Government; this sector also funded all its other research expenditure. While each sector funded at least 50% of their research activities themselves, the Government was the only sector that provided research funding to all other sectors, while the private non-profits, though they got some research money from foreign sources as well as the Government, did not fund research in any other sector except their own. It was clear that the Higher Education sector received little research funding apart from Government sources, which represents a missed opportunity because the Higher Education sectors can and should tap into other sources of research money, particularly the business sector, especially in developing innovations. Indeed, it seems as though private non-profits institutions seldom fund research in other sectors apart from their own, which tallies with the call above for Higher Education and other sectors to tap into these sector.

GERD by type of research

8. Lastly, we found that, of the 487 institutions surveyed, only 52%, 29% and 27% allocated some money for basic, applied and experimental development, respectively. Many institutions did not allocate any resources to any of these categories of research, with fewer than 15% of all institutions spending more than 50% of their resources on research. This is telling given R&D is considered paramount for developing new knowledge, new technology, and new products. It is worth interrogating why these institutions are not spending money on research and what can be done to stimulate this. As indicated under GERD by sector section above, Government funding may be one of the solutions to this, where an injection of research funds from the government might stimulate R&D funding across the board.

Public funding space in Kenya

9. Public funding for R&D can both engender and stimulate the training needed to support the lifelong learning crucial for this social transformation. Yet, despite the prevalence of public research funded programs, there is little consensus about their effectiveness. In Kenya, the Government mainly funds research through the Science, Technology and Innovation Fund that was established in 2006 and administered by the National Council of Science and Technology (NCST). Under the fund, NCST has established various grants available to Kenyan researchers and innovators. Here, we evaluate the impacts of Public Research Funding (PRF) on R&D addressing the following two questions: (i) what is the impact of projects funded by public research funds (in terms of outputs and outcomes); and, (ii) does public funding increase the total spending on research or merely displaces funding from other sources?

10. Under the Research and Innovation Grant, 123 out of 694 (18%) projects have been funded through two general calls for proposals. In addition, a third call focusing only on Food security and Climate change attracted 239 proposals, of which 28 (12%) were funded. Out of these 151 projects, only 28 (18%) had female principal investigators. Thus, a Women Scientists Grant was set up to counter this trend. Its first call attracted 148 applications of which 14 were funded, whilst a second call attracted 127 proposals of which 32 are being funded. Lastly, in order to build human resource capacity, a postgraduate competitive grant funded a total 109 postgraduate research projects in the past two years.

11. In all, the ST&I Grant has disbursed funding worth about KSh450m (c.USD 6.4m) between 2009 and 2010 for various research purposes. Using participatory methods, NCST carried out an independent monitoring exercise on public research funding projects that were funded in the year 2008/09 and 2009/10 FY. Over the last two years projects funded under this grant have generated 14 utility patents in different fields (ICT, Agricultural, Engineering, Health and Physics) registered at the country level by Kenya Intellectual Property Institute. They have also seen the production of several scientific papers published in different journals and conference proceedings. Especially germane for this study, 85% of the projects had performed fair or better in terms of producing the stated research outputs, which is an indication that they are on the right track to achieving the longer term outcomes and desired impacts.

12. In contrast, most of the projects not funded under the PRF scheme representing more than 80% of all applications were either never implemented (85%). A number of projects were downscaled to postgraduate student projects (6%). It's only a few projects that were executed by obtaining alternative funding (9%). These findings clearly indicate that when projects, and by extension, institutions fail to receive public funding, few invest in undertaking the projects; they are also not successful in obtaining alternative research grants. In conclusion, whereas the key methodological challenge in assessing effectiveness of public research funding is the lack of counterfactual evidence (i.e., inability to forecast the project's outcomes if it was not funded), we can infer the key role of Government funding in promoting critical local research in Kenya from two fronts: first, because the immediate outputs and outcomes are realized (i.e., publications and patents), it is likely that longer term impacts are also realized. Secondly, because projects not selected under the PRF scheme get executed, most of these types of local (and often critical) research are heavily reliant on public funds.

3 ST&I LANDSCAPE AND REFORMS IN KENYA

3.1 ST&I and lifelong learning: some impacts of recent reforms in Kenya

13. Science, Technology and Innovation (ST&I) which are based upon Research and Development (R&D) are known to play a critical role in a country's economic and social development. Creation of new knowledge is considered a critical source of economic growth (Diamond 1999). Countries such as India, China, Malaysia and South Korea have been able to make great strides in eradication of poverty and become critical players in the global economy in the last 30 years due to heavy investments in higher education and the emphasis they accorded to ST&I (Republic of Kenya, 2006). Whether or not Kenya achieves the social transformation needed as Kenya makes the transition to a globally competitive, knowledge-based economy, as outlined in the development blueprint Vision 2030 will be dependent upon how much we advance the ST&I arena. Moreover, public funding for R&D can both engender and stimulate the training needed to sustain the lifelong learning crucial for supporting this social transformation. Lifelong learning ensures the continuous building of skills, knowledge and competence throughout life through both formal (training, higher education, etc.) or informal (experiences, situations, etc.) experiences. It not only enhances social inclusion, active citizenship and personal development, but also competitiveness and employability.

14. In Kenya, the importance of STI sector to lifelong learning and social transformation has been recognized for a very long time, leading to the establishment of strong policy and infrastructural support. The Policy Framework on Education Training and Research, Policy Paper No.1, 2005 (Republic of Kenya, 2005) identified technology as a critical form of wealth to our nation. The policy thus called for ST&I, R&D, and ICT (Information and Communication Technology) to be the key pillars of education and training. Vision 2030 identifies ST&I as the foundation on which the three pillars—political, social and economic—rest, calling for its mainstreaming in all aspects of development. It further recognizes ST&I's importance in a modern economy in which new knowledge plays a central role in boosting wealth creation, social welfare and international competitiveness (Republic of Kenya, 2007).

15. The HEST (Higher Education, Science and Technology) sector in Kenya faces several challenges including: Insufficient capacity of universities to offer doctorate programmes in many areas of science, engineering and medical sciences; Poor coordination and harmonization between research institutions and industry leading to a mismatch between curriculum and industry needs; Lack of a national science and research policy; Limited funding for research; Insufficient or obsolete research equipment; Little motivation for researchers; Lack of a vibrant national innovation system; Declining number of science and engineering graduates; Waning interest in science among youth; Limited public awareness on the benefits of ST&I; and Absence of IPR policies in most research institutions, amongst others (Republic of Kenya, 2005; 2006; 2008a; 2008b; MOHEST, 2008a, 2008b).

16. Since 2003, several initiatives have been implemented across the Kenyan HEST sector to address some of the challenges mentioned above, such as increasing the linkages between research and industry, enhancing awareness on IPR in research institutions, and drafting of ST&I Bills. In addition, the Sessional Paper No. 1 of 2005 titled A Policy Framework on Education Training and Research highlighted what needed to be done to advance the HEST sector in Kenya. Some of the key interventions since 2003 touching on the HEST sector include creation of various structures including the National Economic and Social Council and a specific Ministry dealing with Higher Education, ST&I matters, as well as review of various key policies and legislations (Table 3.1).

Table 3.1: Some key reforms post-2003 affecting the Higher Education, Science and Technology Sector in Kenya

REFORM	OUTCOME/IMPACT
The National Economic and Social Council (NESC), a think tank standing committee comprising of eminent persons with diverse experience, knowledge and skills was established in September, 2004 (UNDESA, 2011). NESC is chaired at the highest level in the Government by the President of the Country and in his absence by the Prime Minister. The council has the mandate of identifying and deliberating on policy issues and recommending changes in policy directions to the cabinet in view of prevailing and prospective economic circumstances and trends. The council also monitors and assesses whether current government programmes, activities, and policies are delivering targeted performance and results. Among its initiatives the council has a Science Technology and Innovation Initiative.	"The NESC performed to the expectation by generating the idea of formulating a national development strategy that would guide the transformation of the country from a low-income country in 2008 to a middle-income economy and industrialized in 2030 whose citizens would enjoy high standards of living. The idea was translated into action leading to the development of Vision 2030 that aims to make Kenya, 'a globally competitive and prosperous nation with a high quality of life' in the next 25 years. The policy is hinged on three key pillars namely: economic, social and political pillars with Science, Technology and Innovation (STI) forming the base of the foundation on which the three pillars rest. The Vision underscores the importance of Science, Technology and Innovation (STI) in fast tracking economic growth, poverty reduction, international competitiveness and the achievement of Millennium Development Goals (MDGs).
Sessional Paper No. 1 of 2005 The Sessional Paper No. 1 of 2005, "A Policy Framework on Education Training and Research" was developed and among others it outlined what needed to be done to address challenges facing the HEST sector in Kenya.	In particular, It proposed the restructuring and strengthening of National Council for Science and Technology (NCST) to enable it undertake its advisory and coordination role; creation of National Research and development Fund; allocation of more research funds to university research work and recognition of outstanding researchers (Republic of Kenya, 2005). A number of these have already been accomplished to a large extent.
Creation of Ministry responsible for STI The Ministry of Science and Technology was created in the 9th Parliament in 2005 separating from the wider ministry that included education. In the 10th Parliament (2008) the Directorate of Higher Education was moved to create the Ministry of Higher Education, Science and Technology	This has raised the profile of science, technology and technical training that were previously given little attention as more emphasis was placed in primary and secondary education. As a result funding in the sector has increased.
Endowment Fund for Science, Technology and Innovation The fund was established in 2006 and is managed by the National council for science and Technology (Republic of Kenya, 2006). The research and innovation fund has three components namely: Government ST&I Grant Fund; Kenyan Women Scientists ST&I Grant; and Science and Technology (S&T) infrastructures, a Research Facility Grant.	A total of Kshs. 450 Million has been disbursed to scientists and STI institutions. Annual allocation has increased from Kshs. 250 Million in 2010/2011 to Kshs. 401 Million in 2011/2012 budget estimates.
National Science, Technology and Innovation Policy	The policy will accelerate the harnessing of the potentials

A comprehensive and all-inclusive Science, Technology and Innovation Policy has been developed by the Ministry of Higher Education, Science and Technology through the National Council for Science and Technology with inputs from all stakeholders of the Sector (NCST, 2009).	of Science, Technology and Innovation in the creation of knowledge based economy.
Development of the National Strategy for University Education, 2008 The strategy addresses all areas affecting higher Education including science and technology. It proposed the establishment of Research and Innovation fund as well as establishment of new universities (MoHEST, 2008b).	The strategy is being implemented and many private universities and new public university constituent colleges have been established. One (1) more Public university and 23 constituent university colleges have been established since 2003.
Establishment of new private universities Some of the universities offer Science and technology courses but majority are humanities, business and social sciences oriented (CHE, 2011).	The number of Private universities have increased from 13 in 2003 (MOEST, 2004) to 26 in 2011 (CHE, 2011) while the percentage of students attending private universities increased from **9,541** in year 2003 to **35,179** in 2010
Establishment of more public universities Upgrading of National Polytechnics and other middle level colleges to degree awarding institutions (Republic of Kenya, 2010b)	At total of 24 new universities constituent colleges have been established with each offering science and technology oriented courses among others. This has increased the capacity to enroll more students
Research, Innovation and Technology Sector Working Group The working group was created in the budgetary system in the 2009/10 financial year (Republic of Kenya, 2010b)	This has brought the institutions that deal with STI issues under the same sector and thus better coordination and streamlining of funding.
New Constitution A new constitution was enacted and promulgated on 4th August, 2010. The constitution recognizes the importance of science and technology and has several articles addressing the issue.	Positive articles on the subject that include: Promotion of all forms of national and cultural expression including science; recognition of role of science and technology in national development; right to every person on freedom of expression that includes academic and scientific freedoms; provision for Parliament to enact laws that govern compensation or payment of royalties to communities for use of their cultures and cultural heritage and the protection of indigenous seeds and their genetic diversity. (National Council for Science and Technology, 2010)
Review of legal framework The legal Framework governing the HEST sector was reviewed creating the University, Technical Education Industrial and Entrepreneurship Training (TIVET) and ST&I Bills (Republic of Kenya, 2011)	The universities bill is expected to bring all the universities under one Act of Parliament as opposed to current situation where each of the 7 public universities have their own Acts while Private universities are established as per Universities Act 1985. The universities bill also proposes to restructure and strength the Commission for higher education to enable to carry out quality assurance and accreditation of all universities in the country including both public and private ones.

3.2 An overview of the ST&I landscape in Kenya

17. In 2009, under the auspices of the African Science Technology and Innovation Indicators (ASTII) initiative, Kenya completed the first survey of ST&I Indicators since independence. The survey was carried out by the Ministry of Higher Education Science and Technology (MoHEST) assisted by the Kenya National Bureau of Statistics (KNBS) and in collaboration with NEPAD. It targeted a total of 872 institutions in five key sectors, of which 487 responded by filling the survey questionnaires (Table 3.2; descriptions of sectors in Box 1). The survey's two key objectives were: obtaining gender disaggregated data on R&D personnel, and estimating the amount of Gross Domestic Expenditure on Research and Development (GERD) across the different sectors, sources and research types (definitions in Box 1).

18. In this paper, we begin by using the data from this survey for assessing the status quo of the R&D arena in Kenya, recognizing that it had the basic shortcoming of being an incomplete sample, given only about half of the original targeted group responded, besides the fact that it was not a comprehensive sample in the first place except for Higher Education. However, because those who responded can be considered a random sample of their respective sectors, they can be considered a representative sample, which renders it valid to compute proportions for further analysis. Where absolute figures are necessary, e.g., when calculating the total expenditure on R&D as a proportion of GDP, then the figures calculated from this study are corrected for the fact that they would otherwise be an underestimate due to the institutions that failed to respond.

Table 3.2: Number of institutions included in the ASTII survey in Kenya

Sector	No. originally targeted	Total No. responded
Higher Education	600	285
Government	20	10
Business Enterprise	200	160
Private Non-Profit	40	20
Abroad	12	12
Total	872	487

3.2.1 R&D Personnel by gender and qualification

19. The ASTII Kenya survey found that, for all five sectors combined, only 18% of researchers, 27% of technicians and 23% of managerial staff was female, while the reverse was the case for administrative jobs where nearly 70% were female. This pattern was fairly consistent across the sectors, although most pronounced in Higher Education and Government sectors (Fig. 1a). Overall, there were fewer females trained at higher levels compared their male counterparts, with female making up 23% of PhD holders, and about 35% of Masters, Degree and Diploma holders. However, there was some variation across sectors with Higher Education and Government having the fewer trained females in general compared to the other sectors (Fig. 1b).

Figure 3.1: Research personnel by Occupation and Gender in each of the five sectors in Kenya (Res: Researchers; Tech: Technicians; Mgmt: Administration and Management)

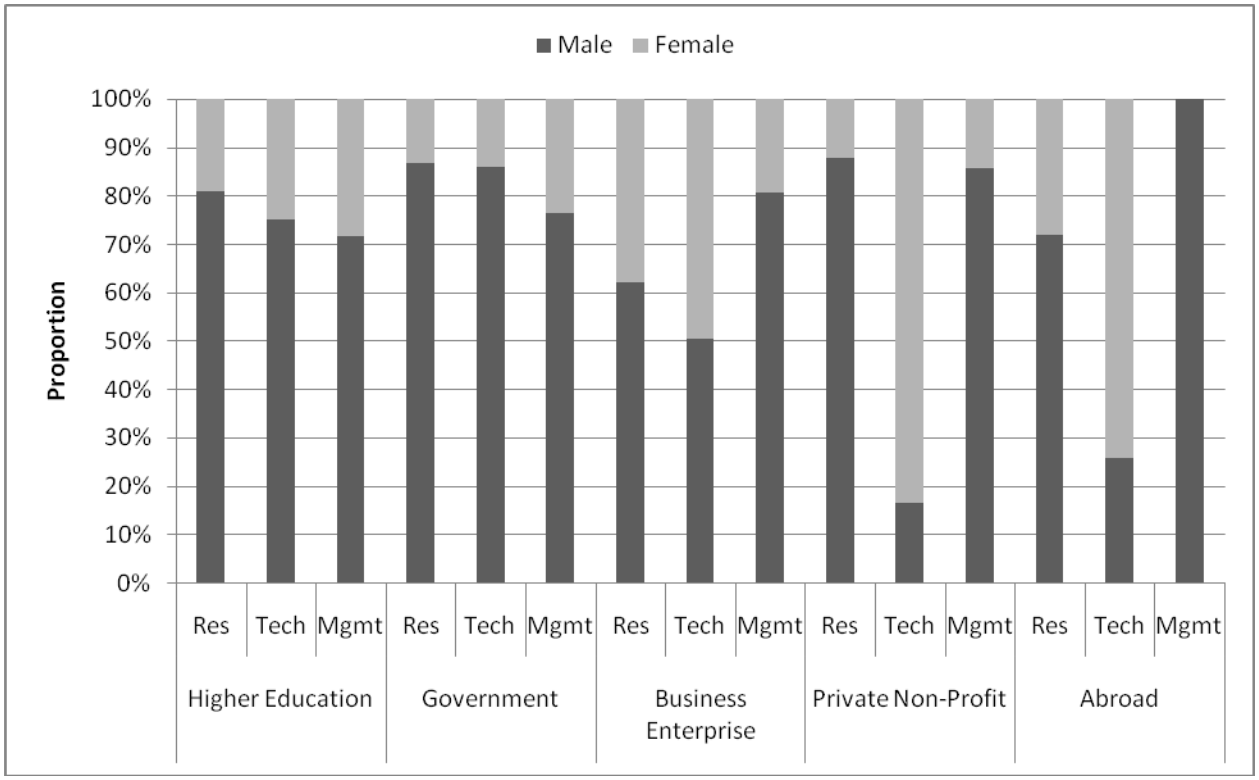
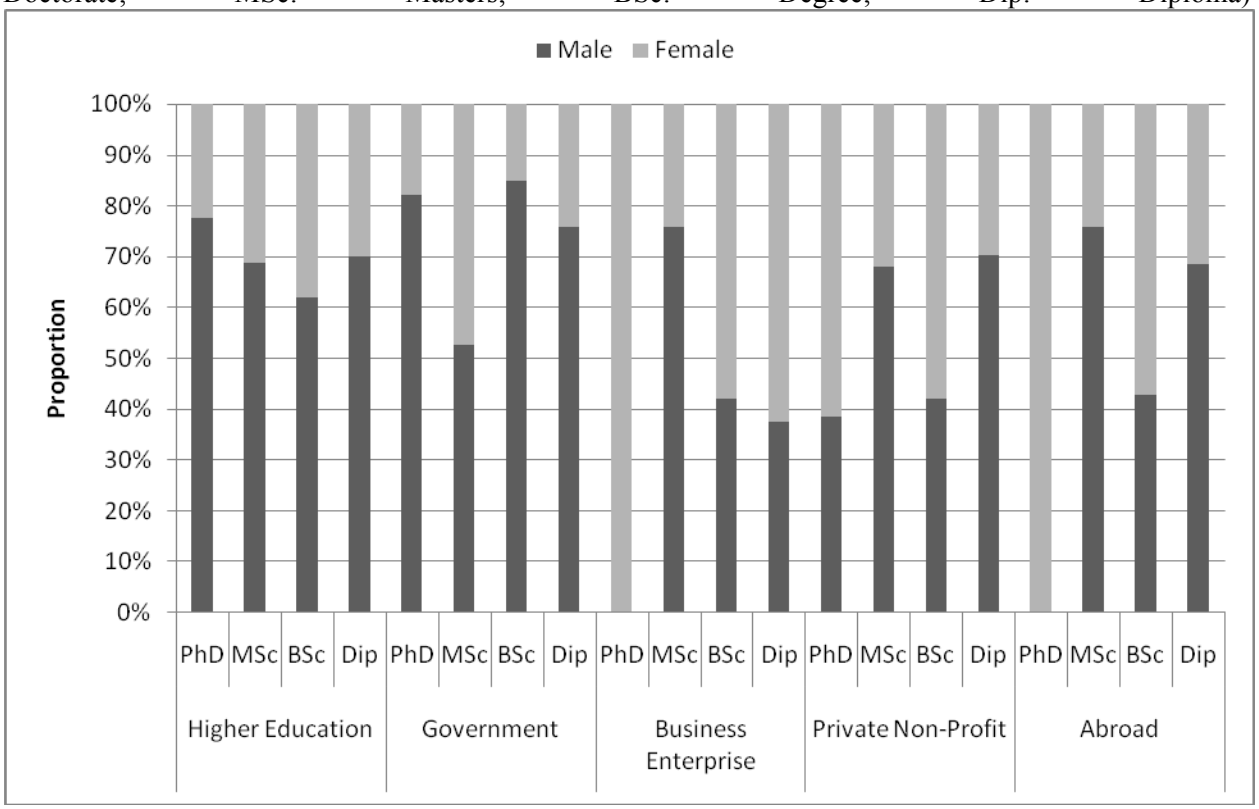


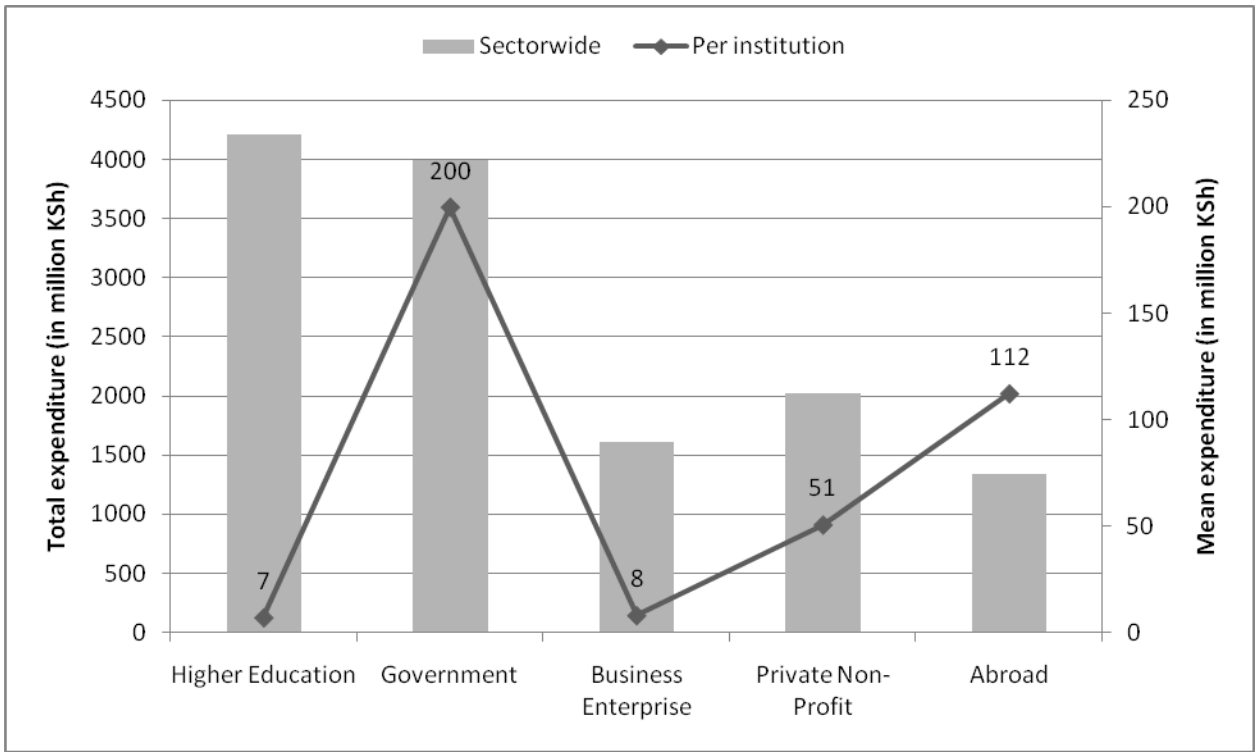
Figure 3.2: Research personnel by Qualification and Gender across the ST&I sector in Kenya (PhD: Doctorate; MSc: Masters; BSc: Degree; Dip: Diploma)



3.2.2 GERD by sector

20. Because all the potential institutions included in the survey in order to achieve a national picture did not respond, we assumed the respondents were a random sample and computed a mean for an institution in each of the five sectors, which we then multiplied by the number of institutions that had been originally contacted in that sector to arrive at the total research expenditure for each sector. Results indicated that the average institution within the Government sector spent nearly Kshs 200m on research compared to only Kshs 7m for Higher Education institutions (line graph on Fig. 2). Still, as a sector, Higher Education spent more money than Government by virtue of having many more institutions (bar graph on Fig. 2). When total expenditure across the five sectors was summed, it was estimated that a total of KSh13.65 billion was spent on research in 2007/8 Financial Year (FY). The GDP estimate for Kenya during the same period was Kshs 4679.25 billion, indicating that approximately 0.29% of GDP was spent on research in 2007/8 FY. Though a rather approximate figure, and possibly an underestimate because the survey was not comprehensive except for the Higher Education sector, it is nonetheless near the calculated average of 0.3% for sub-Saharan Africa (Nordling 2010).

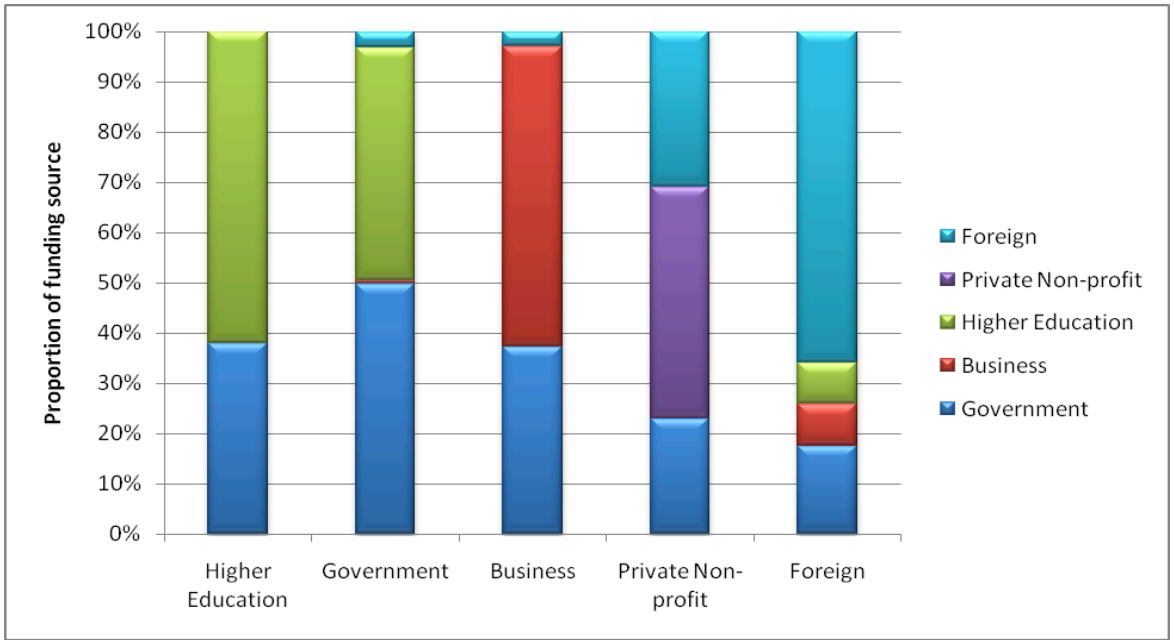
Figure 3.3: Mean expenditure per institution (line) and total Gross Expenditure on Research and Development (GERD; bars) across the five sectors



3.2.3 GERD by source of funding

21. Again, although not all the sampled institutions responded, we assumed the respondents were a random, representative sample, which allowed us to compute the percentage contributions from different sources to research expenditure in each sector. About 38% of the Higher Education sector's GERD came from the Government. Tellingly, this sector funded all its other research expenditure, apparently without tapping into the business, non-profit or foreign sectors for research funds (Fig. 3). In addition, each sector funded at least 50% of their research activities themselves. Lastly, the Government was the only sector that provided research funding to all other sectors, while the private non-profits, though they got some research money from foreign sources as well as the Government, did not fund research in any other sector except their own (Fig. 3).

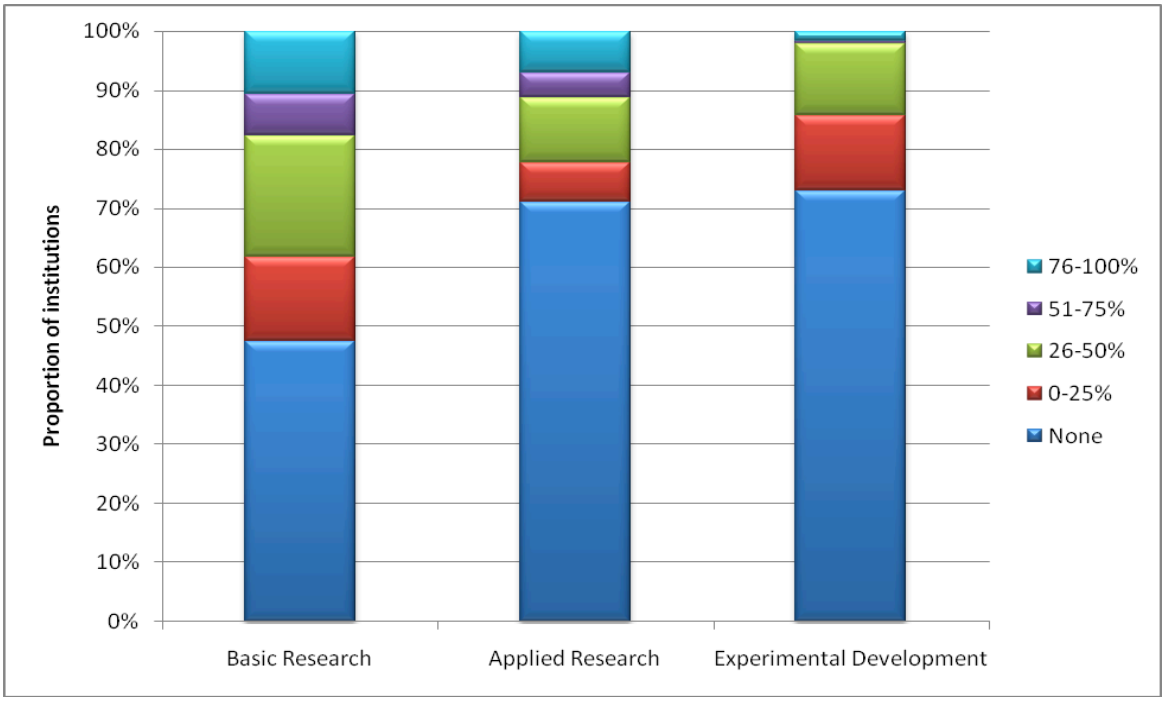
Figure 3.4: Proportion of research funding obtained from various sources for each sector



3.2.4 GERD by type of research

22. Finally, research expenditure was broken down by type of research based on the total amount that the institution spent on research; this was combined for all sectors. We found that, of the 487 institutions surveyed, only 52%, 29% and 27% allocated some money for basic, applied and experimental development, respectively. Many institutions did not allocate any resources to any of the different categories of research, with fewer than 15% of all institutions spending more than 50% of their resources on research (Fig. 4).

Figure 3.5: Proportion of total research funding allocated to each of the three types of research across all sampled institutions



3.3 Conclusions I: policy issues on the R&D landscape in Kenya

3.3.1 R&D Personnel by gender and qualification

23. Why are there fewer females in all occupations except administration? [NB: recent paper on females in science]. Women are often thought to be at a disadvantage during their doctoral training and early stages of their academic careers, due to a lack of social and professional connections available to most women in academic science and engineering departments (Pearson Jr. and Fechter 1994). However, a recent study revealed that overt discrimination against women is a thing of the past, stressing that choices, not discrimination, determine success for women scientists (Ceci and Williams 2011). They suggest that addressing today's causes of underrepresentation requires focusing on education and policy changes that will make institutions responsive to differing biological realities of the sexes. As such, Kenya should learn from this and conduct further research into the choices that women make, why and how they make them. On the one hand, as long as women make the choice and are satisfied with the outcomes, then there is no problem. On the other hand, to the extent that these choices are constrained by biology and/or society, and women are dissatisfied with the outcomes, or women's talent is not actualized, then we do have a problem (Ceci and Williams 2011). Finally, it is also worth interrogating why is this deficiency most pronounced in the Higher Education and Government sectors (and is directly related with qualifications, with these two sectors seeming to fair marginally worse than the worst in the numbers of trained female scientists.

3.3.2 GERD by sector

24. There seems to be significant differences in the mean research expenditure for the average institution sampled within each sector, with the average Government institution spending considerably

more than the rest. This is likely to suggest that the expenditure computations were done based on the sector giving the money and not the one using the money. As such, the Government and the foreign institutions which are largely donors seem to spend more money from their budget on research than the institutions that actually spend the money on undertaking research.

25. A key policy question that also emanates from this study revolves around the likely causes and implications for the approximate 0.3% research expenditure. First, this is a global figure that is likely to have different ramifications for different sectors. For instance, it was recently noted that in 2003, Africa's leaders committed to the African Union Maputo Declaration on Agriculture and Food Security to set aside 10% of their national budgets for agricultural development. But, nine years on, just eight countries have fulfilled their promise (Babalola 2011). Failure of Governments meeting their research funding obligations may have two key implications: first, not filing gaps for critical (national) research that no one else is funding, and second, missing out on the fact that public funding is known to stimulate private funding in R&D (Guellec and Pottelsberghe 1997). In all, the actual public funding for Kenya should be estimated more rigorously than was done here, so that the impacts of the likely shortfalls can be demonstrated to make a case for increased funding by the Government. It is clear however that the current public funding falls short of the recommended 1% which is deemed the minimum necessary to sustain some fundamental research. Indeed, African governments, for their part, agreed in 2007 to increase funding for science and technology, urging one another to direct 1% of their GDP to these areas by 2010 (Nordling 2010); this is yet to be fulfilled for most countries.

3.3.3 GERD by source of funding

26. There were a four salient points regarding the source of funding: first, that Government funded research undertaken across all sectors sampled (which could explain why the average Government institution was found to spend a lot more on research compared to all other sectors). Secondly, the Higher Education sector received funding only from Government (did not tap into the other sectors). If this is indeed the case, then it could represent a missed opportunity because the Higher Education sectors can and should tap into other sources of research money, particularly the business sector, especially in advancing their innovations. Thirdly, is was good that each sector funds at least 50% of its research activities showing that, although many institutions did not allocate any money for research, those that did considered it an important part of their budgetary allocations. It is worth following up to understand why some institutions did not allocate any of their money for research. Finally, it seems as though private non-profits institutions are currently not funding research in other sectors, which tallies with the call we make above for higher education and other sectors to reach out and tap into these resources.

3.3.4 GERD by type of research

27. Lastly, as indicted above, many institutions do not allocate any resources for research, with only half of all sampled institutions allocating money for basic research, and a third for applied research and experimental development. Indeed, fewer than 15% of all institutions sampled spent more than 50% of their resources on research. This is telling given R&D is considered paramount for developing new knowledge, new technology, and new products. It is worth interrogating why these institutions are not spending money on research and what can be done to stimulate this. As indicated under GERD by sector section above, Government funding may be one of the solutions to this, where an injection of research funds from the government might stimulate R&D funding across the board.

BOX 1: DEFINITION OF TERMS

Sector

Higher Education sector is composed of all universities, colleges of technology and other institutions providing tertiary education, whatever their source of finance or legal status

Business Enterprise sector includes all firms, organizations and institutions whose primary activity is the market production of goods or services for sale to the general public.

Government sector is composed of all Government Departments or Directorates

Private Non-Profit sector includes non-market, private non-profit institutions

Abroad (Foreign sector) consists of all institutions whose HQs are located outside a country

Research & Experimental Development (R&D)

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular use in view

Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective

Experimental Development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already in place.

Measurement Units of R&D Personnel

Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods, systems and also in the management of the projects concerned. Postgraduate students at the PhD level engaged in R&D should be considered as researchers

Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences (Technicians) or social sciences and humanities (Equivalent staff). In R&D, they perform scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers

Other supporting staff includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with (or providing services to researchers involved in) such projects.

R&D Expenditures

Labour costs include annual wages, salaries & all associated costs of researchers, technicians & supporting staff-, and other current costs, e.g., non-capital purchases of materials, supplies and R&D equipment

Capital expenditures reported in full for the period when they took place and should not be registered as an element of depreciation.

4 Case study: Public funding for research in Kenya

4.1 Overview: Public funding for R&D: a global perspective

28. For the rest of this paper, we will focus on reforms related to government funding for research. Because knowledge is a non-rival good, it has been shown that, in the absence of policy intervention, the social rate of return on R&D expenditure exceeds the private rate, leading to a socially sub-optimal rate of investment in R&D (Guellec and Pottlesberge 1997, Jaffe 2002, Lööf and Heshmati 2004). This under-investment underlines the need for countries to spend public funds on stimulating R&D and innovation activities. Public support for research can be in the form of tax incentives, direct government funding, co-operation arrangements between firms, research institutes and universities, and loan guarantees. At the end of the 1990s, the share of government funding of the total R&D was approximately one third in the US and Europe and one fifth in Japan (OECD 2000). Ideally, about 10% of commercial firms' R&D expenditures in the OECD should be publicly funded, and indeed they are (Lööf and Heshmati 2004).

29. Despite ST&I being central to recent policy discussions and policy development in Africa, current government expenditure on research remains relatively low, and still very much dependent on external donor funding. African governments have been pledging to spend more on science and technology but poor public finances, combined with flagging political will, have stopped them turning their promises into concrete action. There have been a few promising steps made in setting up new institutions and national funding mechanisms to encourage research and innovation in Africa. The desire to 'nationalize' science by taking direct financial and management control of it is an increasingly common refrain on the African continent (Nordling 2010). Many countries are keen to expand their domestic science budgets; for instance, Tanzania and Kenya both made substantial cash pledges to science and innovation in their 2010 budget rounds. On the same vein, Uganda cut-off a science loan from the World Bank in 2010, stating "The government believes that science and technology is an important sector whose funding it must prioritize and take over. The government has therefore pledged to provide money that it would otherwise borrow from the bank" (Nordling 2010).

30. Yet, taking a broader view, the small increases in science investment in Africa in the five year period between 2002 and 2007 are being outstripped by growth around the world, leaving African research poorly funded by comparison (Table 3). Most sub-Saharan African countries still spend an average of just 0.3% of their GDP on science and technology, a far cry from the 1% promised in 1980 and again in 2005 (Nordling 2010). Consequently, African dependence on foreign funders and aid agencies has resulted in a fragmented, donor-driven research landscape that needs more domestic drivers. Sub-Saharan Africa still lags far behind in the amount of money spent on each researcher on average (Fig. 5a), and thus perhaps not surprisingly lags even further behind on the number of researchers for the population (Fig. 5b).

Table 4.1: Gross annual expenditure on research and development (GERD) and proportionate number of researchers in selected regions and countries. (PPP$: purchasing power parity in USD; SSA[‡]: Sub-Saharan countries excluding South Africa)

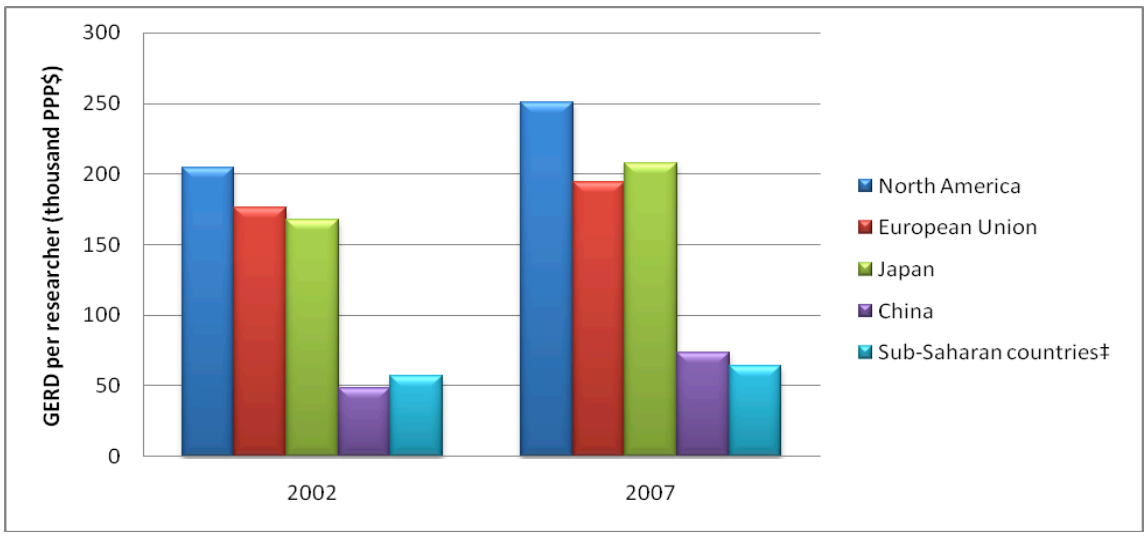
	GERD per researcher (thousand PPP$)		Researchers per million inhabitants	
	2002	2007	2002	2007
North America	204.8	251	4,527.30	4,654.30
European Union	176.1	194.7	2,420.30	2,727.70

Japan	167.3	207.9	5,071.60	5,548.10
China	48.7	73.7	629.1	1,071.30
SSA‡	57.1	64.1	51.3	60.3

Source: Nordling 2010, Nature: 994-5

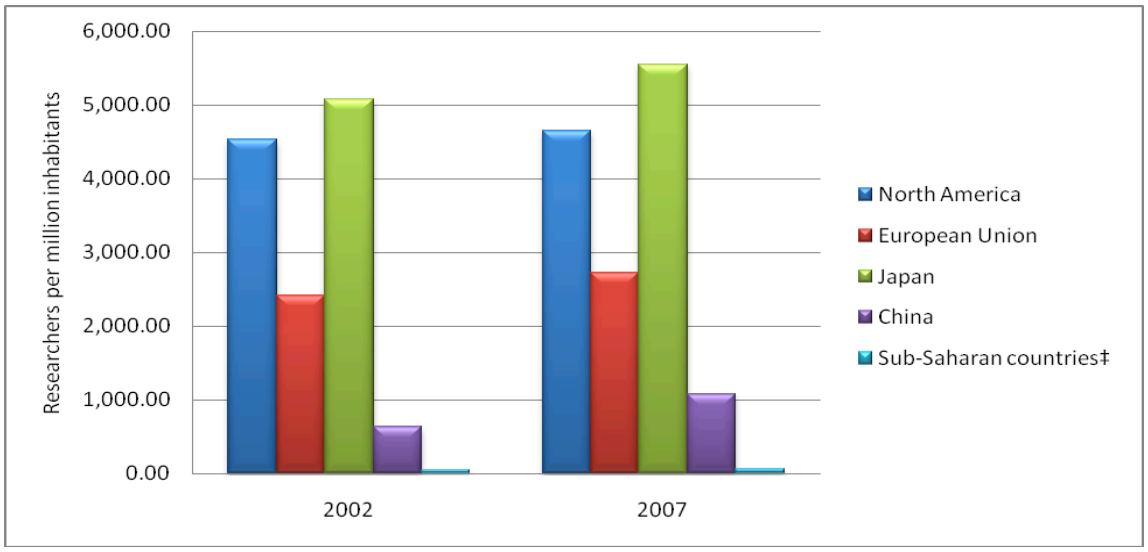
Figure 4.1: Amount of resource allocation for researchers and number of researchers across the population

4.1a: GERD allocation



Source: Nordling 2010, Nature: 994-5

4.1b: Number of researchers



4.2 PRF: the case of the Science, Technology and Innovation Fund in Kenya

31. In order to delve deeper into the impact of Government funding for research in Kenya, we now turn our focus on a Science, Technology and Innovation Fund that was established in 2006 and administered by the National Council of Science and Technology (NCST). This fund disburses government funding for research and innovation purposes in priority areas of national interest. Under the fund, NCST has established various grants available to Kenyan researchers and Innovators that include; Research and Innovation Grants; Research Facility Grants; Women Scientists Grants; Postgraduate (PhD and MSc.) Students Competitive Grants; Kenyan/South African Collaborative Research Grants; Kenya/Japan Society for the Promotion of Science (JSPS) Grants and Kenya/British Council Grants.

4.2.1 Grants administered under the PRF scheme in Kenya

4.2.1.1 Research and Innovation Grant

32. The fund is open to researchers and innovators who are Kenyan nationals in local public and private institutions. The 1st Call for Research and Innovation funding proposals was advertised by NCST on 20th January 2009 in daily newspapers and on NCST website. Three hundred and eighty two (382) applications were received. The review of those applications was done by external reviewers from Universities and research institutions and Ninety Two (92) successful proposals from seven thematic areas were funded under the financial year 2008/09 During the year 2009/10, the 2nd Call for research and innovation proposals advertised in 21st October, 2009 attracted Three Hundred and Twelve (312) proposals from 56 both public and private institutions (Table 4.2), in which a total of 31 projects were funded (NCST, 2009).

Table 4.2: The No. of proposals submitted in different thematic areas in response to the 1st and 2nd Calls for ST&I Grant in Kenya

Thematic area	Submitted (2008/2009)	Submitted (2009/2010)
Agricultural sciences	115	121
Health and life sciences	75	81
Environment and natural resources	101	53
ICT	14	10
Trade and Industry	44	10
Energy	22	31
Human resource management	11	6
Total	**382**	**312**

33. While the first two years of the ST&I grant implementation was open to broader thematic areas, the 3rd Call made for the year 2010/2011 was for a specific thematic area (Food security and Climate change). This was targeting multi-institutional and multi-disciplinary research teams from public and private institutions. During this call a total of 239 proposals were received and 28 projects funded. Since the inception of this government grant the total number research studies being supported has increased to 151 by financial year 2010/2011 (NCST, 2010; CHE, 2011). While the ST&I grant has

generated a huge interest among the research community, there is an indicated significant gender disparity in the funded projects over the period of three years (Table 4.4).

Table 4.3: The number of projects funded under ST&I Grant in Kenya from 2008-2010 in different priority areas

Thematic areas	1st Call (2008/09)	2nd Call (2009/10)	3rd Call (2010/11)
Environmental and Natural Resources	30	4	Food Security & Climate Change thematic area
Agriculture	18	6	
Energy	8	5	
Industry	12	4	
Health	9	8	
ICT	5	2	
Social sciences	10	2	
Total	**92**	**31**	**28**

Table 4.4: The Gender segregation of the ST&I Grant funded research projects from 2008-2010

Financial year	Funded research projects	Gender	
		Female	Male
1st Call (2008/09)	92	15	77
2nd Call (2009/10)	31	5	26
3rd Call (2010/11)	28	8	20
Total	**151**	**28**	**123**

4.2.1.2 Women Scientists Grant

34. Deliberate efforts to mainstreaming gender in ST&I policies and programmes in Kenya to promote the empowerment, equal and full participation of women in scientific, technological and innovation activities are in place under the ST&I Grant. A specific grant targeted to harness the participation of Kenyan women scientists in research agenda in the country was put in place. To facilitate this, the first call for women scientists was advertised on 26th August 2009 attracting one hundred forty eight (148) applications from Kenyan women Scientists. A total of Fourteen (14) successful projects were funded. The 2nd call for women scientists for 2010/2011 attracted a total of one hundred and twenty seven (127) research proposals where 32 projects are being funded (Table 4.5).

Table 4.5: The projects by Kenyan women scientists funded under ST&I Grant in two years

Funded Thematic areas	1st Call (2009/2010)	2nd Call (2010/2011)
Environmental and Natural Resources	3	6
Agriculture	4	8
Energy	1	2
Industry	1	0
Health	4	9
ICT	0	1
Social sciences	2	6
Total	**15**	**32**

4.2.1.3 PhD and MSc Competitive Grant

35. In order to build human resource capacity, a postgraduates (PhD & MSc.) competitive grant is in place under ST&I Grant. The first call was advertised for 2009/2010 financial year and attracted a total of 224 applications comprising of 105 applications from MSc. applicants and 119 for PhD from both public and private Universities. During that year a total of 22 MSc. and 22 PhD research projects were funded. The 2nd call for postgraduate students in 2010/2011 year attracted 113 PhD applications and 65 MSc. projects. In 2010/11 the fund supported 40 PhD and 25 MSc research projects (Table 4.6). Since its inception the Grant has supported a total 109 postgraduate research projects (NCST, 2010, CHE, 2011).

Table 4.6: The postgraduate research projects and the gender segregation of the funded projects

Financial Year	Category	Postgraduate funded research projects	Gender	
			Female	male
2009/2010	1st Call (MSc.)	22	8	14
	1st Call (PhD)	22	4	18
2010/2011	2nd Call (MSc.)	25	11	11
	2nd Call (PhD)	40	15	23
Total		**109**	**38**	**66**

4.2.1.4 Innovations Grants

36. Innovations are important drivers of economic growth. The grant was initiated to harness the potential in line with national policies that will be critical in increasing the role of technological innovations in addressing the country competitiveness. The Innovations Grants support Kenyan innovators and inventors with novel ideas to develop them into prototypes. The grant target potential

ideas that could lead patenting linkages with venture capitals for commercialization. In the last three year a total of 25 innovations projects have been supported and a number patents registered.

4.2.1.5 Kenyan/South African Collaborative Research

37. In recognition of the importance and desire to strengthen cooperation in science and technology, a joint Kenyan/South African collaborative programme was initiated. This is a matching grant under ST&I Grant to promote and support collaboration in all fields of science and technology for mutual advantage of the two republics. The first call in this programme was advertised in 2009 in local dailies attracted eighty (80) research proposals jointly submitted by Kenya and S. African researchers. The second call was advertised in August, 2010 where 43 joint proposals were submitted. In the last two year 16 joint proposals under this programme have been funded.

Table 4.7: The Joint Kenya/South Africa collaborative research programme

FY	Funded projects	Gender	
		Female	Male
2009/10 (1st Call)	6	0	6
2010/11 (2nd Call)	10	3	7
Total	**16**	**3**	**13**

4.2.1.6 Research Facility Grant

38. A research facility grant to support building research capacity in the country is in place. The purpose of the grant is to support acquisition and installation of specialized research facilities in public institutions that can be accessed by researchers from that region. The Call for support for research facility was advertised on July 2009 and fifty seven (57) different institutions applied. On the need basis, eight Universities constituent colleges have been supported in acquisition and installation of Atomic Absorption Spectrometer (AAS).

4.2.1.7 Support of Conferences/Symposia

39. The ST&I grant in Kenya also support public and private institutions to organize conferences in areas which are in line with the Government's development goals as provided in Vision 2030. Such conferences bring together researchers, innovators, policy makers, private sector, technology end-users, entrepreneurs and other stakeholders to share their findings, experience, knowledge and skills. In recognition of importance of ensuring dissemination, application of scientific research results and transfer of technology for economic development, the first call for support was made in 2010. A total of 32 conferences have been supported under this programme.

4.2.2 Goal

40. This part of the study set to evaluate the importance of the Public Research Funding (PRF) scheme in Kenya, focusing largely on the Research and Innovation Fund.

4.2.2.1 Specific objectives

41. In order to undertake this evaluation, we assessed both the projects that were funded through the PRF scheme, and those that were not.

For the funded projects, we assessed completed projects in terms of their accomplishments and impacts in two main areas:

i. Research outputs (publications, products etc)

ii. Research outcomes/impacts: significant economic, societal, and/or environmental benefits

42. For the unfunded projects, we checked whether or not they were undertaken, and if so, what the alternative sources for funds were. This enabled an evaluation of the importance of PRF in terms of provision of critical funds for important research that would have otherwise stood little chance of being undertaken due to lack of funds.

4.2.3 Methodology

4.2.3.1 Literature review

43. Despite the prevalence of public research funded programmes, and in spite of considerable effort devoted to the evaluation of the efficiency of public funding for R&D, there is little consensus about their effectiveness (Jaffe 2002; Hall 2002; Hall and Lerner 2010). This is partly due to methodological issues, with most methods being based on the assumption that public R&D funding, to a large extent, is allocated randomly to research projects and programmes. In such a case, it is essential to have comparative data for projects receiving public financing and those that do not, with the difference in performance between the two groups of projects indicating the worth of the public funding. Yet, if the performance of the supported and non-supported projects differs systematically (i.e., other than the public funding), then a difficulty in this type of evaluation is the potential selection bias, for instance where the projects funded by the government are liable to be from research groups with the best ideas.

44. Besides, it is worth assessing the extent to which institutions receiving public funding would have invested on the funded projects had they not benefited from the public policy scheme. The fundamental research issue is then how to measure the effect of public R&D support on project's performances. A key methodological challenge is the lack of counterfactual evidence, which implies that we cannot forecast the project's outcomes in the absence of public funding. In order to overcome this problem, each funded project is matched with a similar non-funded project that had almost the same probability of being funded. The difference in their performances can then be computed and assumed to reflect the impact of the public research funds.

4.2.4 Results

4.2.4.1 Funded projects

45. The ST&I Grant, established in 2006, has disbursed funding of about KSh450m (c.USD 6.4m) between 2009 and 2010 for various research purposes including: research projects of national interest, innovations, graduate research projects, and research grants for women scientists.

46. Over the last two years the ST&I grant has contributed in generating 14 utility patents in different fields of specializations which have already been registered at the country level by Kenya Intellectual Property Institute (KIPI) (Table 4.8). These innovations are ready for commercialization. The grant has as well enabled production of a number of scientific papers published in different journals and conference proceedings (Table, 4.9).

Table 4.8: The number of utility patents registered from the ST&I Grant funded innovation projects between 2008-2011

Specialized areas	Registered Utility patents
ICT	5
Agricultural	2
Engineering	3
Health	3
Physics	1
Total	**14**

Table 4.9: The Number of scientific papers produced from ST&I grant funded projects from 2008-2011

Journal/Conference	No of Papers published/ presented
Journal of Remote Sensing	1
Journal of Limnology & Oceanography	2
ScienceDirect	1
The 4th National Conference on Dissemination of Research Results & Exhibition of Innovations	50
International Leather Engineering Congress 2011, Izmir, Turkey	1
6th Egerton University International Conference	4
Moi University Annual International Conference	3
The 12th KARI Biannual Scientific Conference	2
Kenya Veterinary Scientific Conference	1
Total	**65**

47. The NCST has been carrying out a monitoring exercise on public research funding projects that were funded in the year 2008/2009 and 2009/2010 financial years. Participatory approach involving the principal researchers making presentations on the project achievements was used as well as interviews by the monitoring team to capture the achievements of the project objectives and outputs, and challenges experienced in implementation of the projects. Other evaluation findings are obtained from presentation of research findings to peers and stakeholders and through field evaluation for projects with field based outputs. The exercises are aimed at monitoring and evaluation (M&E) to provide feedback on the performance of the funded projects in relation to their set objectives and expected results and to identify potential solutions to problems and make recommendations to improve the effectiveness in the management of Science Technology and Innovation (ST&I) Grant.

48. The report of M&E carried out in January-February, 2011 on research and innovation projects funded in year 2008/2009 and women research studies funded in 2009/2010 reported on various parameters including their completion rate, logical frameworks, and coordination. Especially germane for

this study, the time of evaluation overall, 85% of the projects had performed fair or better in terms of producing the set out research outputs, which is an indication that they are on the right track to achieving the longer term outcomes.

4.2.4.2 Unfunded projects

49. We followed up with all the projects that were not funded under the PRF scheme to find out three main things:

i. What is the status of the proposal that was unfunded by NCST: was it undertaken or not?

ii. If not, why not?

iii. If they were: where did the funds come from, and what is the status of the project?

50. A sample of 137 projects that were not funded during the 1st Call were selected randomly. The finding depicted that most of the projects that were not funded under the PRF scheme (which represented more than 76% of all applications) were never implemented (85%). It's only 9% of these projects that were executed through obtaining alternative funding while other projects were downscaled to student postgraduate research projects (6%).

Table 4.10: Fate of the projects that were not selected under the various PRF grants administered by NCST in Kenya

Category	**No. of projects**
Never Implemented	116
Funded as postgraduate	9
Obtained alternative funding	12
Total	**137**

4.3 Conclusions II

51. From the above section, it is clear that when projects, and by extension, institutions fail to receive public funding, few invest in undertaking the projects; they are also not successful in obtaining alternative research grants. In conclusion, whereas the key methodological challenge in assessing effectiveness of public research funding is the lack of counterfactual evidence (i.e. inability to forecast the project's outcomes if it was not funded), we can infer the key role of Government funding in promoting critical local research in Kenya from two fronts: first, because the immediate outputs and outcomes are realized (i.e., publications and patents), it is likely that longer term impacts are also realized. Secondly, because most projects not selected under the PRF scheme are rarely executed, most of these types of local (and often critical) research are heavily reliant on public funds. Indeed, public funds for research do provide distinct additional benefits rather than simply funding initiatives that would have obtained other sources of funding anyway.

52. As such, Kenya should endeavor to maintain or increase the allocation for PRF schemes. This form of public research funding is deemed important for overcoming the shortcomings related to reliance on external funding such as:

- Short-term nature of most external funding, largely concentrated in the research phase of the innovation cycle

- Brooding competition rather than collaboration between scientists within the same institution
- Insulating institutions from the realities of a changing funding environment where, increasingly, public research institutions are expected to generate some income
- Donor priorities differing from national priorities.

53. Finally, in order to achieve this, hence provide the drive necessary for moving Kenya into a developing economy state, there is also the need to increase the allocation of funds for research activities in all the sectors to achieve 1% of Gross Domestic Product (GDP) scale. This will boost and improve the existing facilities in order to maintain the various key institutions' status as centers of excellence in vital areas of research and development.

5 Budget & Timeline

Item	No of days	No of persons	Unit cost	Total cost (Kshs)	Total cost (USD)
Desk study I	30	3	3000	270,000	3000
Desk Study II	20	3	3000	180,000	2000
Communication				20,000	220
Sub-total				470,000	5220
Administrative (including bank charges etc) (5%)				23,500	260
Grand total				493,500	5480

5.1 Budget alteration and reduction rationale

54. Our budget has changed from the original budget largely because of availability of raw information from various sources which enabled the authors concentrate on careful desk analyses to re-analyses these data and derive useful knowledge from them. As such, the budget is largely allowances for time spent on undertaking extensive desk analyses, as well as communication costs for contacting the lead persons of the projects that were not funded. This has led to the reduction in the overall budget without greatly compromising the quality of the final report.

5.2 Timeline: 2011

Activity	March	April	May	October	November
Proposal writing					
First desk study					
Second desk study					
Preliminary report					
Contacting the projects not funded					
Final data analysis					
Final report					

6 References

BABALOLA, Semiu. 2011. *Most African nations 'still not investing enough in agriculture*. http://www.scidev.net/en/news/most-african-nations-still-not-investing-enough-in-agriculture-.html

CECI, Stephen and Williams, Wendy. 2011. Understanding current causes of women's underrepresentation in science. PNAS. doi: 10.1073/pnas.1014871108.

CHE (2011). *9th Exhibition by Kenyan Universities held at Golf Hotel Kakamega 19th March 2011*. Nairobi: Kenya.

DIAMOND, Arthur. 1999. Does Government funding "crowd in" private funding of science? Contemporary Economic Policy 17: 423-431

GUELLEC, Dominique and Pottelsberghe, Bruno. 1997. Does government support stimulate private R&D? OECD Economic Studies No. 29, 1997/II

HALL, Bronwyn. 2002. The Financing of Research and Development. Oxford Review of Economic Policy 18(1): 35-51

HALL, Bronwyn and Lerner, Josh. 2010. The Financing of R&D and Innovation. In Hall, B. H. and N. Rosenberg (eds.), *Handbook of the Economics of Innovation*. Elsevier-North Holland

JAFFE, Adam. 2002. Building Program Evaluation into the Design of Public Research Support Programs. Oxford Review of Economic Policy 18: 22-34

LÖÖF, Hans and Hesmati, Almas. 2004. *The Impact of Public Funding on Private R&D investment*. New Evidence from a Firm Level Innovation Study. CESIS Electronic Working Paper Series, Paper No. 06

MOEST 2004. *Ministerial Public Expenditure Review (MPER) 2003.Unpublished* document:

MoHEST 2008a. *Strategic Plan for MOHEST 2008-2012 Quality Higher Education, Science, Technology and Innovation for National Prosperity and Global Competitiveness*. Nairobi: Government Printer

MoHEST 2008b. *National Strategy for University Education*. Unpublished document.

NCST 2008. *Annual Report, 2008*. Nairobi: National Council for Science and Technology

NCST 2009. *Annual Report, 2009*. Nairobi: National Council for Science and Technology

NCST 2010. *Annual Report, 2010*. Nairobi: National Council for Science and Technology

NCST 2011. *1st Call for Science, technology and Innovation Grants and women Scientist Projects*. End Term and Medium Term Monitoring and Evaluation Report. Unpublished document.

NORDLING, Linda. 2010. African nations vow to support science. *Nature* 465: 994-995

PEARSON Willie and Fechter, Irwin (Eds.), 1994. *Who Will Do Science? Educating the Next Generation.* Baltimore: Johns Hopkins University Press.

REPUBLIC OF KENYA 2005. *Sessional Paper No.1 of 2005*: *A Policy Framework for Education, Training and Research; Meeting the Challenges of Education, Training and Research in Kenya in the 21st Century*. Nairobi: Government Printer

REPUBLIC OF KENYA 2006.*Transformation of Higher Education in Kenya to secure Kenya's development in the Knowledge: Report of the Public Universities Inspection Board (PIUB)*. Nairobi: Government Printer.

REPUBLIC OF KENYA 2007. *Kenya Vision 2030, "A globally Competitive and Prosperous Kenya"*. Nairobi: Government Printer

REPUBLIC OF KENYA 2008a. *First Medium Term Plan (2008-2012)*, Kenya Vision 2030. Nairobi: Government Printer

REPUBLIC OF KENYA 2008b. *Kenya Vision 2030 Sector plan for Science and Technology and Innovations*. Nairobi: Government Printer

REPUBLIC OF KENYA 2010a. *Constitution of Kenya (2010)*. Nairobi: Government Printer

REPUBLIC OF KENYA 2010b. *Research, Innovation and Technology (RIT) Sector, Medium Term Expenditure Framework (MTEF) 2011/12–2013/14 Report*. Nairobi.

REPUBLIC OF KENYA 2011. *Second Annual Progress Report on the implementation of the First Medium Term Plan (2008-2012)*. Nairobi: Government Printer

UNDESA 2011: *Managing Economic and Social Councils as a Driving Force of the National Dialogue on Economic and Social Policies*. Final Report on a Capacity Building Workshop. Nairobi, Kenya. MARCH 7-8, 2011.