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MONITORING AFRICA'S PROGRESS IN RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) INVESTMENTS

The African Observatory of Science, Technology and Innovation (AOSTI)

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Executive Summary

Science, technology and innovation (STI) indicators are crucial in monitoring Africa's scientific and technological developments, formulating, reviewing and implementing STI policies and strategies, and more importantly, guiding the continent's march towards achieving its target of 1% of GDP invested in R&D. Africa's history of measuring and monitoring science and technology (S&T) information is mostly available through estimates on S&T data based on indirect measurements in technology-related use, trade and investment, education, and S & T data of international organizations. International organizations have collected data from countries and aggregated the data in international databases. However, S&T data from many African countries are absent in these databases. Africa needs to build its capacity to collect and analyse STI data. It is not clear whether African countries have made progress towards meeting the target of investing 1% of GDP in R&D due to a lack of data. The absence of a robust common set of STI indicators has also limited the continent's ability to make evidence-based decisions regarding STI. The African Science, Technology and Innovation Indicators (ASTII) Initiative was established in 2007 to inform policies at various levels of leadership and to provide, among other measurements, indicators for monitoring progress towards the achievement of the target of 1% expenditure of GDP on R&D by African Union (AU) Member States. This brief aims to provide an informed assessment of the extent to which decisions to boost R&D for Africa's socio-economic growth and development have been attained. Some recommendations, based on the analysis, follow.

Introduction and background

Science, technology and innovation (STI) are critical for Africa's development and progression from natural resource dependency to knowledge-based economies. The need to move from resource-based economies to knowledge-based economies is underscored by the fact that nations that are increasingly becoming wealthy are depending on the generation and application of knowledge rather than their natural resources. As such, investment in research and experimental development (R&D) remains key in the fight to eradicate poverty, mitigate and adapt to climate change, and promoting shared prosperity, inclusive growth, and sustainable development. In recognition of the need to invest in R&D, African governments through a number of assemblies of the African Union (AU) have committed themselves to invest at least 1% of their gross domestic product in R&D. Such calls for increased investment in R&D can be traced to the Monrovia Declaration of 1979, the Lagos Plan of Action (LPA) for the Economic Development of Africa (1980–2000), the Eighth Ordinary Session of the Executive Council of the AU that met in 2006 in Khartoum, Sudan and the Ninth Executive Council of the AU held in Addis Ababa, Ethiopia in 2007. These calls were based on the understanding that African countries were not investing enough resources in R&D and they lacked a framework to collect reliable data and monitor progress.

To help member states monitor the total national investment in R&D, in 2005 in Dakar. Senegal, the African Ministerial Conference on Science and Technology (AMCOST) adopted the Africa Science and Technology Consolidated Plan of Action (CPA) as a framework to guide S&T development on the continent. Among its proposed projects, the CPA articulates the establishment of the African Science, Technology and Innovation Indicators Initiative

(ASTII). ASTII was established in September 2007. In September 2007, the Intergovernmental Committee on ASTII meeting in Maputo resolved that African countries should apply internationally recognised mechanisms and guidelines to assess R&D and innovation programmes. The Organisation for Economic Development's (OECD) Frascati and the OECD/Eurostat Oslo Manuals were recommended as key points of reference in conducting surveys and developing standard indicators of STI in Africa.

- **ASTII as an R & D Investment Monitoring Mechanism for Africa**

ASTII's overarching objective is to contribute to the improvement of the quality of STI policies at national, regional and continental levels. Specifically, ASTII seeks to: develop and cause the adoption of internationally comparable STI indicators; build human and institutional capacities for developing and using STI indicators and conducting surveys; enable African countries to participate in international programmes for STI indicators; and to inform countries on the state of STI on the continent. For the first time, Africa developed internationally recognised mechanisms and guidelines to assess R&D and innovation programmes in African countries and monitor the implementation of the decision to invest 1% of GDP in R&D.

- **The Benefits of Monitoring Investment in R&D**

Despite pronouncements and calls to action, it is not clear whether African countries have made progress towards meeting the target of investing at least 1% of GDP in R&D due to the lack of data. Africa does not have a history of measuring and managing science and technology information. Most of the estimates on Africa are based on indirect measurements in sectors such as trade and investment, and education, as well as science and technology data collected by international organisations. International organizations have collected data from countries and aggregated the data in international databases. Sadly, S&T data from many African countries are absent in these databases. Africa needs to build its capacity to collect and analyse STI data. STI indicators are crucial in monitoring Africa's scientific and technological developments, formulating, reviewing and implementing STI policies and strategies, and more importantly, guiding the continent's march towards achieving its target of 1% of GDP invested in R&D. Given the importance of STI indicators in steering Africa's development, the absence of a robust common set of STI indicators limits the continent's ability to make evidence-based decisions regarding R&D investment.

In 2008, ASTII commissioned a survey covering the period 2005-7 in nineteen African countries to assess their R&D investments and personnel. The countries were chosen based on their expression of interest. Of these countries, thirteen produce R&D survey data. The survey assessed R&D investment by business enterprises, government, higher education and not-for-profit organizations. However, many of these surveys were of a pilot character and many countries did not cover all sectors. Thus the business sector was not surveyed in some countries, which is a serious omission (AIO, 2010). As such caution is urged in interpreting these data. R&D investment was determined as expenditure on services, consumables, infrastructure and personnel (e.g. salaries/wages), needed to undertake the R&D activities performed by public and private institutions.

Main findings of ASTII-1

The first phase of the ASTII pilot survey covered the business enterprise sector, government sector, higher education sector and private non-profit organisations (PNP).

A common measurement framework was adopted and the core indicators of interest were as follows:

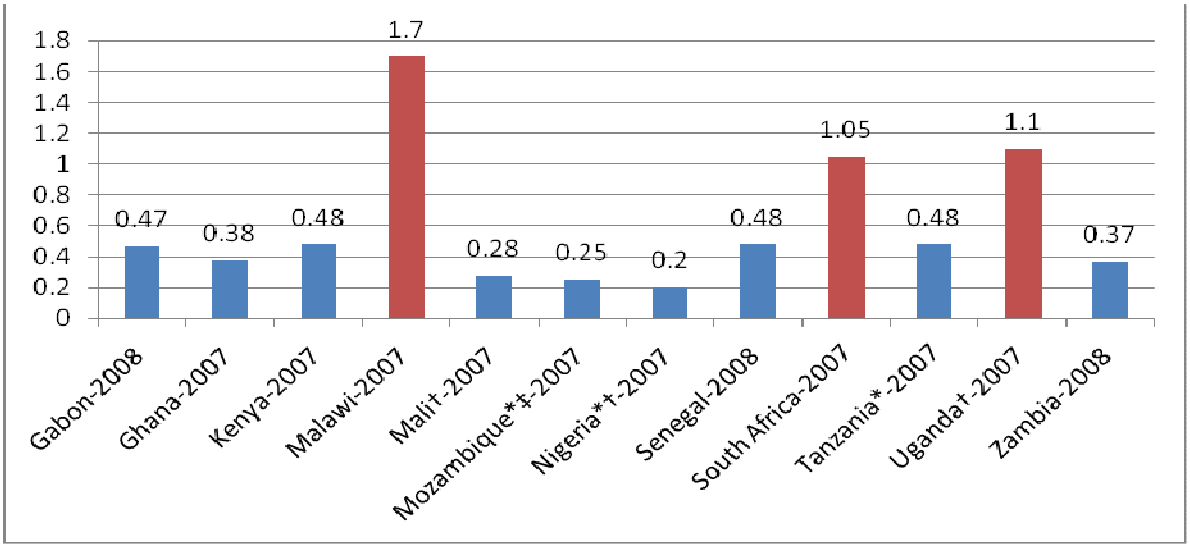
(1) Gross domestic Expenditure on R&D (GERD) by source of funds and sector of performance; and
(2) R&D personnel (headcount and full-time equivalent) by gender, sector of performance, level of formal qualification and occupation, as well as researchers by gender and field of study/research.

The survey results on R&D expenditure indicated that:

- Reported R&D investment in surveyed countries ranged between 0.2% and 0.48% of the GDP and only three countries (Malawi, Uganda and South Africa) reached the 1% of their GDP (Figure 1) (AOI, 2010). Many of these data have been questioned (.e.g. the GERD from Uganda and Malawi). In the case of South Africa the GERD/GDP ratio is known to be slightly below 1% at 0.92% (Centre for Science, Technology and Innovation, (CesTII), South Africa, personal communication). The variance between the results reported in the AIO-2010 report and CesTII may be attributed to the different conversion factors used. Thus, data from this pilot survey should be interpreted with caution and should be used in future to compare with data from other surveys such as the AIO 2013 report;
- The public sector (government and higher education) was the first R&D performer except in South Africa and Malawi where the business sector is dominant;
- The government was the most important funding source of R&D activities, especially if higher education was lumped together with government (Figure 2). Kenya and Uganda (and to some extent Zambia) stood out as the only countries where the higher education sector itself accounted for a considerable share of R&D funding;
- R&D activities were to a large extent financed by international donors and other foreign sources. Among the countries surveyed, Mozambique was the most dependent on foreign donors, since over 50% of its R&D was financed from abroad, followed by Mali (49.0%), Tanzania (38.4%), Senegal (38.3%) and Malawi (33.1%). This support is important to register, since the dependency should be expected to decrease over time, despite the fact that international support is important at a capacity-building stage. Nigeria and Zambia showed very low dependence on foreign funding of only about 1.0% (Figure 2);
- The business enterprise sector accounted for a considerable share of the funding of R&D activities in some countries (Ghana 50.9%, South Africa 42.7% and Malawi 22.8%), while in most countries; the share of funding was less than 10% (Fig 1). The Ghanaian business sector stood out because it heavily funded R & D in comparison to other funding sources.

The data on researchers revealed very interesting information. Among the countries surveyed, South Africa had by far the highest number of human resources (headcount) available for R&D activities, with a researcher density of 825 per million inhabitants. Senegal was not far behind with a researcher density of 635 per million inhabitants. At the other end of the scale, was Mozambique (with a researcher density of 24.4). Uganda (25.4) and Ghana (27.1) lagged further behind. It was not clear why these huge differences were observed between countries. A possible reason could be that the definition of a 'researcher' varied between countries. This issue warrants further investigation.

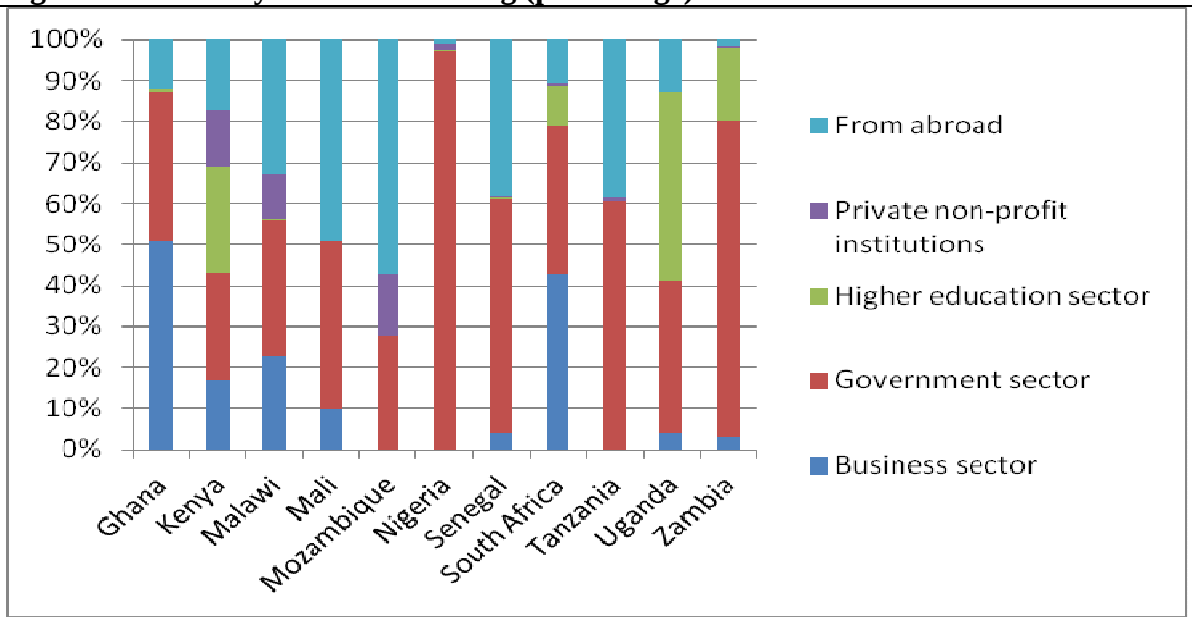
Figure 1: Gross Domestic Expenditure on R&D as a percentage of GDP



Sources: ASTII R&D Surveys; PPP data from UNDP (2010); population and GDP data from AfDB (2010)

Note: Not all sectors have been surveyed by some countries. For countries that did not survey all sectors the result is not GERD per se.
* Data do not include the business enterprise sector
† Data do not include private non-profit institutions/organisations

Figure 2: GERD by source of funding (percentage)



Note: Not all sectors have been surveyed by some countries. For countries that did not survey all sectors the result is not GERD per se.

Estimating the extent to which a country devotes its financial resources to research and experimental development, and how these resources are allocated among sectors, is perhaps the most visible and internationally acceptable R&D indicator. However, it is also important to estimate the human resources that are available and actually utilised, to do research in a country.

The share of researchers among the R&D personnel is, as a rule, between 55% and 75% in most OECD countries (OECD 2010). In the case of South Africa, the share was 67.5%. Among the countries surveyed, there were only a few countries with ratios in the same range. In some countries the ratio was as low as 25% (Malawi and Mozambique) and around 30% (Ghana and Zambia). This could be interpreted in different ways. If it is assumed that the 'normal' researcher/research personnel ratio would lie between 55% and 75%, what would then explain the fact that the ratio was far lower in some countries? It could mean that researchers in some countries were supported by a much larger staff than in other countries, and this is not necessarily a bad thing. However, it could also indicate that there is an inefficiency problem in such countries. Another – rather simple explanation – is that 'researcher' was defined differently in the surveyed countries. This issue requires further research.

Challenges to Conducting STI Surveys in Africa

This was the first survey ever for some of the countries, and lessons learned should include harmonising methodologies, definitions and ensuring countries identify and delineate indicators important for their national system of innovation (NSI) while maintaining international comparability. Some bottlenecks to R&D data collection in Africa were identified as follows:

- Lack of institution or dedicated body to collect STI indicators;
- Low prioritization of the collection of STI data in national budgets;
- Lack of awareness on the significance and use of STI information;
- Insufficient capacity to conduct STI surveys: human, infrastructure and institutional.

Policy Recommendations

Evidence from the implementation of the ASTII programme has demonstrated that Africa has established a foundation to continue experimenting and measuring the effects of STI on its economic and social transformation. However participating countries need to:

- Prioritize the measurement of STI on their national development agenda;
- demonstrate political commitment to the process through sustained data collection;
- Promote continued participation and enhanced ownership of the ASTII programme at country level;
- Build on the experience gained in collecting and analysing STI data by allocating sufficient resources to comply with the 1% target of GDP invested in R&D. This would help to sustain the ASTII programme and increase its significance for the development and implementation of STI policies;
- Embark on additional work as required, including the use STI indicators for policy formulation, review and implementation;
- Strengthen the statistical capabilities of participating countries to improve the quality of data through investment human capital development and Information communication Technology (ICT) infrastructure;

- strengthen collaboration and linkages between line ministries involved in science and technology and the National Statistics Office.

These recommendations will promote efficiency in the conduct of R&D surveys on an annual basis and ensure that collected data become official national statistics. Compilation and analysis of R&D data will also allow for systematic monitoring of R&D investments as well as cross-country comparisons of indicators.

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