

Challenges and needs of African geoscience research

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A survey of geoscience researchers from across Africa highlights key challenges in conducting impactful research. Improved access to skills training can boost research success.

The African continent is endowed with vast natural resources^{1,2}. About 30% of all global mineral reserves are found in Africa and the continent contains the highest reserves in the world of diamond, platinum group metals, phosphate, gold, chromium, manganese, vanadium, cobalt and aluminum^{1,3,4}. Many African countries are economically dependent on their mineral resources and minerals have accounted for an average of 70% of total African exports and about 28% of gross domestic product over the past decade^{4,5}. Simultaneously, Africa is facing a vast array of geological, geodynamic and climatic hazards including land degradation, flooding, drought, earthquakes, volcanism, and landslides – all of which threaten the continent's development.

Geoscience research in Africa is therefore critical in addressing key sustainable development challenges that have direct impact on the lives of Africans, such as resource development, land use management, natural hazards mitigation, and access to clean water⁶. Integrated geoscience research and education is needed to strengthen local research capacity and develop a skilled workforce capable of addressing these challenges. Geoscience research in Africa also contributes to global scientific knowledge as Africa's unique geological, geodynamic and climatic setting offers valuable data and insights that enhance our understanding of Earth's processes.

However, geoscience research in Africa has not yet reached its full potential. Africa's contribution to the global geoscientific literature remains concerningly low. Africa-based authors represent only about 2% of the geoscientific literature published in high impact journals during the last four decades and only 30% of geoscientific articles about Africa are produced by Africa-based researchers (compared to most other countries outside Africa that produce 60–80% of their geoscientific articles)².

Survey of African geoscience researchers

The UNESCO-supported Fostering Researchers in the Geosciences (FoRGe) programme and the American Geosciences Institute co-developed a survey to determine the challenges and needs of African geoscience researchers. The aim was to identify critical steps for career development as well as prioritize workshop topics for professional skill development. Conducted between April and September 2023, the online survey was distributed through an e-mail list and promoted at conferences and through the Geological Society of Africa; it was made available in four languages: English, French, Portuguese, and Arabic.

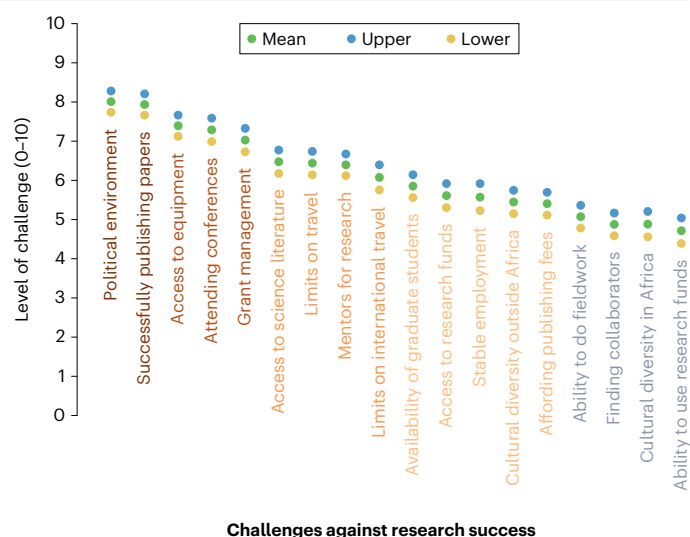


Fig. 1 | Rating of challenges to research success by survey respondents. The three dots represent the mean, upper and lower ranges of responses in the 0 to 10 Likert Scale. The text colours represent the different levels of challenge in conducting research: dark brown (very high level of challenge), brown (high level of challenge), orange (moderate level of challenge), light orange (low level of challenge) and grey (very low level of challenge).

The 355 respondents were based in 51 countries with Nigeria providing about one quarter of responses, while Tanzania, South Africa, Kenya, Namibia and Ghana together accounted for an additional third. Nearly 75% of respondents identified themselves as male and 22% as female. About 85% of respondents were within 10 years of their highest degree, indicating that the survey particularly reflects the views of early career researchers (ECRs). This skewed distribution to ECRs and male respondents did not allow meaningful statistical comparison between ECRs and other career stages. Approximately 53% of respondents were associated with academia, 17% with government institutions, and 16% with the private sector, while unemployed and other employment sectors account for the remainder. Nearly 35% of respondents identify themselves as active researchers and 22% as researchers and educators, 15% as technical staff, 13% as students and another 11% work in management positions.

The survey utilized a Lickert scale ranging from zero to ten to gather the opinions of researchers regarding the impact level of various research challenges. We find that African geoscience researchers face multi-faceted challenges ranging from navigating the political environment to hurdles in publishing papers.

Five dominant challenges emerged from the survey results (Fig. 1): navigating the political environment, publishing papers, access to

equipment, attending conferences, and grant management. Other challenges of more moderate impact to African geoscience researchers include limits on international travel, access to scientific literature, access to research mentors, and availability of graduate students. For example, systemic limitations on international travel – a challenge recognized across all fields of science for researchers from the global south (for example, see refs. 7 and 8) – hinder African geoscientists from promoting their research findings which negatively affects their professional development, and limits their chances of forging research collaborations and networks. It also strongly limits their contribution to global knowledge production.

Access to funding, flexibility to travel, publishing in reputable journals, presenting at conferences, and access to mentors are also identified in the survey as crucial for career progression. The strong emphasis on securing grants and publishing may be the result of pressure on researchers to bring additional streams of income to their institutions. Respondents also identified financial concerns and the political climate as the biggest life challenges affecting their research endeavours. This highlights the importance of economic and geopolitical stability in supporting research productivity.

When it comes to immediate skill development, there is strong demand for training across many topics, and respondents emphasize the need for training on computing, field methods, data management, and scientific writing (Fig. 2).

Overcoming research challenges

Although there are limitations of this survey due to the small sample size and the need for more granular detail to reflect diversity within the continent and among different career stages and genders, the results do provide an initial foundation for developing policies and strategies to alleviate the main barriers for African-led geoscience research. We argue that the following interventions can help overcome the barriers faced by geoscience researchers in Africa.

Investment in research and educational infrastructure. African governments should partner with private industry to increase investment in geoscience education and research infrastructure. This should include supporting development of accessible continental geosciences databases and online libraries, and establishing accessible and affordable regional geochemical laboratory hubs. Prioritizing training of professional and technical staff by modernizing their geoscience curricula to ensure a more comprehensive skill set across the African geosciences workforce is also important.

Research funding. African governments need to meet their commitment of contributing at least 1% of their GDP to research and development, which still remains at continental average of only 0.42%.⁹ This would allow African researchers more flexibility to define their own research agenda commensurate with the developmental and societal needs of the continent. African funding bodies also need to combine forces through continental and regional collaborative funding schemes to support larger and more impactful regional research projects.

Inter-Africa research mobility programmes. Research mobility schemes for ECRs within African institutions would help ECRs from less developed African countries obtain access to research equipment and research mentors in African countries with more advanced research infrastructure, strengthen research collaborations, and create strong continental research networks. The Geological Society of Africa

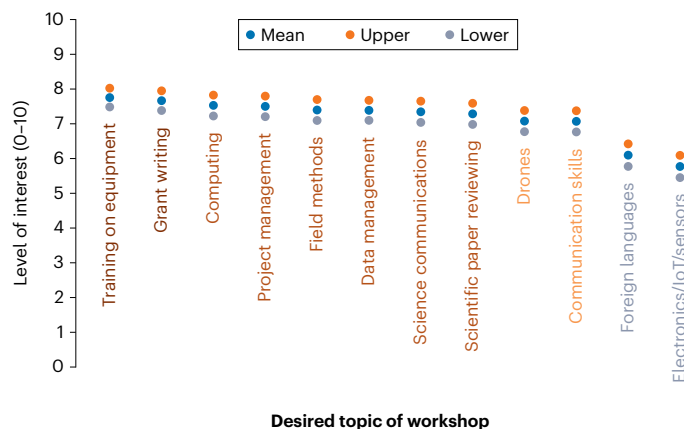


Fig. 2 | Respondent rating of topics for potential training workshops. The three dots represent the mean, upper and lower ranges of responses in the 0 to 10 Likert Scale. The text colours represent the different levels of interest in potential training workshop topics: dark brown (very high level of interest), brown (high level of interest), orange (moderate level of interest) and grey (low level of interest).

in collaboration with national professional societies and universities can take the lead and coordinate such initiatives. This could build on such initiatives such as UNESCO's African Network of Earth Science Institutions mobility programme and the Past Global Changes African Mobility Fellowship programme.

Support for professional development and accreditation. Providing targeted training and workshops to ECRs on crucial skills such as grant writing and management, equipment use, and scientific communication would enhance professional development. Successful models include summer school programmes organized and hosted by universities with funding from the private industry and research foundations. UNESCO, the African Academy of Sciences, the World Academy of Sciences and national academies of sciences could all support such initiatives.

Collaboration and networking. The fostering of collaborations between African and international geoscience societies will build research capacity and enhance the professional engagement of African researchers in global scientific communities. Professional societies, particularly those outside Africa, need to create more open and participatory engagement of their Africa-based members, including in leadership positions. In addition, global professional organizations such as the International Union of Geological Sciences (IUGS) can advocate and lobby governments through declarations and position statements to alleviate the travel barriers faced by African researchers in attending international conferences and scientific events both within and outside Africa.

Gender equity initiatives. Programmes that promote gender balance in the geosciences such as gender-responsive research funding, educational opportunities, scholarships, mentorship programmes and gender-sensitive policies should be developed and implemented by governments, universities and funding agencies.


Outlook

The ForGE survey provides a snapshot of the lived experiences and perspectives of African researchers on the current state of geoscience research in Africa. The continent's young and dynamic geoscience

research community faces multi-faceted challenges that must be addressed to ensure that the continent's researchers can do their part to tackle environmental and societal challenges. All actors in the African research landscape – governments, universities, professional societies, industry, nonprofit organizations, civil society groups – have a role to play in improving the quality, effective delivery, and dissemination of African geoscience research.

Data availability

The raw survey data used for this article are provided in the following public data repository via Github at <https://github.com/AmericanGeosciencesInstitute/UNESCO-Geo-Africa> (ref. 10).

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Competing interests

The authors declare no competing interests.

Additional information

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