

PATHWAYS TO RESEARCH LEADERSHIP FOR EARLY CAREER RESEARCHERS IN AFRICA: A POTENTIAL ROLE FOR AFRICAN AND GLOBAL FUNDERS

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ABSTRACT

Early career researchers at African universities face numerous challenges and demands within a context of minimum resources; yet on the other hand, there is significant expectation for doing excellent science that is of high quality with integrity, while aligning science with societal goals. Furthermore, there is also expectation to increase outputs, make the system more inclusive, attract international partners and contribute to the University's global rankings. The need therefore to build research capacity, expand the number of active researchers and advance the careers of African researchers has never been more critical, particularly if continental and other global priorities are to be achieved. There is consensus that research leadership is essential to building research capacity in African universities. As a result, there have been increasing investments in building research capacity and research leadership, with initiatives ranging from the creation of north-south research partnerships across disciplines and empirical subjects, to training research leaders and university administrators in top ranking universities in Europe and North America, as

well as building the capacity of funders and science systems in Africa. This article will examine the competencies required to be a research leader and the programs that are currently available that support capacity building in research leadership. In addition, it will provide perspectives on the role that global and African funders should play to advance the careers of early career researchers to transition into research leaders, foster innovation, build linkages with policy makers and promote scientific leadership in Africa.

Key words: Early career researchers, Research Leadership, Funders, Africa, Professional development and Career pathways

INTRODUCTION

The African research landscape

Despite decades of capacity development programs, researchers remain a scarce resource across the research landscape in Africa. According to the science report of UNESCO (2015), the average number of researchers per million people globally is 1,478 (2015); for most of Africa, the statistics does not bode well. The only country that exceeds the global average is Tunisia with 2000 researchers, with the next closest countries including Morocco (1,100) Egypt (680), Senegal (550) and South Africa (494). For the majority of countries in sub-Saharan Africa (SSA), the average number of researchers per million people is less than 50 (UNESCO 2015).

The African Union (AU) has recommended that member states should set a target of at least 1 per cent gross domestic product (GDP) for the funding of research and innovation (world average 1.68%, 2014). However, according to findings from the 2019 Africa Innovation Outlook, the Gross Domestic Expenditure on R&D (GERD) data for 11 African countries indicated that they were all investing less than 1 per cent. Only Kenya (0.98%), Egypt (0.80%), and South Africa (0.82%) came close to the 1 per cent. They were followed by Ethiopia (0.62%), Botswana (0.54%), Senegal (0.54%), Namibia (0.40%), Ghana (0.38%), Mozambique (0.38%), Eswatini, (0.32%), and Uganda (0.18%) (AUDA-NEPAD 2019). This data suggests that in SSA only South Africa and Kenya are nearing the target, as each currently invests at or above 0.8 per cent.

Despite these resource challenges, according to Duermeijer, Amir, and Schoonbee (2018), Africa has by far the strongest growth in scientific production compared to other regions; over the 5-year period from 2012 to 2016, the region experienced a growth of 38.6 per cent in the number of scientific articles and a 43 per cent increase in the number of authors. This was 10 per cent higher than the Middle East, which was the next growth region that recorded a 33 per cent increase in the number of authors during the same period. The majority of Africa's scientific production originated from Algeria, Egypt, Kenya, Morocco, Nigeria, South Africa

and Tunisia; while Mozambique, Rwanda and Zambia more than doubled their average citation that resulted in significant impact globally (Duermeijer et al. 2018). The health sciences including infectious disease, public, environmental and occupational health, immunology and pharmacology research areas accounted for the largest share of scientific production in Africa (Clarivate InCites 2021). In addition, international collaboration with European and US researchers accounted for most of the research output, with the highest coming from researchers in South Africa, Egypt, Kenya and Uganda (Clarivate InCites 2021). Intra-regional collaboration between researchers across Africa accounted for below 15 per cent, thus indicating that networking and partnerships between African academics needs to be prioritized.

In their latest report on gender and research, Elsevier (2020) reported that the past fifty years saw enormous strides for and by women in research globally. The number of women graduating from science, technology, engineering, mathematics (STEM) and medical fields were higher than ever before. There was also increased focus on gender equity in participation and in research, as well as research on gender itself. While this was also the case in Africa, there still remains a lot of work to do in terms of gender, as data from the UNESCO Science Report indicated that on average only 25 per cent of academic staff in tertiary education across SSA were women (UNESCO 2015). While the numbers varied between countries in SSA, from 45 per cent in South Africa, 37 per cent in Botswana, many countries reported less than 10 per cent of their academic staff were women. There was also slower growth in the number of articles published by women, higher numbers of women leaving research and a broad range of understudied research areas of great relevance to women (Elsevier 2020). Women were also not participating in collaboration networks at the same level as men, for example, men had more coauthors than women and they tended to collaborate with those of the same gender across the subject areas and regions studied (Elsevier 2020). These findings have potential impacts on the career progression of women academics and demonstrate that much more work is needed to address issues that cut across diversity and inclusion.

According to the UNESCO report (2015), international research and researcher capacity partnerships were primarily academic exchanges and doctoral training for African researchers in the global North as South-South collaborations were still rare. This was corroborated by the bibliometric analysis of African science reported by Mouton and Blanckenberg (2018), who found that the vast majority of Africa's collaboration, based on their journal articles, were national and international. National collaboration accounted for 40 per cent of all papers, and in these, the authors co-published with others at institutions in their own country. International collaboration accounted for approximately 50 per cent of all papers, was primarily north-south, and the majority of these were with non-Africans (Mouton and Blanckenberg 2018). There were

notable examples of south-south collaborations including The Consortium for Advanced Research Training in Africa (CARTA) and the pan-discipline African Doctoral Academy, a PhD training hub based at Stellenbosch University in South Africa, funded by the Carnegie Corporation.

The funding of research is also a challenge in Africa. A recent article in *Nature* reported that only about 2 per cent of African researchers from a few countries and research areas reported receiving large grants over a million dollars for their research (Omungo 2018). The majority did not receive any funding for their research, and in many cases, most research was often self-funded (Omungo 2018). Research areas such as agriculture and health sciences were the most likely fields to receive funding and most of the funding for African research was from international funders based in Europe and the United States. This has implications for research agenda setting and areas of concern in the African research landscape such as the advancement of early career researchers.

Characteristics of research leadership and the African context

The available studies reported on research leadership in Africa provided important foundational trends and understandings of leadership styles, the competencies of research leaders, the gendered perspectives of research leadership and the experiences of early career researchers from Africa (The Path to Research Leadership in Africa 2019). Seven studies reported on the career trajectories of early career researchers from Kenya, Ethiopia, South Africa and the African continent in general (Ezeh et al. 2010; Daniels et al. 2015; Moseti 2015; Gebru 2016; Osman and Hornsby 2016; Lembani et al. 2016; Izugbara et al. 2017). The focus in the studies was on the programs available for research leadership capacity development and also the experiences of early career researchers as they transitioned to research leaders. This dearth of published research on research leadership in Africa, indicated that there was much more work needed in this important area.

Globally, there has been agreement on the role and responsibilities of eminent research leaders; however, it was only relatively recently that similar studies begun to explore the African context (Curry et al. 2012; Owusu et al. 2017; Niemczyk 2018; McNutt 2019). Top research leaders were considered to be trailblazers in terms of the state of the art in their field, publishing excellent research in top ranking journals, attracting large research grants, mentoring graduate students and successfully implementing large research programs (Curry et al. 2012; Owusu et al. 2017; Niemczyk 2018). However, it was clear that research leadership went beyond doing excellent research and having research strategies and vision; it also involved issues specific to the local research context. For example, building linkages with science and

policy leaders, being an advocate for science, engaging with other stakeholders including funders to influence the type of research conducted and its funding, and supporting the next generation of researchers were also critical roles of research leaders (Curry et al. 2012; Owusu et al. 2017; Niemczyk 2018). Research leaders engaged in translation of their research findings beyond academic publishing including creating impact in communities, developing evidence-based policies that address global challenges and converting their innovations into products and services. Finally, as a result of their authority, knowledge, position, and relationship with specific audiences, research leaders also hold critical roles as influencers and transformers of institutional, national and international research systems locally and globally (Curry et al. 2012; Owusu et al. 2017; Niemczyk 2018).

The most common styles of leadership in Africa reported in the literature have been described as value-based, team-oriented, participative, consultative, charismatic, aspirational, visionary, relations-oriented with a strong sense of patriotism and pursuit of community or public goals (Haruna 2000; Fowler and Owiti 2002; Bolden, Marturano, and Gosling 2003; Masango 2003; Bolden and Kirk 2009; Haruna 2009; Curry et al. 2012; Owusu et al. 2017). The findings by Curry et al. (2012), provided new and emergent constructs of African leadership that conceptualized it as communal rather than individually focused; and applied communal goals with transparency and accountability skills and knowledge. This view of African leadership as being more collectivist, supports the views presented by Campion and Wang (2019) that leadership practices and organizational environment is determined by whether the country's culture is collective or individualistic.

Objectives

The research reported in this article is part of a larger study on the perspectives of researchers about their path to research leadership in Africa, including recommendations to researchers, institutions, and funders about their role in building the capacity of the next generation of African research leaders. This article focuses specifically on the role of funders of African research and provides data driven recommendations for supporting the research leadership development of early-career researchers. The article is presented in four sections. The first section is an introduction to the study and lays out the African research landscape and the characteristics of research leadership in Africa. We introduce in the second section, the methodology used for data collection and analysis. The third section includes the presentation of the focus group and survey results, the bibliometric analysis and the training opportunities available for research leadership development in Africa. In the final section, we present implications of our findings and propose recommendations for global and African funding agencies.

METHODOLOGY

We assessed the perspectives of researchers in Africa regarding their experiences as they transitioned to research leaders as well as selected funders of research in Africa to establish the level of support they provided for the career advancement of early-career researchers in Africa. We had three broad research questions in this study, firstly what were the organizational, individual and societal barriers or enablers that affected the journey of early-career researchers to research leadership and how did women researchers differ from men. Secondly, using the leadership lens of the Vitae Researcher Development Framework (2012), what were the core competencies, skills and experiences needed to be a successful research leader, and what were the training programs available to strengthen research leadership. Finally, who were the top funders of research in Africa, and what research areas did they support. The overall goal was to provide funders of African research with evidence based data to better support the research leadership development of early-career researchers so they could successfully advance in their careers. The Institutional Review Board, Office of Regulatory Affairs in the Human Research Protection Program at Michigan State University approved the study.

The participants were early-career researchers who were primarily from the health sciences and based at higher education and research institutions in East, West and Southern Africa. A team of scholars from those regions who had prior experience in multi-country studies and publishing their work, collected and analyzed the data. The study team provided participants with information about the study including their rights as a research participant and requested them to sign a consent form if they agreed to participate in the study. The study utilized a combination of approaches employing qualitative (focus group discussion) and quantitative (survey and bibliometric) data collection and analysis.

Focus group discussion and survey administration

We undertook a mixed methods approach that included firstly a focus group discussion with 11 senior research leaders and directors (two women and nine men) that were team members from the Developing Excellence in Leadership, Training and Science in Africa (DELTAS) program. The discussion took place during the DELTAS Annual General Meeting in July 2018 and the goal was to elicit themes and interview questions for the qualitative and quantitative study that would follow between July – December 2018.

Additional focus group discussions were held with 27 early-career researchers from Côte d'Ivoire, Uganda, South Africa, and Ghana (Table 1). The discussions focused on 1) current challenges and the institutional support provided to researchers in their career development;

2) perceptions of the competencies and qualities required for successful research leadership; and 3) recommendations for funders about how to address career development of researchers. Guided by the expert facilitators, the focus group discussions were held in English and French. An online survey was then administered to researchers at African institutions. A total of 139 responses were received from early-career researchers in 24 countries in Africa.

Table 1: Gender of the respondents in the focus groups and survey of the study

Gender	Focus group	Survey
Men	19	69
Women	8	70
Total	27	139

Bibliometric analysis

The bibliometric analysis was used to map the top impactful funding agencies of research in general and health research specifically, in Africa (as proxied by the citation impact of funded published work) over the 10 year period 2010–2020. The data were extracted and visualized from Clarivate’s InCites dataset by leveraging unified funding acknowledgment data from the Web of Science (Clarivate InCites 2021). The analysis was based on publications and citations data related to research authored or co-authored by at least one researcher in Africa. In addition, the data were further filtered by funding agency location to understand the trends for global and African based funders.

Research leadership training provision

A desk-based review of the current leadership training and development programs run by external and institutional providers in Africa was conducted to map the provision and general content of research leadership capacity building programs available to African researchers. In addition, we also compared the focus of each of the external programs, that is, whether they focused on the development of research skills, on developing the researcher, leadership skills or on developing women researchers.

Data analysis

The analysis phase involved a synthesis of findings to develop and recommend potential frameworks for the development of research leadership in Africa.

Limitations of the study

Our research sampled early-career researchers from several African countries, different types of research organizations such as universities, research institutes and the private sector and took

into consideration the gender dimension. However, the study was conducted across mostly Anglophone Africa and would need further testing in Francophone and Lusophone countries in order to make generalized statements for Africa. Secondly, the researchers were only asked about gender issues, so other equity and inclusion issues could not be interrogated.

RESULTS

Perspectives on barriers and enablers to career advancement

Early career researchers emphasized that more structured career planning at the early stages of their careers was an enabler; and more emphasis on this was needed to help them identify their research areas and collaborators, strengthen skills in writing grants and publications and to build their research profile. Being able to better manage work-life balance was crucial and they emphasized the need to better navigate the cultural and institutional environments, especially as it related to managing societal expectations and family responsibilities. This was especially true for women researchers. Some university policies and practices contradicted prioritizing research and were drawbacks to career advancement; for example, there was always strong emphasis on research in promotion, yet limited funding support and time provided for research activities.

The role of mentorship programs and role models were both seen as enablers to career development; and beneficiaries of mentorship programs reported satisfaction with their careers. However, very few early career researchers had experience of formal mentorship programs. Some indicated that they had informal mentors, who provided both career advice and advocated for them at various institutional levels but this number was quite low. They all recognized that engaging with a broad network of research leaders, taking time for post-doctoral training and sabbaticals, working on international collaborative teams, and participating in formal, structured leadership training were key opportunities that would support their career development. They concluded that part of the role of a research leader should be to provide early career researchers with these opportunities for gaining exposure and developing their leadership potential. There was a genuine sense of frustration that these opportunities were not facilitated for them in the daily business of research.

Most of the barriers and stereotypes discussed were from mostly women researchers, in particular as it related to their roles in the family, as mothers and homemakers. The expectation they said was that women researchers could not be trusted with leading teams or proposal development due to their home and social responsibilities; a view that many of them also shared.

This did not apply to men researchers. Therefore, early-career women researchers needed more convincing about their abilities to be a research leader than their male counterparts. This suggested that there was significant culture change needed at individual, family and institutional levels at the early stages of the education pipeline to enable girls and young women to feel able to take up challenges.

Early-career women researchers, recognized that there were a number of systemic challenges, at the institutional and societal levels, that constrained advancing their careers. Many of them stressed that it often appeared that there was lack of transparency and equality in many of the research opportunities available. Many felt that they were often pressured in their professional pursuit and that home responsibilities such as childbearing, childcare, family obligations and other gendered roles were not acknowledged for women researchers and programs put in place so that they were not unduly disadvantaged.

Early-career women researchers also observed that it was no longer acceptable to have men only in research teams and suggested that more focus needed to be on integrating gender into research at institutional levels, which may increase the number of women researchers getting included in research teams. There was need to create new and expand existing programs that provided research incentive grants, training in research leadership, and opportunities for women researchers to be appointed to positions of responsibility in research. They also suggested that early-career women researchers should engage with a broad network of research leaders for strategic mentoring, take opportunities for post-doctoral and sabbatical research leave, participate in international collaborative partnerships and enroll in formal, structured research leadership training. It was emphasized that early career-women researchers in particular should be provided with opportunities to take up responsibilities such as leading teams, manuscripts and grant proposals and other tasks targeted to developing their leadership potential.

Research leadership characteristics and competencies

Our findings confirmed what was in the literature that research leadership involved developing vision and strategy, being a role model and having subject matter expertise. However, what was also very important were the relational characteristics that are illustrated in the T-shaped model in Figure 1, which indicates both breadth and depth of expertise. The depth in the central vertical “pillar” was regarded as fundamental to research excellence while the breadth of experience or the horizontal “pillar” is where they applied their research expertise for the common good, mentoring junior colleagues, facilitating communication and engaging locally and globally.

This supports previous research on the T-shaped model of professionals (Brown 2010; McIntosh and Taylor 2013; Demirkan and Spohrer 2015; Van Veenendaal 2020; Butler 2020) and the dual role of African research leaders, contributing to global research excellence and local societal impact (Ofir et al. 2016). Researchers that were able to succeed in this dual role were described as “*successful research leaders*” and were at the forefront in terms of research leadership.

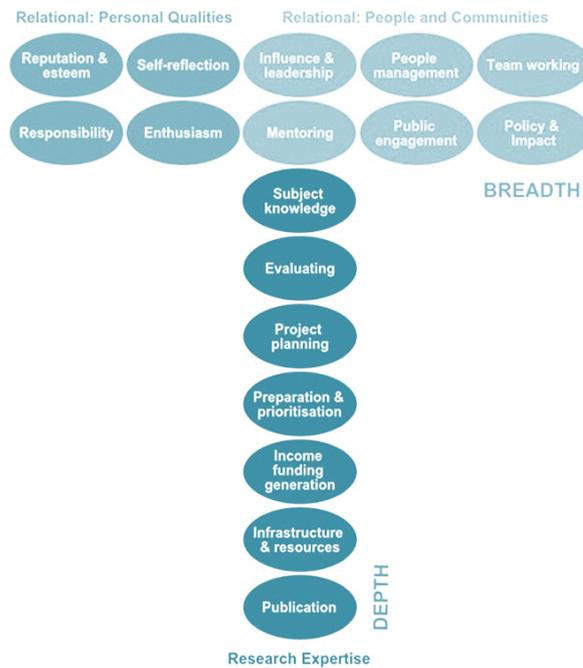


Figure 1: T-shaped model of the characteristics of African research leaders

The priority competencies of research leaders are shown in Figure 2. As can be seen, all of the competencies related to the knowledge and intellectual abilities domain, that is knowledge base, cognitive abilities, and creativity, were recognized as fundamental; and researchers, regardless of gender, emphasized that these should be the primary focus at the beginning of a research career. For the mid and latter stages of the career, there was general agreement that a combination of the other competencies was needed to deal with the complex tasks necessary for research leadership. In the personal effectiveness domain, only the personal qualities competency was highlighted, while professional conduct, research management, finance, funding and resources were stressed in the research governance and organization domain. Finally, working with others, and engagement and impact were emphasized in the engagement, influence and impact domain.

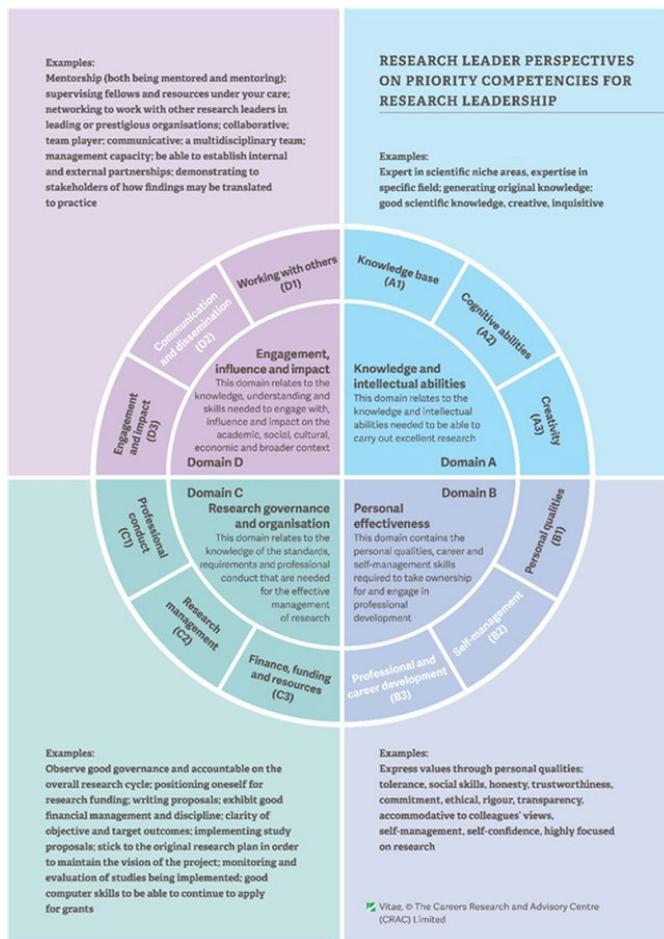


Figure 2: Perspectives of women and men researchers on competencies for research leadership (most important competencies are shown in bold)

Research leadership training provision

Our analysis of the current training available for African research leaders showed a stark gap in what was available compared to what was needed to support the leadership characteristics and competencies discussed above. Over 40 per cent of the researchers we surveyed were unaware of any programs at their institution; for those that exist, the majority of programs were focused on only strengthening research expertise of early career researchers. Training programs facilitated by external providers, were also limited and focused largely on research capacity strengthening or on generic leadership / management skills, rather than both.

Table 2 illustrates an inventory of available programs that are relevant to research leadership development in Africa. One of the well-funded programs that focuses on strengthening research excellence is the Developing Excellence in Leadership, Training and Science (DELTA) in Africa program, which supports the Africa-led development of world-class researchers and leaders in Africa. In addition, the DELTA program also supports the improvement of the research environment in Africa, from infrastructure in laboratories to areas

such as research management and ethics. The Consortium for Advanced Research Training in Africa (CARTA) program as the name suggests, focuses mainly on research capacity strengthening, in particular on key skills such as data management and data presentation. There are several examples of programs that offer individual leadership development, such as those by the Centre for Creative Leadership and the Centre for African Leadership Development. However, these are more targeted at the business and public sectors and are not contextualized for higher education and research institutions.

There were very few programs designed for women leaders working in academia. One based in the U.K. is the Women in Leadership event organized by the Centre for International Development and Training (CIDT) at the University of Wolverhampton. A relatively new program, established in 2019 called the African Futures Research Leadership Program offers all of the components for research leadership, including research development, researcher self-development, leadership development and also targets women researchers. It is a collaborative mentorship program offered partly in the US and in Africa, but is currently open only to consortium members of the Alliance for African Partnership (AAP 2019). Another program that supports research and leadership development is the Climate Impact Research Capacity and Leadership Enhancement (CIRCLE), which develops leadership skills and research results for early career African researchers in the field of climate change. Potential setbacks to the success of some of these programs are funding and sustainability challenges as many of them are donor funded and have not yet identified opportunities for continuing beyond the current funding.

Table 2: Training and development programs relevant to research leadership in Africa

Programme	Research development	Researcher self-development	Leadership development (relational transferable skills)	Women self-development
DELTAS Africa (Developing Excellence in Leadership, Training and Science Africa)	X	X		
CIRCLE (Climate Impact Research Capacity and Leadership Enhancement, AESA)	X	X		X
CARTA (Consortium for Advanced Research Training in Africa)	X			
FLAIR (Future Leaders African Independent Research)	X		X	
AMARI (The African Mental Health Research Initiative)	X	X		
GYA (Global Young Academy)		X	X	
AAU (Association African Universities)		X	X	
AFRLP (African Futures Research Leadership Program)	X	X	X	X
CCL (Centre for Creative			X	

Programme	Research development	Researcher self-development	Leadership development (relational transferable skills)	Women self-development
Leadership)				
CALD (Centre for African Leadership Development)			X	
CIDT Women in Leadership Course			X	X
PWC – Africa			X	
The Knowledge Academy			X	

Women and men researchers did not appear to differ significantly in terms of the key leadership qualities that they identified should be the focus when developing the next generation of research leaders as indicated in Figure 3. Working with others, building a network and achieving work-life balance were equally top priorities for both women and men early career researchers. Men more so than women researchers felt that building a research profile was also a major priority. Despite the fact that the cultural environment was reported earlier as a major barrier especially for women researchers, neither women or men saw it as an area for major focus in capacity building programs. This is potentially short-sighted as these cultural issues, while ingrained in society, will only change if there is continuous interrogation at various levels within countries.

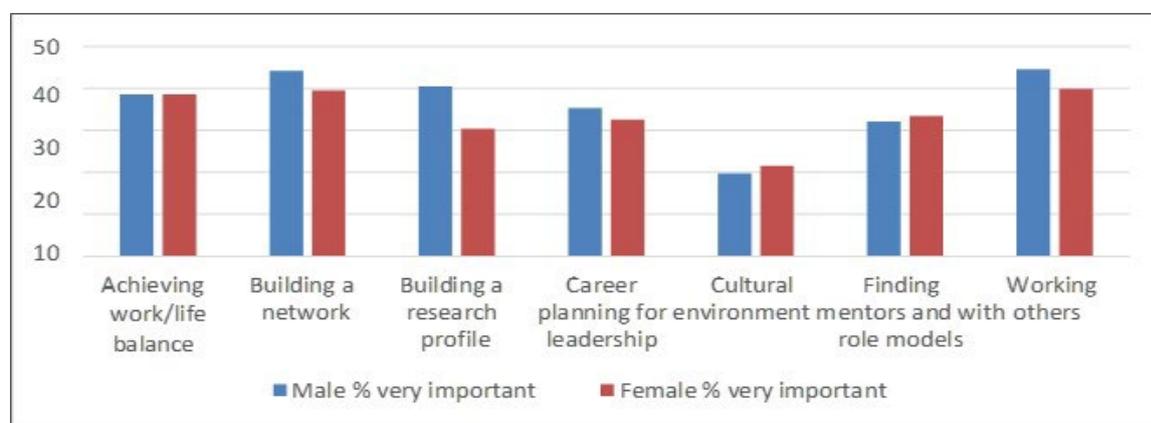


Figure 3: Responses by women and men researchers on the qualities that are of importance to them in research leadership development

Bibliometric analysis of African Research Funders

As shown in Figure 4A, the top funders of all research conducted in Africa over the last 10 years were European and US based funders. These included the European Commission (EC), the US Dept of Health and Human Services (USDHHS), UK Research and Innovation (UKRI), the National Science Foundation (NSF) and the Medical Research Council of the UK (MRC). For health research specifically, the top funders were the USDHHS, the EC, UKRI, MRC and

the Bill and Melinda Gates Foundation (BMGF). The only major African funder of research was the National Research Foundation of South Africa (NRF). The major research areas receiving funding in Africa are illustrated in Figure 4B and as previously reported were in the area of health (infectious disease, public health, immunology), energy and the environment (energy and fuels, environmental science and ecology), material science (nanotechnology), as well as space sciences (astronomy and astrophysics). These research areas are likely to be based on collaborations of large, multidisciplinary teams based internationally and in Africa.

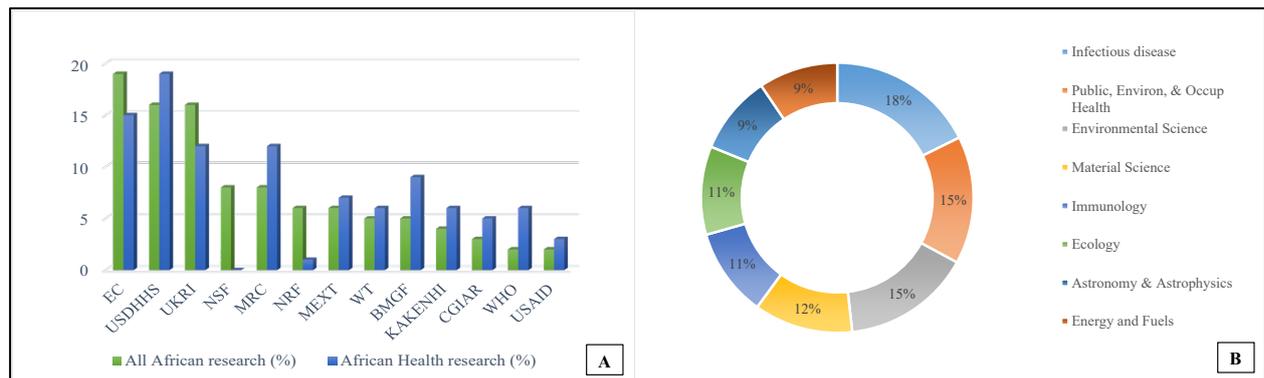


Figure 4: Top research funders of African research (A) and the research areas supported (B) between 2010 – 2020 (Source: Clarivate InCites Dataset)

The consequences of having the majority of African research supported by global funders are that if they were to stop funding, research on the continent would be seriously disrupted, as was the case with the recent reduction in the UK government foreign-aid budget, some of which funded research. Just as important, is the fact that global funders will continue to set the research agenda for Africa, which for decades was not always aligned with African priorities. The current trend is funding of large, transdisciplinary and transregional teams, working on global challenges. Supporting the development and career advancement of early career researchers are not always the key priorities of these programs.

IMPLICATIONS AND WAY FORWARD

Through our engagements with researchers, and those who support their development, we identified key recommendations for African and Global Funders and interesting case studies of initiatives that focus on research leadership and institutional development that should be amplified. To accelerate research that is excellent, nurture innovation, build bridges with policy makers and promote research leadership in Africa, funders must place greater emphasis on investing in both individual as well as institutional capacity to drive sustainable research leadership for early career researchers. System approaches to research leadership development

and new and innovative training programs must be integrated into a wider funding strategy if we are to ensure that there is a researcher pipeline in Africa. Based on our findings, developing strong research leaders requires not only developing excellent research skills but developing relational leadership through practical experience of leadership opportunities, mentoring and coaching, balanced with career development planning.

Key transition points in the careers of research leaders included progressing from acquiring the doctoral degree, to leading other researchers, to leading other leaders, and finally leading organizations. In developing the next generation of leaders, it is important that as researchers go through each transition, that there is opportunity to adequately prepare for the next role. This should involve re-assessing their time, tasks and value, and readiness for transitioning from the individual, to the broader local and global good. Most of the early career researchers indicated that opportunities were not available for them to reflect and prepare for the next career stage. If funders understood that leadership development is a continuous process with key transition points, where additional time and support are required, then investment in those programs would help leaders settle into their roles more effectively and result in more successes.

The T-shaped model for research leadership that we proposed balances expertise in research, functional skills and relational competencies that were most valued by researchers. It was also inclusive as it focused on the needs of both women and men researchers in Africa. However, the model demonstrates that whilst research training was important at the beginning of a research career and part of the continuous learning for a researcher, it did not adequately prepare researchers for the additional responsibilities that come with leadership later in their careers. The key message is that focusing on research excellence alone does not always guarantee that a researcher would develop into an effective research leader. Researchers must therefore have opportunities to not only deepen research skills but also develop those relational skills and competencies needed. Most importantly, this path should not be exclusive, but should be available to early career researchers to cycle through, or indeed, work on both at the same time. Research leadership development therefore requires many interventions, and capacity and funding challenges can determine the success and shape of the approach that is adopted. In planning novel approaches, the importance of relevance to the African context and co-creation with the research community cannot be over-emphasized.

Within the last decade, there have been a number of centers of excellence (CoE) established to build research skills, increase research productivity and promote the economic transformation of the African continent. These CoE have resulted in increased capacity building at the postgraduate level especially within STEM fields, developed new academic programs

and knowledge in the discipline and increased the numbers of women scientists graduating (World Bank 2014). Because of the success of the CoE approach, we now propose the establishment of a new CoE on research leadership development in Africa funded through a partnership between global and African funding partners. The CoE should be a joint initiative with roots across multiple institutions in East, West and Southern Africa, that generates new knowledge about research leadership in Africa, and offers training programs that are tailored for local contexts, and different career stages. This collaborative CoE should lead, support and guide institutions on emerging and good practice in building capacity of African research leaders who would be relevant locally but can compete globally. It would also be mandated to implement flagship programs across multiple institutions using tools such as global classrooms that would allow the sharing of people, and ideas, and develop delivery expertise locally. This approach would facilitate sustainable approaches to research leadership development especially in resource limited environments.

Many funding agencies have now recognized the linkage between research excellence, gender and equity more broadly and are developing programming and promoting the equitable inclusion of women, increasing the number of women in leadership positions and integrating gender and equity dimensions in research content and curricula. Two initiatives involving African and global funders, the Science Granting Councils Initiative (SGCI) and the Alliance for Accelerating Excellence in Science in Africa (AESA) are worth mentioning.

The SGCI is one of the important research funding developments in Africa that has resulted in the strengthening of 15 Science Granting Councils (SGCs) across East, West and Southern Africa. SGCs perform several crucial functions in national systems of innovation, including disbursing funds for research and development, building research capacity and thus contributing to the effective and efficient functioning of science systems (Mouton, Gaillard, and Van Lill 2015). Since 2016, the capacity strengthening of the SGCs supported management of research, data driven design and monitoring of research programs, knowledge exchange with the private sector and strengthened partnerships between the SGCs and other science system actors. It was envisaged that the SGCs would develop programs to increase research capacity, in particular of early career and women researchers, as well as strengthen regional collaboration in Africa through joint funding of programs that are of relevance to Africa.

One of the increasingly important areas for the SGCs is their focus on gender in research in Africa. They have the potential to be transformational in this area given their funding and policy roles in Africa. While most SGCs did not have clear policies or frameworks to support mainstreaming and promotion of gender at the beginning of the SGCI, almost all indicated a commitment towards tackling gender disparities and mainstreaming gender considerations

across all sectoral activities. Researchers in our study have proposed a number of measures to support women researchers striving to succeed, such as mentoring, support groups, information about child-care, and family-life balance. A number of the SGCs have implemented some of these programs that promote gender equality. For example, the SGCs in Senegal, Zambia, Ethiopia, and Kenya have a special fund to promote women's participation in higher education and a specific program to encourage youth into science, technology, engineering, and math (STEM).

All of these strategies are important and are geared to guide women researchers as they negotiate institutional and social barriers in the academic environment. However, what may be more transformational for the SGCs is to also focus on making changes to the institutional environments where women work. That is, understanding and changing the policies, practices, and habits at the academic institutions that they fund, that are preventing women researchers from thriving. This approach incorporates supportive initiatives such as mentoring, coaching and networking, but goes further to examine the strategies that create environments that encourage the success of women scholars. These may include supporting institutions to eliminate implicit bias processes during recruitment, hiring and promotion; providing incentives to research teams for including women and for incorporating gender considerations in their research; developing institutional leadership and faculty professional development programs and interventions to enhance the visibility for women scholars. Other initiatives could include supporting dual-career professionals, flexible working arrangements, family-friendly adaptations, as well as career advancement grant programs.

One of the important goals of phase two of the SGCI, is providing training and technical support to the SGCs in promoting the equality and status of women in research environments, diversity and inclusivity beyond gender equality in research environments, and the sex, gender and inclusivity dimension in research design and content. This is a positive step that demonstrates the commitment that is being given to gender and inclusivity at the funding and policy level and it is highly recommended that the SGCs use its role to create institutional changes that would support early career women researchers to thrive.

Another important development in the funding of research in Africa was the creation of the Alliance for Accelerating Excellence in Science in Africa (AESA) in 2015. AESA was a partnership of the African Academy of Sciences (AAS), the African Union Development Agency (AUDA-NEPAD), and a number of global funding partners such as the Wellcome Trust and the Bill and Melinda Gates Foundation. The mission of AESA was to shift the power dynamics for African science to Africa through agenda setting, mobilizing funding, and managing continent-wide research programs. Their 6P model, which emphasised people,

places, programs, policies and processes, practices and partnerships was established to support balance in excellence with equity across the continent. The AESA model has the potential to foster research excellence, promote and inspire research leaders, strengthen research systems, and accelerate innovation and the commercialization of research that will improve and transform lives in Africa.

AESA therefore needs to create more opportunities for diversity and inclusion in science, and support those marginalized to receive funding for game changing ideas that could transform Africa, and advance their path to research leadership. For example, improving and strengthening existing research institutions and environments into state-of-the-art facilities that meet global standards for research and graduate training as well as facilitating further access through scholarly research exchanges and mobility grants globally, will provide the places for research and innovation to happen. They need to foster greater collaboration between well-resourced and less-resourced research institutions and research leaders. This can be accomplished through long-term, continental, consortia-based science programs that would advance training, joint supervision, and mentorship and provide a platform for balancing excellence with equity.

All of these can only happen within the context of supporting policies and processes for research and innovation. AESA's work in developing comprehensive grants management and research-based policies and processes for providing oversight in research program implementation contribute towards building the DNA of research environments. Other policies that they can facilitate include those related to safeguarding, bullying and harassment, anti-fraud and other financial control policies, whistleblowing, research malpractice, supervision and mentorship, governance and oversight related policies, as well as maternity and sick leave.

One of the weaknesses of African research organizations is their financial grant systems. In response to this, AESA developed the Good Financial Grant Practice (GFGP), a standard for good grant governance, which has now become a global standard. AESA has used the GFGP to streamline the due diligence process for awarding research grants, for encouraging good grantsmanship in general and strengthening research institutions in a major way. As part of their grant-giving role, they should use the GFGP as a training tool to strengthen weaker research institutions on the continent to become more competitive in attracting research grants from national and international funding agencies.

Identifying, building, and nurturing partnerships with entities who share mutual aspirations cannot be overemphasized. When properly managed, partnerships provide a vast reservoir of resources including funding, expertise, and sources of new programs. In 2015, AESA and the AAS created the Coalition for African Research and Innovation (CARI) in

collaboration with key global funding partners including Wellcome Trust, the U.S. National Institute for Health (NIH) and the Bill and Melinda Gates Foundation. The CARI platform needs to be positioned to support major science, technology and innovation (STI) initiatives in Africa and leverage funding that would expand and sustain a large portfolio of programs to be implemented at AESA. CARI also presents an opportunity for AESA to engage with a wider range of partners, including African governments, other global funders, industry leaders, and civil society to address priority research areas, drive African investment in African research and deliver the potential of STI for Africa's development.

AESA's 6P model and their experience as a continental funder has demonstrated that by reviewing current funding decision models and criteria and introducing changes that prioritize the need to balance excellence with equity and promote intra-African research collaboration, can influence, and achieve phenomenal change and impact on the continent at no extra cost. A key outcome of such a process change, would include expanded access, inclusivity, diversity, and participation by weak research institutions across various parts of the continent that face perennial national and international research funding deficiencies. These are research institutions that are not able to win competitive grants based on current funding decision models largely defined by excellence-based criteria. In the context of reduced funding for research globally due to economic challenges brought about by the COVID-19 pandemic (Else 2021), innovative ways by AESA to improve the value of interventions in research programs would go a long way to circumvent a near total collapse of the research enterprise on the continent.

In all of these recommendations, it is important to provide data driven evidence of success and effectiveness. A monitoring and evaluation framework should be established, perhaps at the proposed CoE with linkages to existing initiatives, to collect and share data openly on the profile of researchers in Africa and their career paths, identifying and promoting role models and describing their leadership development as incentives for other researchers. In addition, success stories should be celebrated widely across the continent to inspire and motivate the next generation of research leaders to achieve the highest.

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