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## SCIENTIFIC PRODUCTIVITY OF THE AFRICAN UNION MEMBER STATES (2005 TO 2010)


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

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# Scientific Productivity of the African Union Member States (2005 to 2010)

## Executive Summary

*The African Union's scientific output is relatively small, but growing rapidly, with a growth rate similar to that of India, China and Brazil between 2005 and 2010. The propensity to publish in highly cited journals has grown rapidly between 2005 and 2010. One of the most important findings of this study is how infrequently African countries collaborate—only 4.3% of the papers in 2008-2010 included inter-African country collaboration, contrasting with a score of 40% for extra-African collaboration between at least one African and one non-African country. A programme to foster cooperative research might help increase the rate of cooperation and accelerate the pace of STI development in Africa. In terms of specialisation and impact by fields of science, the recommendations contained in this Policy Brief are based on the profile of the African Union as a whole entity. At the individual country and economic communities levels however, the pictures of specialisation and impact follow the general trends observed at the African Union (AU) level but are varied in places, and would necessitate specific country and Regional Economic community (REC) bibliometric profiling. Overall, the trend of science and technology improvement in the African Union is quite promising, and further investigation in a number of areas at a more granular level is warranted.*

## Introduction

The African Union's strengths and weaknesses in Research and Experimental Development (R&D) are highlighted in a study on the state of science and technology in the African Union, 2005-2010, by the African Observatory of Science, Technology and Innovation (AOSTI, 2013). How much scientists in the Africa Union are putting out in terms of publications in scientific journals was assessed for all the 54 member countries of the African Union. This study made it possible to compare various African countries in a single shot.

The results are generally positive, with high levels of growth in both total scientific production as well as production quality. The scientific production of the African Union grew 22% faster than that observed at the World level over the 2005-2010 period. Several African regional economic communities (RECs) saw even faster growth: the Arab Maghreb Union's indexed production grew by 60%, that of the Community of Sahel-Saharan States by 50%, and that of the Common Market for Eastern and Southern Africa and of the Economic Community of West African States by 47% each. At the country level, production in Algeria grew the fastest (74%) for the 2005-2010 period. The main constraint while comparing the scientific production in RECs is the issue of double counting generated by few countries which belong to more than one community.

## Intra-African collaboration and international collaboration in Science and technology

The portrait of extra-African collaboration is radically different from that of bilateral AU collaboration. For instance, if one examines the proportion of papers with only non-AU countries, namely international collaboration solely with countries not in Africa, the AU-level percentage is 40%. When computed by taking the score measured for each country instead, the non-weighted average dropped somewhat from 51% in 2005-2007 to 49% in 2008-2010. Although having a high percentage of external collaboration with non-African countries is usually seen as a positive aspect in scientific knowledge production, a too high level of external collaboration may denote a situation of dependence. Mostly, external funding and

the related grant conditions, compounded with the scarcity of significant funding sources from within Africa may drive the high weight of international collaboration found in this study. Further, the lack of strong collaboration frameworks in science and technology to foster cooperative research within Africa can also be cited as a culprit.

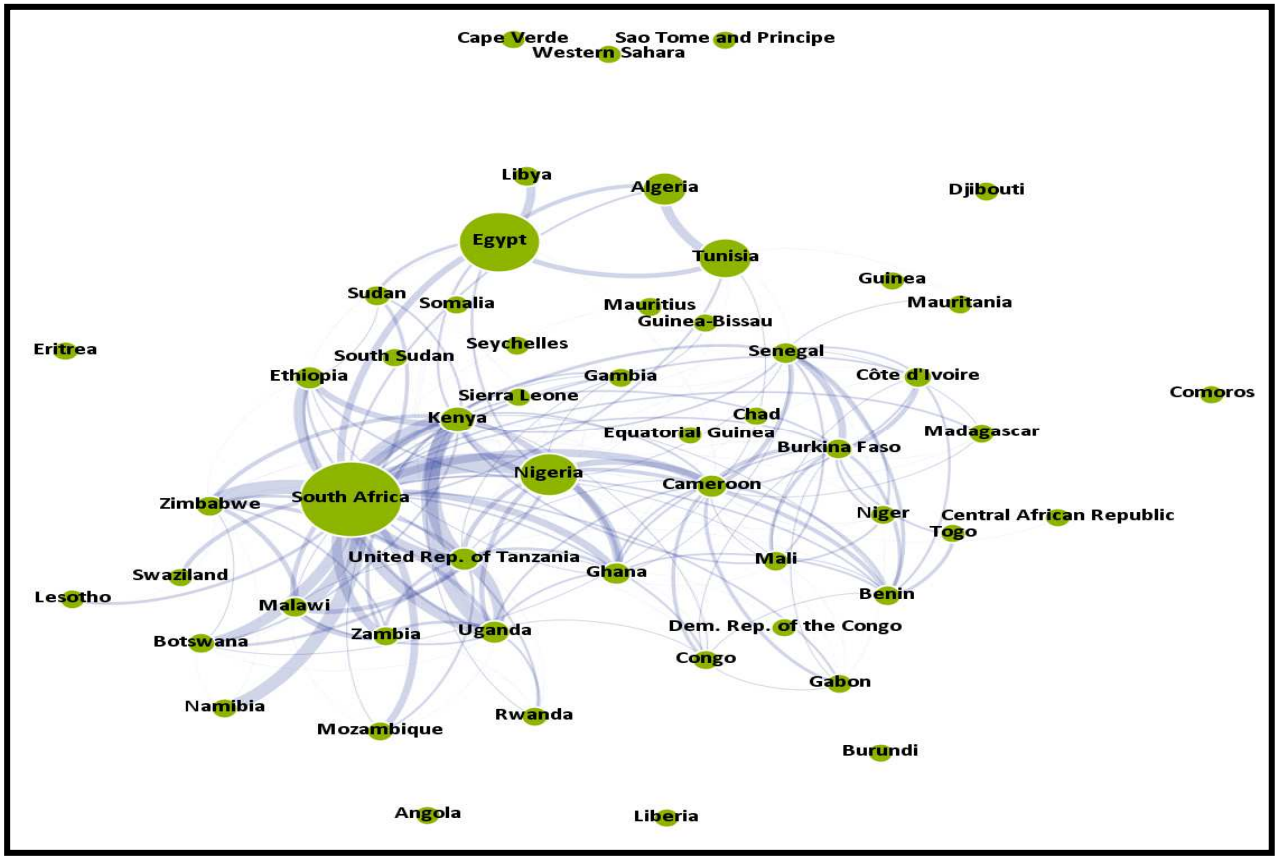


Fig1: Collaboration among the AU countries, 2005-20 Source: AOSTI, 2013

The trend of the analysis of the scientific production profile of institutions, countries, regions or individual scientists shows that South Africa hosts the largest number of leading scientists, consistent with its leading role in African science followed by Tunisia, Egypt, Kenya, Algeria, Nigeria and Cameroon. The leading 7 countries host 90% of the most active scientists in the AU.

## Scientific and technological production of the African Union

The "Assessment of the state of science and technology in the African Union, 2005-2010" study has revealed that scientists in South Africa and Egypt had the highest number of scientific papers published over that period, an indication of the scientific and technological activities occurring in these countries; followed by Nigeria, Tunisia and Algeria. However, Tunisia becomes the top performer, followed by Seychelles, when the number of papers produced is divided by the number of people in a country, known as scientific production per capita (Million inhabitants).

Analysis of 505 "most active scientists" in the African Union who had published 40 or more papers in highly ranked journals between 2005 and 2010 showed that half of them (250 out of 505) have their publications referred to by other scientists than the world average scientist.

Likewise, 52% of Africa's "most active scientists" have an output growing faster than the world average.

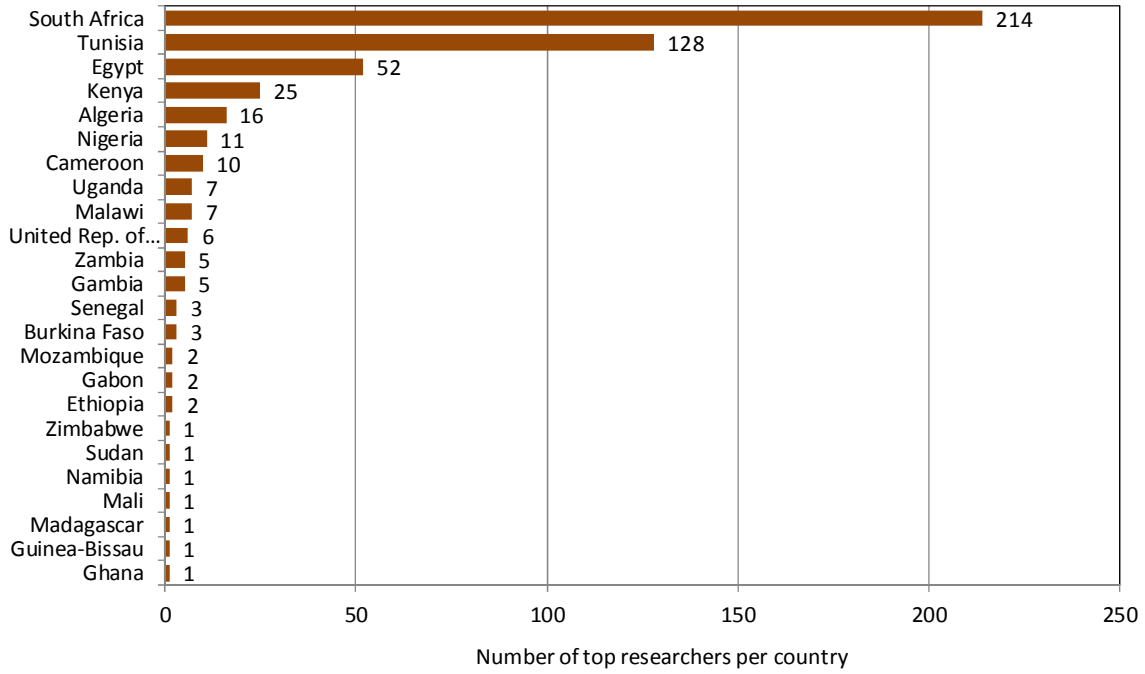


Figure 2: Number of highly active scientists per AU member states, 2005-2010
Source: AOSTI, 2013

A very interesting finding is that 49% of the leading researchers have more than 50% of their publications authored with collaborators from a different country. The possibility of such researchers with international collaborators to have their publications cited by other researchers is greater than the average world scientists.

## Lessons from the Scientific and technological production of the African Union

Whilst acknowledging the positive development in science output by AU scientists, we must also acknowledge that Africa's scientific outputs over the years have been very small and as such any little upward push can make it look too good, statistically. The contribution of the African Union to the World scientific production (2005-2010) remains small at 1.8% of the World production. The low level of contribution to the World production shows that much effort still needs to be deployed in developing STI systems in Africa in order to catch up with the production levels of the rest of the World and to effectively use STI for development.

It is also important to note that collaboration between African researchers is very low, occurring in only 4.1% of AU scientific papers in 2005-2007 and in 4.3% of the papers in 2008-2010. However, collaboration between African researchers and non-African colleagues is very high. External collaboration can be responsible for the increased publications in highly cited journals. But this drive towards non-African collaboration should not only be seen as a positive aspect in scientific knowledge production because it may just denote a situation of dependence. External funding and related grant conditions, compounded with the scarcity of significant funding sources from within Africa could be responsible for the high weight of international collaboration. The lack of strong collaboration frameworks in science

and technology to foster cooperative research within Africa cannot be overlooked as a contributing factor to this development.

Scientists in the African Union are highly active and demonstrated research excellence in the traditional fields such as Health sciences, Natural sciences, Applied sciences (especially in agriculture, fisheries and forestry) Economic and Social Sciences and Arts and Humanities. But in new and emerging sub-fields like ICT (Information and Communication Technologies), bioinformatics, biotechnology, materials, energy, nanoscience and nanotechnology the AU is far below the world average in terms of concentration of research effort and quality of research.

Many African scientists who publish in national or continental journals are limited in terms of the visibility of their output. The Web of Science (WoS) (produced by Thomson Reuters and covering about 12,000 peer-reviewed journals), and Scopus (produced by Elsevier and covering about 18,000 peer-reviewed journals) are the two comprehensive databases that offer extensive coverage of international scientific literature and index the bibliographic information required to perform robust and extensive bibliometric analyses. But even these two still have limitations for Africa with regards to the linguistic bias for countries that publish in English-language journals. Thus, the scientific production is underestimated for countries whose researchers publish more often in languages other than English, an important fact due to the linguistic diversity observed in Africa. Also, African scientists who publish in national journals sometimes find their work not included in these two comprehensive databases.

## Challenges to Science output in the African Union

The vast majority of Africa's scientific publications do not make their way into the citation index used by bibliometric studies to evaluate scientific production, mostly because of perceived low quality standards of the so called local journals that publish them. The challenge, therefore, is finding ways to raise the quality of African local journals for their inclusion in the citation index or to find ways around the citation index outlets.
Researchers in AU member states are not collaborating as compared with how they collaborate with the world outside Africa. The insignificant intra-African cooperation in science and technology means that synergies and complementarities of African STI systems are not fully harnessed by Africans.

New and emerging fields of specialisation in the applied science such as Engineering, Information and Communication Technologies (ICT), Enabling and Strategic Technologies, continue to have low research effort concentration.

## Policy Recommendations

### 1. Increase the visibility of the African Union's scientific production

- Encourage the creation and operation of high quality science and technology publishing houses in Africa
- Improve access of African researchers to journals with high impact factors
- Create incentives for publishing in journals referenced in the citation index, similar to the South African incentive that rewards scientist per publication in the citation index. This policy is actually boosting scientific publications in citation index journals by

South African researchers and could be replicated by other African countries. In that line, the National Council for Science and Technology of Kenya has followed suit by offering dollar incentive to scholars in public and private universities, research institutes and the NGO sector for every international publication in peer reviewed journals.

- Create open and free access publication outlets for Africa, with improved review committees. The African most active researchers found by this study and the leading scientists of the African diaspora could play a major role in these committees. Indeed, one of the major bottlenecks to publishing in some referenced journals is the publication fees; some of the citation index journals request high costs that African scientists and institutions can hardly put on the publication of a single paper.

## 2. Boost the intra-African cooperation in STI while maintaining strong collaborations outside Africa

Though little, the trend of increased collaboration observed between some African countries must be supported, enhanced and replicated in the other African countries through Pan African programmes engaging AU member states in common science and technology cooperation frameworks.

## 3. Address gaps in fields of science that are essential to today's competitive knowledge economy

In fields where the AU has low concentration of research efforts and/or low research impact, there is a need for urgently addressing this due to the strategic importance of these fields for today's economic growth.

- In engineering: critical mass is needed
- In information and Communication Technologies: both critical mass and quality research are needed
- In enabling strategic technologies: critical mass is needed

## 4. Sustain the current growth trend of Africa's scientific production by adequate policy measures

The growth of scientific production observed at the African Union, regional and individual country level is substantial. These growth figures, although coming from an initially small stock of production show that efforts undertaken to promote science, technology and innovation in Africa are starting to bear fruits and need to be scaled up and sustained for a long lasting effect on economic growth and development.

## Reference

This policy brief is a summary of the bibliometric project of the AOSTI entitled ***"Assessment of the scientific productivity in the African Union, 2005-2010"*** published in the African STI Outlook, Bibliometric series #01, 2013.

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