



Reforming African universities for climate action

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Abstract

This Commentary explores the responses of African universities to the challenges posed by climate change, focusing on their roles as centers of research, education, and community engagement. Given the continent's vulnerability to climate impacts, African universities are increasingly integrating climate change into their curricula, promoting sustainability initiatives, and conducting region-specific research. The Commentary identifies key strategies employed by these institutions, including interdisciplinary approaches to climate education, partnerships with governmental and non-governmental organisations, and initiatives aimed at enhancing resilience in local communities. It also addresses the barriers faced by universities, such as funding limitations and political instability, which hinder effective climate action. The article also highlights the innovative solutions and best practices adopted by African universities, offering insights into how they can further contribute to global climate change mitigation and adaptation efforts. It concludes with recommendations for enhancing institutional capacities, fostering collaboration, and leveraging technology to advance climate action across the continent.

Keywords Climate change · Africa · Universities · Curriculum · Innovation · Adaptation

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Introduction—African universities and climate change

The African continent is especially vulnerable to climate change due to a combination of factors. Firstly, Africa encompasses diverse ecosystems, from arid deserts to tropical rainforests, making various regions susceptible to different climate-related impacts. Changes in temperature and rainfall patterns can disrupt local climates and significantly affect agriculture and water resources (Nhemachena et al. 2020).

Secondly, a large portion of Africa's population relies on subsistence agriculture for their livelihoods. Climate change threatens food security through increased droughts, flooding, and changing weather patterns that can reduce crop yields (Nhemachena et al. 2020). Moreover, many African nations lack the necessary infrastructure to manage climate impacts effectively. Poor road networks, inadequate irrigation systems, and insufficient disaster response mechanisms exacerbate the effects of extreme weather events (Adenle et al. 2017). Moreover, a key aspect is the existence of economic constraints. Many African economies are struggling and have limited financial resources to invest in climate resilience measures. This economic vulnerability hampers their ability to adapt to the changing environment and increases their susceptibility to climate-related shocks (Nakouwo and Zhang 2024). Finally, rapid population growth in many African countries places additional pressure on resources such as water and arable land, further intensifying conflicts and competition for these essential resources as climate impacts increase. These challenges disproportionately impact marginalised communities, exacerbating existing socio-economic disparities (Nakouwo and Zhang 2024).

There are also historical disadvantages. The legacy of colonialism and continued socio-political instability in some regions has created systemic challenges that limit the capacity of governments and communities to respond effectively to climate change (Mlambo et al. 2024). The pressing need for African universities to address climate change stems from the continent's unique vulnerabilities—as outlined above—and the key role these institutions play in fostering sustainable development (Atwoli et al. 2022). Thus, universities, as hubs of knowledge and innovation, are uniquely positioned to spearhead initiatives that not only educate but also empower local populations to adapt to and mitigate these effects (Atiase et al. 2020; Atwoli et al. 2022). Moreover, with the twenty-first century projected to see more people educated in Africa than in any other region, the future of higher education will be shaped by African institutions. Realising this potential depends on adequate institutional capacities and infrastructure from the school level upwards, including sustainable and equitable

electricity access in African schools (Moner-Girona et al. 2025). At the same time, critical climate-justice scholarship notes that most university systems remain poorly structured and are not yet adequately engaging with or preparing for the rapidly destabilising futures they face, thereby limiting their capacity to act as genuinely transformative institutions (Stephens 2024).

Key strategies of African universities for climate-conscious engagement

Many universities are incorporating climate themes across various disciplines, from science and engineering to social sciences and humanities (Maxwell et al. 2022; Nyahunda and Tirivangasi 2021). This approach of integrating various academic programs across diverse disciplines enhances the understanding of climate change challenges among students and communities (UNESCO 2017). Such integration enables students to grasp the multifaceted nature of climate issues, positioning universities as key informants and influencers in shaping how society addresses the impacts of climate change while fostering a sense of climate-conscious guardianship (McCowan 2020).

Effective climate solutions emerge from institutions that prioritise research and foster interdisciplinary collaboration across fields such as environmental science, economics, health, and urban planning (Ruwoko 2024; Nyahunda and Tirivangasi 2021). Universities also play a vital role in promoting climate awareness and sustainability practices through community engagement across diverse geographical contexts. This includes outreach programs, workshops and partnerships with local organizations, allowing communities and students to apply their knowledge in real-world contexts.

Boosting the academia–industry–community linkages, regional integration, under the capacity-building as well as empowerment component, makes universities the center of collaboration (Waruru 2024). For instance, the University of The Gambia, University of Nairobi, Kenya, and Université des Sciences Juridiques et Politiques de Bamako in Mali already have training programs targeting security, resilience, and climate change adaptation through active community participation (WASCAL 2020; Salzinger and Desmidt 2023; University of Nairobi 2022).

Strong partnerships have emerged with Kenyatta University partnering with state organizations, CBOs, and local NGOs to address climate literacy in higher education and institutional collaborations in climate action to make communities more aware of the consequences of their actions and behaviours (Kenyatta University Green Education Hub 2022). Equipping students and communities with climate

information bridges literacy gaps. African universities are emerging as key drivers of climate action, leading progressively through practical and context-specific innovations.

Challenges to climate leadership in African higher education

African universities face significant barriers to effective climate action, including insufficient funding, political instability, and inadequate infrastructure. Nonetheless, by advocating for policies that prioritise climate education and sustainability investments, these institutions can make substantial contributions to national and regional climate strategies.

Ssekamatte (2018) examined the experiences and perceptions of stakeholders at Makerere University in Uganda and the University of Dar es Salaam in Tanzania, highlighting key challenges in implementing climate-related programs. The findings revealed critical funding shortfalls for climate research, limited financial support from governments and local institutions, and inadequate resources for student research and field excursions. Political instability and interference further impeded community engagement and negatively affected public attitudes toward university-led climate initiatives. Additionally, the poor delivery of courses and programs was attributed to a lack of infrastructure and institutional support.

Mawonde and Togo (2019) evaluated the integration of sustainable development goals at the University of South Africa's science campus in Johannesburg. They found that financial constraints limited students' participation in sustainability-related activities, particularly in distance education contexts, as many lacked the resources to live on campus and were unable to fully engage with climate change education programs.

Bothun (2016) presents a case study on sustainability efforts across several universities in Sub-Saharan Africa, highlighting common barriers such as limited funding, insufficient awareness and information, inadequate human resources, and weak national policy support. Similarly, Leal Filho et al. (2017) identified administrative and political management challenges as the most significant obstacles to climate action in universities, followed by a general lack of institutional interest in or commitment to climate-related issues. Their global study included African countries such as Côte d'Ivoire, Ghana, Nigeria, South Africa, Tanzania, and Uganda.

Innovative climate solutions and best practices from African universities

Against this backdrop, several African institutions are advancing climate-smart agricultural practices to help farmers adapt to changing environmental conditions. These include the promotion of drought-resistant crops, agroforestry, and sustainable land management techniques. In parallel, universities across the continent are exploring technologies to convert municipal solid waste, agricultural by-products, and food waste into bioenergy. This often involves collaboration with local communities for waste collection and management.

African universities have developed decentralised energy solutions—such as solar microgrids, bioenergy hubs, and electric vehicles—with the aim of reducing carbon emissions. At the University of South Africa (UNISA), extensive research has been conducted in the field of electric transport (Mawonde 2019). As part of these efforts, the university has established an electric vehicle charging system at one of its campuses, reinforcing its commitment to low-carbon innovation and sustainable energy transitions (Mawonde 2019). Moreover, to progress the clean energy revolution, the university has installed a solar plant at one of its campuses (Mawonde 2019). This has created opportunities for the development of small community-based solar grids that are cost-effective and easy to maintain. In Kenya, Moi University has conducted extensive research on improving solar battery storage to enhance the reliability and capacity of such grids (Katche et al. 2024). Universities such as Strathmore and Cape Town have also been involved in solar energy-related research, aiming to develop solar energy efficiency on the African continent (Ayora et al. 2023). At Strathmore, the solar energy research is being advanced through the Strathmore Energy Centre (Ayora et al. 2023). Finally, the Innovation Hub at the University of Zimbabwe has made notable progress in developing solutions across key sectors, including energy, water, and food security (Gandidzanwa 2021).

Future action—building resilient climate institutions in African higher education

In order to strengthen climate protection measures on the African continent, it is essential to improve institutional capacities at universities in a sustainable manner. This requires the application of established strategies, the mitigation of key barriers, and the continued development of innovative solutions and best practices, as outlined in Fig. 1. A first recommendation is to establish additional specialised research centers focusing on environmental and climate



Fig. 1 Conceptual overview illustrating key strategies, contextual and institutional barriers, and innovative solutions contributing to climate action and sustainability in African higher education. (Source: concept by authors)

sciences in order to develop local solutions. Universities should also invest in training skilled workers who are capable of implementing innovative strategies. In addition, the establishment of regional networks between universities, such as the WASCAL network, is beneficial for promoting knowledge exchange and collaborative research.

Cooperation between African universities and international partners can be intensified through formal cooperation agreements, joint research projects, and exchange

programs. Such cooperation provides access to additional resources, expertise, and state-of-the-art technology. It also makes sense to invest funding specifically in cross-border projects in order to maximise the regional impact. Since technology plays a central role in the implementation of climate protection measures, modern digital platforms should be used to collect and analyse data and support decision-making. The use of satellite technology, cloud-based databases, and mobile applications can facilitate the monitoring

and assessment of environmental changes. It is also important to improve access to technologies through training and capacity building to encourage widespread use across the continent.

Overall, the strategic combination of stronger institutional capacities, intensive cooperation, and modern technology can significantly advance the way climate change is taught and investigated at African universities. Additionally, university curricula need to provide robust training on gender equality and women's empowerment. This is not only a social imperative but also a critical climate strategy. Research on gender and sustainability indicates that investing in the education and empowerment of women and girls can deliver substantial benefits for climate mitigation and climate-resilient development, particularly through more just low-carbon energy transitions (In 2024; Sadiqa et al. 2023). Embedding the principles of empowerment directly into training schemes equips future leaders to harness these synergies, fostering a generation that can simultaneously advance social equity and environmental sustainability. These measures may help to address regional and local challenges more effectively and promote sustainable development on the continent.

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Declarations

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