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Developing equal, mutually beneficial partnerships with African universities

Recommendations for a new
European collaboration strategy

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The Guild
of European Research-Intensive Universities



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Previously he has been the director of the Center for Higher Education Policy Studies (CHEPS), University of Twente, the Netherlands. He is the editor of the book series Higher Education Dynamics (Springer), has produced more than 200 international publications on public governance and organization issues with respect to higher education and science, and been active in multiple national and international expert committees for various national and international organizations, such as the European Union, the OECD, national governments, and the German Science Council.

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Foreword

This paper sets out a rationale for a new ambition of collaboration, based upon the need for new levels of investment in Africa's research capacity. As the African Union and the European Union are developing a new strategy for jointly addressing our global challenges, they have a unique opportunity to invest in African research universities, and support new collaborative networks of universities and researchers in both continents. This is key to the ability of both continents to address our societal challenges like climate change and digital transformation. Both, the European Union and the African Union, have emphasized the importance of supporting research and innovation, and the universities within which these take place. This is a crucial time to act, to ensure that collaboration between Africa and Europe is future-oriented and strategic, and carries the support of universities, governments, and the two Unions.

This Insight Paper was written by Professor Peter Maassen from the University of Oslo, and its content was informed by discussions in The Guild's North-South working group over the past 18 months. It also reflects deliberations amongst our Vice-Presidents in repeated meetings, as well as our General Assembly of Presidents in October 2019. I am grateful to all of the colleagues who were so generous with their time and contributions to these meetings. Finally, this paper is fully endorsed by the African Research Universities Alliance (ARUA), and forms the basis for a number of key recommendations jointly articulated by ARUA and The Guild, and published together with this Insight Paper¹. The spirit of partnership and collaboration between research intensive European and African universities is what this paper calls for, and what we are fully committed to.

Jan Palmowski
(Secretary-General of The Guild)

¹ ARUA-The Guild (2020), Recommendations for Strengthening African Research Universities (Brussels): <https://www.the-guild.eu/publications/arua-guild-position-on-africa>

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Peter Maassen

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Executive Summary

The positive development transformations that large parts of Africa are experiencing provide an important window of opportunity for a new strategic political partnership between Europe and Africa. This is acknowledged by the first visit of new EU Commission President Ursula von der Leyen outside of Europe, to Addis Abeba in December 2019. On this occasion she presented an ambitious plan for a new EU-Africa strategy in which especially climate change, digitalization, and peace and security are emphasised.

All African heads of state have agreed on an ambitious action plan (Agenda 2063) to stimulate further development throughout the Continent. Realising Agenda 2063 is strongly dependent on enhancing adequate skills and competences among the labour force, as well as increasing the volume, relevance, and quality of frontier-led research. Currently most of all the research output in Africa is produced by universities, even though their overall performance is still lagging behind their counterparts in the rest of the world. Consequently, strengthening universities is a crucial component in building African knowledge societies. This includes the universities' role in enhancing the R&D capacity and innovation potential of the private sector, in setting up successful incubation projects, and in contributing to the digital economy in Africa.

From a demographic perspective, too, the role of universities is crucial. In the worst-case scenarios, the rapid growth of the African population will lead to dramatic

challenges for Africa and Europe, in the form of massive shortages in basic food and water supplies, environmental transformation, and the rising numbers of migrants. Substantially increasing the educational capacity of universities especially at the postgraduate level is a necessary condition for a growing part of the population to enter sustainable ways of life.

Overall, to realise Africa's development potential and ambitions, huge investments in the university sector are needed. These have to come partly from Africa's national governments. In addition, investments from outside the continent are required. Various new initiatives for strengthening bilateral university collaborations have been introduced, e.g. in China. Notwithstanding these initiatives, Europe as Africa's closest neighbour and most important trade partner should have the ambition to play a key role in the strengthening of African universities. To realise this, the new strategic Africa-EU political partnership should prioritise major investments in research universities in Africa. The aims should be to support research collaborations in selected fields among African and European universities, and to strengthen the research infrastructure at African universities. Measures should also include developing joint African-European PhD programmes, introducing postdoctoral scholarship programmes for African research talents, and developing long-term career opportunities at African universities for young scholars.

1. Introduction

The African continent is currently undergoing a remarkable period of political, economic and social transformation, witnessing an increase in the average life expectancy in the whole of Sub-Saharan Africa in just one generation by 11 years¹, and high levels of economic growth over a number of years by many African countries². For further advancing this transformation in a sustainable development direction, the role of higher education in general and research universities in particular is crucial. This is acknowledged in the seminal Agenda 2063³ and its accompanying action plan agreed upon by all African Heads of State. The Agenda sets a number of key continental milestones, including the building of an African knowledge society through investments in higher education, science and technology. One of the intended outcomes of the Agenda's action plan is that Africa will have a large number of globally competitive research universities by 2063.

While many African universities have recently realised promising increases in their academic productivity, overall they are still lagging behind universities in other parts of the world. They face major capacity challenges in many areas, such as human resources management, education and research facilities, the institutional room to manoeuvre, and the unstable institutional budget situation, resulting from insufficient national funding and fragmented, unsustainable investments from development aid agencies, which often hinder further academic development and growth. Therefore, they are generally not regarded as equal scientific partners for universities from outside the Continent.

The overall transformation of Africa requires a dramatic rethinking of Europe's relationship with Africa, as acknowledged, for example, in President Macron's 2017 lecture at the Sorbonne University⁴, and in Commission President Von der Leyen's rationale for selecting Africa for her first visit outside Europe (December 2019)⁵. The latter is argued to mark a radical shift for the European Union (EU) from a relationship with Africa embedded in development aid investments to building a strategic political partnership, based on common interests and a mutually agreed upon collaboration agenda. A new African-European strategic partnership requires a strong knowledge foundation for legitimising and implementing joint programmes, policies and action plans. Strengthening African research universities is also from this perspective an

1 See: UN's 2018 human development index (<http://hdr.undp.org/en/content/human-development-index-hdi>; accessed 17 February 2020).

2 See 'Africa Growth at 7-Year High, no Thanks to its Major Economies': <https://www.bloomberg.com/news/articles/2019-04-03/africa-growth-at-7-year-high-no-thanks-to-its-major-economies>; accessed 17 February 2020.

3 See: <https://au.int/agenda2063>; accessed 17 February 2020.

4 Emanuel Macron, 'A Vision for Europe': <http://international.blogs.ouest-france.fr/archive/2017/09/29/macron-sorbonne-verbatim-europe-18583.html>; accessed 17 February 2020.

5 See, for example: 'Into Africa: von der Leyen visit kicks off 'Geopolitical Commission': <https://www.politico.eu/article/into-africa-von-der-leyen-visit-kicks-off-geopolitical-commission/>; accessed 17 February 2020.

inevitable issue of common interest.

Following discussions amongst the leadership of Guild universities and its North-South working group, and the leadership of the African Research Universities' Alliance (ARUA), in this paper a number of considerations, arguments and recommendations are presented concerning the importance and timeliness of major European investments in research universities in Africa. Such investments will enhance the academic productivity and socio-economic relevance of African universities. In addition, it will contribute to making equal, mutually beneficial partnerships among African and European universities possible.

2. Demographic challenges

The political recognition that research universities are critical to development in Africa challenges traditional perspectives, which strongly concentrate on primary education and regard higher education as a 'luxury'. In many respects, these traditional perspectives still dominate development aid agendas and programs. Nonetheless, also in Africa universities are key knowledge institutions that are integral to the continent's ambitions to address its 'grand societal challenges'. One of the most devastating challenges affecting the attempts to advance socio-economic progress and implement Agenda 2063 is the demographic development on the continent. By 2025, a quarter of the world's population in the under-25 age group will be African, while between 2019 and 2030 the African population will grow with 1.2 billion people (more than 50% of the world's total population growth). By 2035 more students will come from Africa than from any other Continent, whilst the most pessimistic scenario for the year 2100 predicts that Africa could have over 4 billion inhabitants⁶. At the same time, currently less than 10% of African 18-24 year olds are enrolled in some form of post-secondary education or training. In addition, public expenditures per university student in Africa dropped from USD 6800 in 1980 to less than USD 1000 in 33 sub-Saharan African countries by 2009⁸, amongst other things, because of disinvestments in higher education in favour of other donor preferences.

A continuous, non-altered demographic development trajectory would create dramatic challenges for Africa, as well as the rest of the world and especially Europe, amongst other things, in the form of massive shortages in basic food and water supplies, the impact on the environment, and the rising numbers of migrants. Huge efforts are needed to stimulate more sustainable demographic, as well as economic and social development paths in Africa, and investments in universities are among the central measures identified for countering the negative demographic development scenarios. An argument in this is that the increasing cohorts of students that are now enrolled in secondary education throughout the continent should have the opportunity to continue their education in universities and colleges in order to be able to enter sustainable ways of life. Currently, the higher education capacity in Africa is insufficient to absorb the growing number of secondary education graduates. Consequently, a relatively large number of them run the risk of entering society with insufficient skills and competences, most likely resulting in unsustainable ways of life.

⁶ United Nations, World Population Prospects. The 2017 Revision. Key Findings and Advance Tables (2017), p.1 table 1. (See: https://population.un.org/wpp/Publications/Files/WPP2017_KeyFindings.pdf; accessed 17 February 2020).

⁷ In 2015 only 7% of young people in the relevant age group were enrolled in tertiary education in Africa. See: African Union, 'Continental Education Strategy for Africa 2016-25', p. 18 ([http://edu-au.org/downloads/Strategic%20Documents%20and%20Frameworks/Continental%20Education%20Strategy%20for%20Africa%20\(CESA%2016-25\)/AU_CESA_16-25_en.pdf](http://edu-au.org/downloads/Strategic%20Documents%20and%20Frameworks/Continental%20Education%20Strategy%20for%20Africa%20(CESA%2016-25)/AU_CESA_16-25_en.pdf); accessed 17 February 2020). See also: Darvas, Peter, Shang Gao, Yijun Shen, and Bilal Bawanay (2017). Sharing Higher Education's Promise beyond the Few in Sub-Saharan Africa. Washington, DC: The World Bank. (See: <http://documents.worldbank.org/curated/en/862691509089826066/pdf/120693-PUB-PUBLIC-PUB-DATE-10-25-17.pdf>; accessed 16 February, 2020).

⁸ See: World Bank (2009). Accelerating Catch-up: Tertiary education for growth in sub-Saharan Africa. Washington DC: The World Bank. (http://siteresources.worldbank.org/INTAFRICA/Resources/e-book_ACU.pdf; accessed 16 February, 2020).

3. The rise of research universities in Africa

In the 1980s and 1990s, the scientific contributions of African scholars⁹ in the form of academic articles or books slightly decreased as a percentage of the total global scientific production, while also stagnating in absolute numbers¹⁰. This situation has changed from the beginning of this century on, implying that scientific output has increased in absolute terms, while also Africa's share of world scientific papers has grown (see figure 1). In addition, international research collaboration of African scholars with scholars from other continents has increased, especially the collaboration with scholars from China, Brazil, and India. At the same time, there remain areas of concern, for example, the low investments by national African governments in higher education and (public) Research and Development (R&D), implying a continued reliance by many African countries and universities on foreign funding¹¹ (see figure 2), and the negligible cross-boundary scientific collaboration in Africa¹² (figure 3).

An important issue of relevance for African-European university cooperation is the growing intra-African diversity in socio-economic and academic development trends. The World Bank's 2019 country classification¹³ classifies 24 African countries as low-income countries (with a Gross National Income (GNI) per capita in 2018 of USD 1,025 or less); 21 African countries as low-middle-income countries (with a GNI per capita between USD 1,026 and USD 3,995); 8 African countries as upper-middle-income countries (with a GNI per capita between USD 3,996 and USD 12,375); and one African country as a high-income country (with a GNI per capita of over USD 12,376). Also among universities in Africa a growing diversity can be observed¹⁴, for example, in the increasing inter-country variety in participation and graduation rates, especially at Master's and PhD levels; in enrolment patterns per academic field; in student-staff ratios; and the employability of graduates. When it comes to university research, diversity is increasing in areas such as national R&D investments and research budgets of universities; R&D staff and facilities at universities; research output and productivity; and size and quality of doctoral programmes.

9 African scholars refers to scholars employed by one or more universities or research institutes located in an African country.

10 Mouton, J. & J. Blanckenberg (2018). African science: A bibliometric analysis. In J. Mouton, C. Beaudry, & H. Prozesky (Eds.), *The Next Generation of Scientists in Africa* (pp. 13-26). Somerset West: African Minds, pp. 13-14.

11 Mouton, J. (2018). African science: A diagnosis. In J. Mouton, C. Beaudry, & H. Prozesky (Eds.), *The Next Generation of Scientists in Africa* (pp. 3-13). Somerset West: African Minds, p. 11.

12 Mouton, J. & J. Blanckenberg (2018). African science: A bibliometric analysis. In C. Beaudry, J. Mouton, & H. Prozesky (Eds.), *The Next Generation of Scientists in Africa* (pp. 13-26). Somerset West: African Minds, p. 22.

13 See: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>; accessed 17 February, 2020.

14 See: Cloete, N., P. Maassen & T. Bailey (Eds.) (2015) *Knowledge Production and Contradictory Functions in African Higher Education*. Somerset West: African Minds; and: Cloete, N., I. Bunting & F. van Schalkwyk (Eds.) (2018) *Research Universities in Africa, Somerset West: African Minds*; see also: Darvas, P., S. Gao, Y. Shen, & B. Bawany (2017). *Sharing Higher Education's Promise beyond the Few in Sub-Saharan Africa*. Washington, DC: The World Bank.

The diversity poses a challenge for future African-European university cooperation when it comes to combining a continent-wide approach with an approach that does justice to the specific strengths, weaknesses and needs of individual African universities. Currently, most European national development aid programmes focus on the 24 low-income countries in Africa, and link higher education (sub)programmes to poverty reduction, instead of to the notion of an African knowledge society.

4. Major academic trends in African universities¹⁵

Embedded in these general developments, the main current academic trends in African universities include the following:

- A remarkable growth in undergraduate capacity, enrolment and graduation, with relatively low undergraduate dropout rates¹⁶.
- At graduate level, growth is taking place especially at the Master's level, but mainly in professional Master programmes. Doctoral education is lagging behind, and the number of doctoral graduates per million inhabitants is extremely low throughout Africa compared to the rest of the world¹⁷. An exception is formed by South Africa, which has attracted large numbers of doctoral students from other Sub-Saharan African countries. However, recent funding proposals by the National Research Foundation of South Africa (NRF) might significantly reduce the number of doctoral students from the rest of Africa at South African universities.
- Even though the doctoral education output of African universities remains low, the number of African doctoral degree holders graduating from African and non-African universities is increasing. As recent studies show¹⁸, most of these young scholars prefer to develop an academic career in Africa. However, there are limited career possibilities at African universities for the growing number of young African scientists.
- Research output in African universities is increasing, but there are no fields (yet) where scholars employed by African universities are both qualitatively and quantitatively strong (in relative world share) and highly visible (figure 4). In addition, a considerable part of the increase in research output comes in the form of academic publications produced together with scholars from outside the Continent. Unfortunately, academic publications produced by two or more African scholars employed by universities in different African countries forms a negligible part of the total academic output of African universities¹⁹.
- A specific characteristic of the scientific landscape in Africa is that by far the most research activities²⁰ take place inside or in units attached to the continent's

15 For detailed data on academic trends in Africa, see the references mentioned in note 14, as well as Beaudry, C., J. Mouton, & H. Prozesky (Eds.) (2018). *The Next Generation of Scientists in Africa*. Somerset West: African Minds.

16 See, for example, Cloete, N. et al. (2018): pp. 40-42.

17 See: Salmi, J. (2017). *The Tertiary Education Imperative*. Rotterdam: Sense Publishers.

18 See, e.g.: Beaudry, C., Mouton, J. and Prozesky, H. (eds.) (2018). *The Next generation of Scientists in Africa*. Somerset West, Cape Town: African Minds.

19 Mouton, J. & J. Blanckenberg (2018): p. 21.

20 Overall, the university sector produces up to 80%-95% of the national basic research output in Africa, as shown by various studies conducted by DST/NRF Centre of Excellence in Scientometrics and Science, Technology and Innovation Policy (SciSTIP).

universities. The knowledge production activities inside non-university research institutes and in the business sector are very small compared to the rest of the world. In a number of African countries, the national flagship university produces more than 50% of the national research output (table 1). This implies that strengthening the overall R&D and innovation capacity in Africa has to be based on the research universities as the core knowledge institutions on the continent. Only through major, targeted investments in the research and graduate education capacity of these institutions, the R&D output and innovation capacity of the private sector can be built up to a level comparable to the rest of the world.

- There is a fundamental lack of competitive research funding in nearly all African countries. The percentage of the national GDP invested in academic research is significantly lower than in the OECD area, and in most African countries there is either no or an underfunded national research council²¹.
- Most universities in Africa receive a large part of their research budget in the form of earmarked project funding by donors from the North. In general, there are very few incentives in this type of research funding for producing academic publications, that is, African university staff are in general not required by the donors from whom they receive project funding to produce academic publications in international peer-reviewed journals²².
- Strategic efforts to strengthen university capacity by moving from traditional project funding ('projectisation') by donors²³ to long-term programmes aimed at supporting the development of higher education systems have recently emerged²⁴. However, national and international support for the enhancement of the academic productivity of African universities, for stimulating inter-university collaboration within Africa ('knowledge networks'), and for building strategic partnerships with universities outside Africa are still relatively rare, even though the global interest in the development potential of African universities is on the rise.

21 The European Union was, for example, the second most important funder of the research output of African scholars in the period 2009-2014, see: Kozma, C., C. Medina & R. Costas (2018). Research funding landscapes in Africa. In C. Beaudry, J. Mouton, & H. Prozesky (Eds.), *The Next Generation of Scientists in Africa* (pp. 26-42). Somerset West: African Minds, pp. 34-35. See also: Jowi, J., M. Obamba, C. Sehoole, M. Barifajjo, O. Oanda, & G. Alabi (2013). *Governance of Higher Education, Research and Innovation in Ghana, Kenya and Uganda*. (OECD: <https://www.oecd.org/sti/Governance%20of%20higher%20education%20research%20and%20innovation%20in%20Ghana%20Kenya%20and%20Uganda.pdf>, accessed 17 February 2020).

22 See, for instance, Maassen, P. (2012), 'Universities and the Effects of External Funding: Sub-Saharan Africa and the Nordic Countries'. In A. Nelson & Wei, I. (Eds), *The Global University. Past, Present and Future Perspectives*. Basingstoke: Palgrave Macmillan, pp. 231-54.

23 The term 'donors' refers to national and international public agencies with a mandate in the area of development cooperation, as well as private foundations that have specific development cooperation programmes.

24 See: Cloete, N., et al. (2018), *Research Universities in Africa*, pp. 110-11.

5. EU–Africa research collaboration from a global perspective

Various strategic initiatives are emerging around the world aimed at strengthening the collaboration with African universities. Recently, China announced that it would increase its investments in African higher education as part of a new multi-year programme for stimulating China-African collaboration in education²⁵. In addition, a number of US organisations has taken the initiative to develop a multi-year programme for African – US higher education collaborations with a strong focus on research universities.

In Europe, there are various EU and national programmes that provide funding opportunities for collaboration between European and African higher education. For example, in Horizon 2020 one of the Marie Skłodowska-Curie actions, called “International and inter-sectoral cooperation through the Research and Innovation Staff Exchanges (RISE)”, supports short-term mobility of research and innovation staff at all career levels both within and outside Europe. Also in the Erasmus+ programme there are various opportunities for support for collaboration projects with African universities. In addition, there are many national examples of relevance, for example, a programme by the Swedish International Development Cooperation Agency (Sida) for stimulating higher education and research collaboration between Mozambique and Sweden²⁶; and the Norwegian Programme for Capacity Development in Higher Education and Research for Development (NORHED), which aims at strengthening capacity in universities and colleges in low- and middle-income countries²⁷. In addition, the Africa strategy of the German Federal Ministry of Education and Research, introduced in 2018 with a budget of at least EUR 300 million provides ample opportunities for German universities to develop more equal collaboration projects with African partner universities²⁸.

These EU and national programmes are very important for the bilateral collaborations between African and European universities. They provide funding for these collaborations, contribute to building capacity in African universities, and allow for many important and productive academic connections between African and European universities. At the same time, most of the European programmes are characterised by their project orientation, their often short-term funding perspective, and the relative lack of coordination among individual European countries as well as between

25 See: <https://www.universityworldnews.com/post.php?story=20180907083412817>. Further: in 2000-2014, China committed \$671m to African Universities. ‘US Investment in African University Fails as China Advances’ in Wall Street Journal (21 July 2019; <https://www.wsj.com/articles/u-s-investment-in-african-university-fails-as-china-advances-11563706802>; accessed on 17 February 2020). For a discussion of the influence of China and India on (higher) education in Africa, see: <https://wenr.wes.org/2019/04/how-china-and-india-are-influencing-education-in-africa>; accessed on 16 February, 2020.

26 See: <https://www.sida.se/English/where-we-work/Africa/Mozambique/Our-work-in-Mozambique/>. accessed on 21 January, 2020.

27 See: <https://norad.no/NORHED>: accessed on 21 January, 2020.

28 See: <https://www.bmbf.de/de/perspektiven-schaffen---neue-afrika-strategie-vorgestellt-7304.html>: accessed on 17 February 2020.

the national and the EU programmes. The consequence is that while there are many important, well-functioning project-based collaborations between individual European and African universities, more comprehensive and long-term support programmes for European-African collaboration of continental university networks or alliances are currently not operating. At the same time, the extensive experience within Europe with international, multi-institutional research and education collaboration provides an important set of opportunities for developing new African-European university collaboration.

6. The African Research Universities Alliance

The establishment of ARUA²⁹ is aimed at pooling limited institutional resources and stimulating inter-country research collaboration within Africa. Concerning the latter, for the moment the ARUA member universities have agreed to concentrate their research collaboration on two thematic areas, that is, natural sciences, with a specific focus on climate change, and social sciences & humanities, with a specific focus on poverty and inequality. For this purpose, ARUA members are setting up joint Centres of Excellence, such as the African Centre of Excellence for Inequalities Research (ACEIR)³⁰, coordinated by the University of Cape Town; and the ARUA Centre of Excellence in Water, coordinated by Rhodes University³¹. While ARUA is an illustration of the ambitions of leading African research universities when it comes to strengthening their scientific research activities, the development of ARUA until now also shows the complexities and difficulties for African universities to move beyond their traditional missions and societal positions. These relate to building up an effective meta-organisational structure for ARUA and research management capacity at the member universities; moving from self-standing development-aid funded research and consultancy projects, to joint centers of excellence that are funded first and foremost through basic institutional and competitive external funding (national and international); moving from an emphasis on a limited number of traditional development fields, to a broader, more globally embedded focus on academically and socio-economically relevant thematic areas; developing research-based graduate programmes, including excellent joint doctoral education programmes; promoting the careers of young scholars in Africa; and investing in high-quality facilities and infrastructure.

Another challenge is the concentration of ARUA member universities in English-speaking Sub-Saharan African countries. To become more representative for the continent as a whole, ARUA is aiming at increasing its membership numbers to 20-25 universities, and is currently negotiating about ARUA membership with universities from French-speaking Africa, and Northern African universities.

29 The African Research Universities Alliance (ARUA) was inaugurated in Dakar in March 2015, and has currently 16 member institutions from nine countries (see: <http://arua.org.za/>): accessed 17 February 2020).

30 See: <https://aceir.org.za/about-us/>; accessed 20 January, 2020.

31 See: <https://www.ru.ac.za/iwr/networks/arua/>; accessed 20 January, 2020.

7. Recommendations for a way forward

The coming ten years will be crucial for the further development of African research universities, and the realisation of the goals of Agenda 2063 with respect to an African knowledge economy. To be able to further strengthen their productivity and relevance, African research universities are in need of large investments in their human capacity and infrastructural foundations, and the development of equal, mutually beneficial partnerships with universities within the continent, as exemplified by the establishment of ARUA, as well as with non-African universities. For various reasons, Europe as Africa's closest neighbour and most important trade partner is in a position to play a key role in the efforts aimed at strengthening African universities in the coming decade.

The European decisions and actions that will be of importance in the coming ten years include:

1. Stimulating an increase in public investments in higher education and science by national African governments.

2. Making long-term, structural European (EU and national) investments in the academic capacity building and research infrastructure of African research universities. This can be assumed to make equal, mutually beneficial partnerships between African and European research universities more feasible than currently possible. An important opportunity for this lies in the EU budget supporting the African-EU partnership. Key activities to be funded through these investments would include African-European doctoral education collaboration, post-doctoral scholarships, joint academic appointments in selected areas between European and African universities, and supporting African-European research collaboration networks in areas of high relevance to both continents and covered by the Sustainable Development Goals (SDGs), such as climate change, sustainable energy, security, digital technologies, and inequality. The intended impacts of these investments would include:

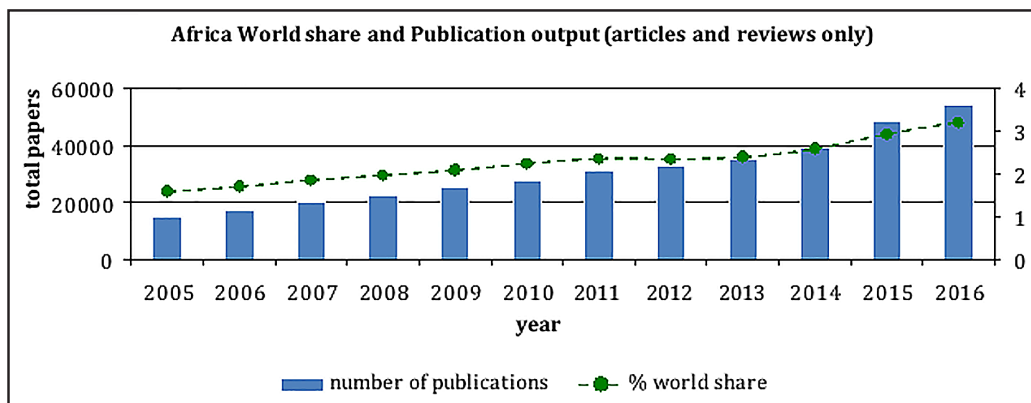
- Strengthening of intra-African research collaboration, amongst other things, through African universities alliances, such as ARUA.
- Enhancing, in close partnerships with European universities, the research quality and capacity of research universities in Africa.
- Stimulating joint African-European doctoral education programmes in the areas covered by the SDGs.

- Enhancing academic capacity building at African research universities for the development and use of digital technologies and for stimulating innovations that can contribute to the growth of the private sector in African.
3. Introducing new continent-wide and regional competitive research funding programmes in Africa that will contribute to promoting the quality, productivity as well as the global visibility and relevance of research conducted at African universities. This includes the possible establishment (with European support) of an African Research Council (ARC).

8. Annex

FIGURE 1

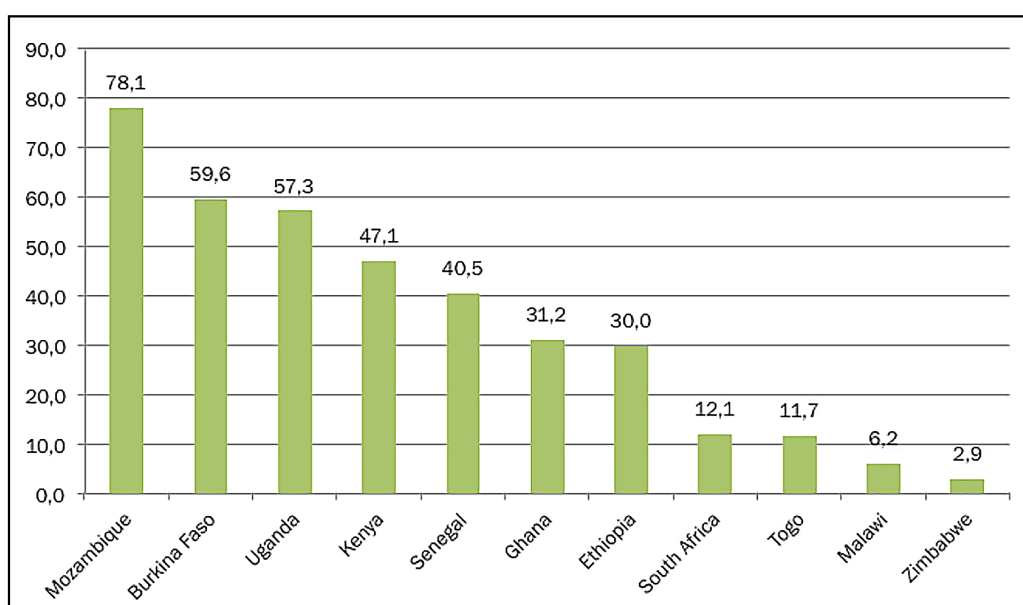
Increase in Africa's scientific articles and reviews (2005–2016)



Source: Mouton, J. & J. Blanckenberg (2018). African science a bibliometric analysis. In: C. Beaudry, J. Mouton & H. Prozesky (Eds.), *The Next Generation of Scientists in Africa* (pp. 13-26). Somerset West: African Minds, p. 14.

FIGURE 2

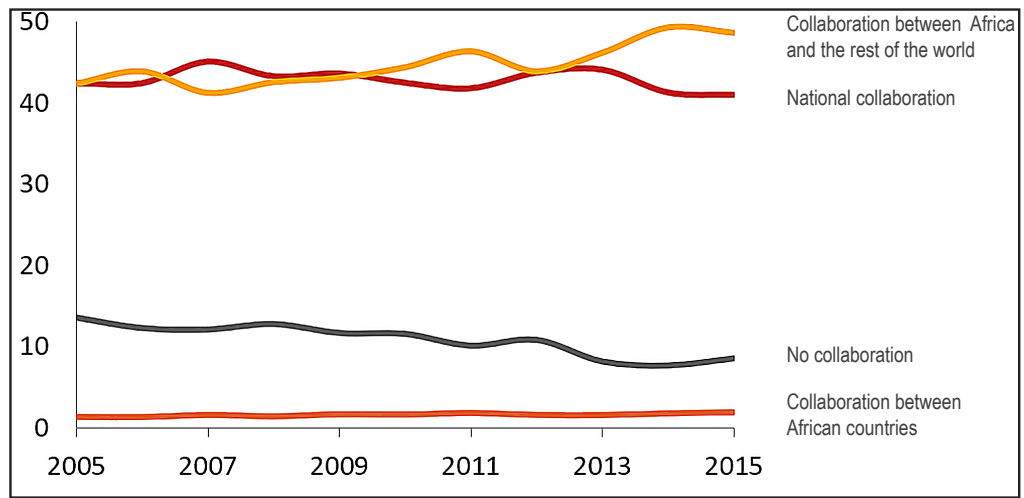
Foreign funding of country's R&D activity (%)



Source: ASTII R&D surveys 2010 or latest year available; www.nepad.org

FIGURE 3

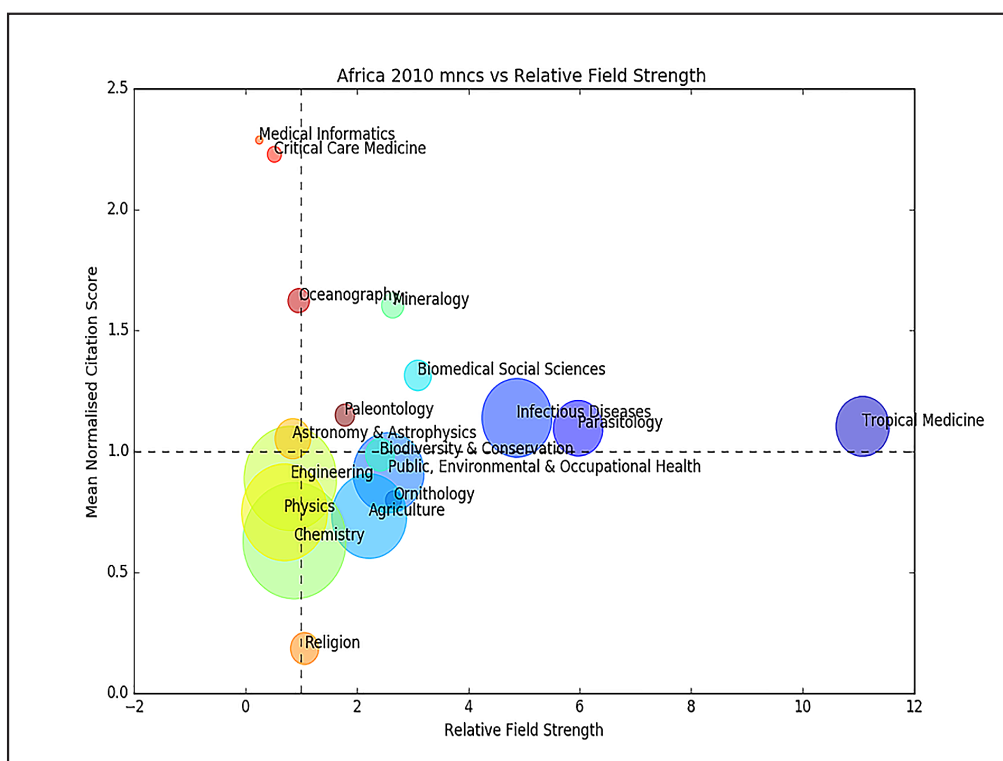
Research collaboration: African scientists WoS (2005–2015)



Source: Mouton, J. & J. Blanckenberg (2018) African science a bibliometric analysis. In: C. Beaudry, J. Mouton & H. Prozesky (Eds.), *The Next Generation of Scientists in Africa* (pp. 13-26). Somerset West: African Minds, p. 22).

FIGURE 4

Positional analysis of scientific fields and subfields in Africa³²



Source: SciSTIP/CREST; Mouton and Blanckenberg, 2017

32 This figure is produced by scholars from SciSTIP/CREST, University of Stellenbosch, South Africa. The bibliometric analyses undertaken combine two variables: the citation impact of a field or subfield with the score on the relative field strength index. The two-dimensional diagrams plot fields on these two axes. They have essentially identified those fields that are both strong (in relative world share) and highly visible. The fields that score high on both of these two indicators would typically be in the top right-hand quadrant. The size of the bubble is commensurate to the number of publications in that field: the larger the bubble the bigger the volume of output.

TABLE 1

Relative share of selected universities to national research output: WoS publications 2000-2016

Universities	Country	University publications	Total publications for the country (nrs)	Total publications for the country (%)
University of Mauritius	Mauritius	858	1 311	65%
University of Botswana	Botswana	2 074	3 397	61%
Makerere University	Uganda	5 146	9 263	56%
Eduardo Mondlane University	Mozambique	768	1 956	39%
University of Ghana	Ghana	3 761	8 586	36%
University of Cape Town	South Africa	23 209	133 385	17%

Source: N. Cloete, I Bunting & F van Schalkwyk (2018) Research Universities in Africa, Somerset West: African Minds; see also: N. Cloete, P. Maassen & T. Bailey (2015) Knowledge Production and Contradictory Functions in African Higher Education. Somerset West: African Minds

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