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PERSPECTIVE PAPER

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African women in science from diverse perspectives

AJIBOLA F. OLADEJO,[1,2] JOANA O. ADELEKE,[3] ABOYEJI PEACE,[2] ABIMBOLA OLUWAKARE,[2] ABOROWA CALEB,[2] ADEAGA OLUWAGBEMISOKE,[2] ADEGBILE DOMINION,[2] UKWU STEPHEN[2]

AFFILIATIONS:

[1]African Science Frontiers Initiatives (ASFI), Nigeria

[2]Department of Economics and Development Studies, College of Management and Social Sciences, Covenant University, Ota, Ogun State, Nigeria

[3]Bowen University, Iwo, Nigeria

CORRESPONDENCE:

Dr. Ajibola F. Oladejo

Department of Economics and Development Studies, College of Management and Social Sciences, Covenant University, Ota, Ogun State, Nigeria

Email: ajibolaoladejo95@gmail.com

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ABSTRACT

The contribution of African women to science remains significant yet underappreciated, making it a vital research area. This study analyzed African women's contributions across medicine, environment, and technology, while examining the cultural and systemic barriers they face. This perspective paper deployed the integrative literature review as the research methodology as well as applied content analysis. The paper highlights the need to amplify the voices of African women in science, celebrate their achievements, and address persistent gender gaps in Science, Technology and Mathematics (STEM) fields across Africa. Historical biases and limited educational access, combined with societal pressures, have constrained women's aspirations in science. Despite these challenges, African women demonstrate remarkable resilience, developing innovative solutions to global issues, including climate change, public health, and sustainable development. Through a multidisciplinary lens, this study highlights the intersection of gender, culture, and scientific advancement, emphasizing how diversity drives innovation. Key findings reveal critical policy and program needs to address educational and professional advancement barriers faced by women in STEM. Clearly, gender equity is not merely a matter of fairness but essential for scientific and societal progress. This paper supports policy formulation, advocacy for gender-responsive initiatives, and creation of a more inclusive global scientific community.

KEYWORDS:

Scientific Contributions, STEM, Gender Disparities, Empowerment, Global Challenges

INTRODUCTION

African women have long participated in scientific activities, yet their contributions have been marginalized in male-dominated historical narratives. [1] Many African women have pioneered fields including medicine, engineering, environmental sciences, and technology, breaking stereotypes while overcoming educational and career obstacles.[2] Dr. Wangari Maathai exemplifies this significance, becoming the first African female Nobel Laureate through her environmental conservation efforts.[3] Investigating African women's scientific contributions is crucial for recognizing achievements and understanding diverse challenges.[4] Historical factors including gender biases, limited resource access, and socio-cultural expectations have constrained women's opportunities across the continent.[5]

Despite the challenges faced, women consistently demonstrate competence when provided equal opportunities, challenging stereotypical gender role notions, and establishing new boundaries in diversity and representation discourse[6]. This paper examines African women's roles, achievements, and institutional barriers through an interconnected analysis of historical, cultural, social, political, and economic factors. Each perspective builds upon the others, revealing how systemic inequalities affect STEM disciplines in Africa and how addressing these barriers through comprehensive approaches can unlock the continent's full scientific potential.[7]

METHODS

This perspective paper deployed the integrative literature review as the research methodology as well as applied content analysis. There were no primary data readily available for this study and therefore the most suitable methodology was the integrative literature review. The use of this method has been documented by Mkwizu[8] and Snyder[9]. An integrative literature review synthesizes results from books, articles and other published texts. The five steps of integrative literature review are: identify the appropriate topic, justify literature review methodology, search literature, analyze and criticize the literature, and synthesize results. These steps were employed for this perspective paper.

The first step was to conduct preliminary literature searches to explore African women in science from diverse perspective. The second step was to synthesize the reviewed literatures that were relevant to addressing the central question, ensuring a comprehensive exploration of the topic. Thirdly, a systematic search for published articles was conducted on Google, Google Scholar, Scopus, and Web of Science. The journal articles were chosen based on the peer review process. In addition, conference papers reports, and any documentary evidence to support the topic of interest for research purposes. The next step was to analyse the selected journal articles and reports using content analysis for the specific themes. Lastly, the synthesis of the results was done.

FINDINGS AND DISCUSSION

Historical Foundations and Early Pioneers

In the Ancient knowledge systems, African women's scientific contributions span centuries, with traditional knowledge systems in agriculture, medicine, astronomy, and metallurgy featuring women in important positions.[10] In ancient Egypt, women scholars like Peseshet, possibly history's first known female physician around 2700 BCE, made significant contributions.[11] However, much of this history remains inadequately documented due to gender prejudices and absent standardized records[12]. These early foundations established patterns that would persist through centuries: women as custodians of indigenous knowledge, particularly in healing practices and environmental stewardship, yet facing systematic exclusion from formal recognition and documentation.

In addition, colonial disruption and its legacy have had impact on African women in science. The colonial era (19th-20th centuries) significantly declined African women's scientific participation through imposed Western education systems and patriarchal social structures, marginalizing African women's knowledge systems and limiting formal educational opportunities.[13] Colonial educational systems focused on basic literacy, offering limited advanced education opportunities, especially in sciences, with women facing additional restrictions due to societal gender norms and colonial biases.[14] This colonial disruption

created lasting impacts that continue to influence contemporary challenges. The imposed Western educational framework not only limited access but also devalued indigenous knowledge systems where women had traditionally held important roles, creating a double marginalization that affected both educational opportunities and cultural recognition.[15]

However, there were also reconstructions in the post-colonial reconstruction that made way for modern pioneers. Post-colonial periods saw African countries addressing inequalities through increased educational investment and encouraging women's scientific participation, though challenges including funding shortages and enduring prejudices persisted.[16] During this era, exceptional women began breaking through barriers, establishing foundations for future generations. Dr. Wangari Maathai (1940-2011) represents this transformative period.[17] The first female professor in Kenya and the first African female Nobel Peace Prize recipient, Dr. Maathai started the Green Belt Movement in 1977, which aimed to counter deforestation by encouraging women to think ecologically and plant trees in their local environments.[18] Her work, which led to the planting of more than thirty million trees, demonstrates how environmental science intersects with community empowerment and policy change. Organizations like the Forum for African Women Educationalists (FAWE), established in 1992, began advocating for policies supporting girls' education and women's scientific involvement, marking the beginning of systematic efforts to address historical disadvantages[19].

Cultural Foundations: Tradition, Transformation, and Scientific Identity

Building on this historical foundation, culture significantly influences African women's scientific participation, defining values, expectations, and opportunities through complex interactions between traditional knowledge systems and modern scientific frameworks. Contrary to common perceptions, many African cultures have historically supported women's engagement with scientific knowledge, particularly in areas that intersected with traditional roles[20]. Esther Mahlangu, though not classified as a conventional scientist, exemplifies how African women have maintained scientific knowledge through art, incorporating principles of geometry and symmetry that demonstrate the intersection of aesthetic and scientific understanding[21].

In Southern Africa, women have traditionally served as biodiversity custodians through seed selection and crop management, practices that form the foundation of agricultural science[22]. West African female herbalists and midwives have contributed to pharmacology and maternal health, blending traditional practices with evolving medical knowledge[23]. This heritage provides a strong foundation for contemporary scientific engagement when properly recognized and built upon.

Traditional gender roles have created complex challenges for women's scientific participation and paved the way for cultural barriers and evolving expectations. Most African cultures historically assigned men provider roles while confining women to domestic duties, limiting formal education and STEM career access[24]. UNESCO reports on celebrating African most talented young female scientists show that women comprise approximately 30% of Sub-Saharan African scientists, partly due to cultural beliefs about appropriate gender roles[25]. Early marriage remains prevalent, particularly in rural areas, limiting college opportunities. UNICEF's 2020 report shows Sub-Saharan Africa has among the world's highest child marriage rates, depriving girls of educational and career opportunities[26]. Cultural beliefs often question women's abilities in male-dominated sectors like engineering, physics, and mathematics, with teachers and community members inadvertently discouraging girls from science.

However, these cultural patterns are not static. As demonstrated by scientists like Dr. Ameenah Gurib-Fakim, a biodiversity scientist who served as President of Mauritius, success in scientific fields can transform cultural perceptions. Dr. Gurib-Fakim's extensive research on the healing attributes of native plants furthers understanding in ethnobotany and pharmacology while showcasing how traditional African medicine intersects with contemporary scientific research.[27]

Social Structures: Family, Community, and Educational Ecosystems

Cultural foundations directly shape social structures that influence African women's scientific trajectories[28]. These structures, including family expectations, community norms, and educational institutions, form the immediate environment in which scientific aspirations either flourish or are constrained. Family dynamics in particular play a significant role in determining the educational pathways for most African women. Progressive families, especially in urban settings, often encourage their daughters to pursue science, recognizing long-term benefits for social and economic mobility[29]. These families seek resources including scholarships, tutoring, and mentorship opportunities, creating supportive environments that enable scientific achievement.

The experience of Professor Francisca Nneka Okeke exemplifies how family support can shape remarkable achievements[30]. In her inaugural lecture at the University of Nsukka, she recounted how her father, Chief Patrick Okoye, nurtured her early interest in science particularly mathematics which later developed into her passion for physics. Her husband's support also played a crucial role, as witnessing his work during his PhD motivated her to intensify her own academic efforts. She emphasized that "It should be noted that my desire to become a physicist did not start when I got married to the love of my life, P. N. Okeke. Rather, the ease with which I saw him solve his Ph.D problems, when I got married to him, made me to redouble my efforts and took my dream of becoming a physicist to the next level, by making it a reality. His encouragement and support cannot be quantified or measured; it was but second to none". Such family support systems illustrate how personal relationships can influence women's advancement in demanding scientific disciplines [31].

As a Nigerian Professor of Physics and the first female to head the University of Nigeria's faculty of physical sciences[32], Prof. Okeke was later awarded the L'Oreal-UNESCO for Women in Science Award for her contributions to climate change research. Her success enabled her to advocate for further inclusion of women in her department, resulting in the employment of three new female faculty members and demonstrating how individual accomplishments can inspire systemic change.

Furthermore, community structures also influence women's opportunities by creating role model effect on most African women in science. Community norms and traditional expectations still limit academic pursuits by socializing women into domestic roles. However, as more women succeed in STEM fields, these norms create role models that inspire subsequent generations. The career of Dr. Margaret Mungherera illustrates the transformative potential of these role models. As a Ugandan psychiatrist and the first female president of the World Medical Association, she spoke frequently about self-belief and perseverance, inspiring countless young women across Africa to pursue medical careers despite societal expectations.[30]

Besides, mentorship is especially female mentors in science, has directly impacted women's persistence and success in STEM fields[31]. Women's underrepresentation in science and leadership positions limits mentorship availability, while male-dominated mentorship, though valuable, may not fully address gendered obstacles women face.[32,33] Gender bias in educational systems manifests through teacher expectations, curriculum design, and social stigmas attached of careers perceived as "unfeminine" has also influenced long term academic choices.

Political Frameworks: Policy, Governance, and Institutional Change

Recognition of cultural and social challenges faced by Africa women in science has prompted political responses across the continent, with governments and international organizations implementing policies to address gender disparities in STEM through systematic approaches that acknowledge the complexity of barriers women face. A vital aspect is the development and implementation of gender responsive policies. Countries like Rwanda have implemented constitutional reforms mandating gender equity in education and employment, significantly increasing women's STEM program participation. Rwanda reported 20% increase in female STEM enrollment between 2015-2022, demonstrating how comprehensive policy approaches can create measurable change[34]. South Africa's Gender Equity in STEM Strategy promotes equal access and retention through targeted interventions that address multiple

barrier levels simultaneously.[35] Ghana's STEM-focused schools with gender-sensitive curricula increased girls' science course participation, while Nigeria's "Girls in STEM" initiative encourages secondary school female students through scholarship schemes and mentorship programs.

Economic Dimensions: Resource Access, Opportunity Costs, and Empowerment

Political frameworks must address underlying economic realities that often determine whether policy intentions translate into practical opportunities for African women in science.[36] Economic factors critically shape scientific education and career access through poverty, wage disparities, and resource limitations that intersect with cultural and social barriers. One of the impediments that has affected African women in science is financial constraints and resource allocation. The average African family's often prioritize male children's education because of limited financial resources, particularly in expensive scientific fields requiring laboratory work and research investments. This economic reality reinforces cultural preferences while creating practical barriers that policy interventions must address[37].

Rwanda's Digital Ambassadors Program exemplifies a comprehensive approach to economic empowerment, designed to improve five million citizens in the area of digital literacy while training women in technology for data science, IT, and engineering sector participation. [38]This initiative simultaneously addresses skills development, economic opportunity, and cultural change. The African Women in Agricultural Research and Development (AWARD) program provides fellowships and mentorship for women in agriculture, focusing on scientific innovation and capacity building.[39]

These multi-level interventions are increasingly being supported by technological advancement that generate new pathways for African women's STEM participation while connecting local efforts to global scientific communities[40].Technology advances significantly impact African women's STEM participation through initiatives like South Africa's Code for Cape Town and STEM education programs that enable young women to become IT leaders. Organizations like TechWomen provide networking and mentoring opportunities that help overcome visibility and access barriers, connecting African women scientists with international collaborators and resources.

CONCLUSIONS AND FUTURE DIRECTIONS

This multidisciplinary analysis shows that empowering African women in science requires comprehensive strategies that address structural barriers across multiple interconnected levels. Progress depends on coordinated efforts from governments, communities, and international partners that acknowledge historical, cultural, social, political, and economic factors interact to shape both challenges and opportunities. The progression from historical marginalization through contemporary policy reforms and emerging technological opportunities reflect significant progress yet gaps remain. Cultural transformation continues alongside policy implementation, social support systems expand through economic empowerment, and technological integration enables global connectivity helping to amplify women's scientific achievements. A key limitation identified through literature review is limited availability of documentation of African women who have excelled in scientific careers. The gap highlights the need to further research, improve reporting and documentation that brings greater visibility of the impact of African women in science".

Future research and targeted activities remain essential for sustained growth and inclusivity. The unique perspectives and innovative solutions African women bring to global challenges demonstrate the critical importance of their full participation in scientific endeavors. Investing in African women's scientific potential benefits not only Africa but also contributes to addressing global challenges through diverse and inclusive approaches to scientific innovation.

The evidence from the perspectives examined in this paper demonstrates that gender equity in science is not only a matter of fairness but also a critical component of scientific and societal progress. Continued commitment to comprehensive, multi-level interventions will unlock the full potential of African

women's contributions to science and foster more inclusive global scientific communities.

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CONFLICT OF INTEREST

None declared.

AUTHORS' CONTRIBUTIONS

AFO: Original conceptualization of idea, refinement, and revision JOA: review of original draft, edited the revised version, AP, AO, AC, AO, AD, US: original draft.

REFERENCES

1. Bouilly E, Rillon O, Cross H. African women's struggles in a gender perspective. Rev Afr Polit Econ. 2016;43(149):338-49.
2. Nweje U, Amaka NS, Makai CC. Women in STEM: Breaking barriers and building the future.
3. Maathai W. Unbowed: A memoir. New York: Knopf; 2006.
4. Githire N. Recognizing achievements of African women scientists. Nature. 2018;553(7689):417-8.
5. Taghizadfanid A, Aghayari Hir M, Ahmadzadeh Naghadeh S. Evaluation of Gender Inequality in Women's Education and Employment and Analysis of Factors Affecting it (Case study: Villages of urban Peripheral Tabriz). Peripheral Urban Spaces Development. 2024 Apr 20;6(1):131-56.
6. Lwamba E, Shisler S, Ridlehoover W, Kupfer M, Tshabalala N, Nduku P, et al. Strengthening women's empowerment and gender equality in fragile contexts towards peaceful and inclusive societies: A systematic review and meta-analysis. Campbell Syst Rev. 2022 Mar;18(1):e1214.
7. Ochi A. Inequality and the impact of growth on poverty in sub-Saharan Africa: A GMM estimator in a dynamic panel threshold model. Reg Sci Policy Pract. 2023 Aug 1;15(6):1373-95.
8. Oladejo AI, Olateju TT, Okebukola PA, Sanni R, Akintoye H, Onowugbeda F, et al. Breaking Barriers to Meaningful Learning in STEM Subjects in Africa: A Systematic Review of the Culturo-Techno-Contextual Approach. Sustainability. 2025 Mar 6;17(5):2310.
9. Mkwizu KH. Tourism in Africa: opportunities and challenges perspectives from Eastern and Southern Africa. African Science Frontiers Initiatives Research Journal (ASFIRJ). 2025; 2(1): e12048.
10. Snyder H. Literature review as a research methodology: An overview and guidelines. Journal of Business Research. 2019; 104: 333-339.
11. Mji G. Women as healers and indigenous knowledge systems and its holders: An intertwined epistemological and ontological struggle for recognition. In: Mji G, editor. The walk without limbs: Searching for indigenous health knowledge in a rural context in South Africa. Cape Town: AOSIS; 2019. p. 73-108.
12. Watterson B. Women in ancient Egypt. Stroud, England: Amberley Publishing; 2015.
13. Female Physicians in Ancient Egypt [Internet]. World History Encyclopedia. Available from: https://www.worldhistory.org/article/49/female-physicians-in-ancient-egypt/[cited 2025 Dec 09].
14. ElMorally R. Feminism, Identity, and the Status of Women in Egypt (19th–20th Century). In: Recovering Women's Voices: Islam, Citizenship, and Patriarchy in Egypt. Bingley: Emerald Publishing Limited; 2024 Sep 9. p. 37-71.
15. Duncan GA. The changing face of colonial education in Africa: Education, science and development. HTS Teol Stud. 2022;78(1).
16. Ntiwunka GU, Nwaodike CA. Women and Colonialism in West Africa. In: The Palgrave Handbook of African Women's Studies. Cham: Springer International Publishing; 2021 Oct 29. p. 1169-84.
17. Baten J, De Haas M, Kempter E, Meier zu Selhausen F. Educational gender inequality in Sub-Saharan Africa: A long-term perspective. Popul Dev Rev. 2021 Sep;47(3):813-49.
18. Wagner CL. Restoring Relationship: How the Methodologies of Wangari Maathai and the Green Belt Movement in Post-Colonial Kenya Achieve Environmental Healing and Women's Empowerment [master's thesis]. Johnson City, TN: East Tennessee State University; 2016.
19. Forum for African Women Educationalists. Nairobi: FAWE; c2024. About FAWE. Available from: https://fawe.org/about-fawe/

20. Bhuda MT. The role of art in sustaining the livelihoods of Amandebele women in South Africa. Potchefstroom, South Africa: North West University; 2019.
21. Forum for African Women Educationalists. 30 years of advancing girls' education in Africa. Nairobi: FAWE; 2022.
22. The Gaia Foundation, African Biodiversity Network, African Women's Development Fund. Celebrating African Rural Women: Custodians of Seed, Food & Traditional Knowledge for Climate Change Resilience [Internet]. Gland: IUCN; 2016 Aug. Available from:https://iucn.org/news/commission-environmental-economic-and-social-policy/201608/celebrating-african-rural-women-custodians-seed-food-traditional-knowledge-climate-change-resilience-%E2%80%93-new-report-gaia-foundation
23. Musie MR, Anokwuru RA, Ngunyulu RN, Lukhele S. African indigenous beliefs and practices during pregnancy, birth and after birth. In: Mulaudzi FM, Lebese RT, editors. Working with indigenous knowledge: Strategies for health professionals. Cape Town, South Africa: AOSIS; 2022. p. 85-106.
24. Rankin-Smith F, Nettleton A. Esther Mahlangu: Contemporary South African artist. Johannesburg: Wits University Press, South Africa; 2019.
25. Tamunomiegbam A, Arinze D. From tradition to transformation: evolving gender norms in contemporary Africa. Am J Public Policy Adm. 2024;9(3):1-36.
26. UNESCO. Celebrating African most talented young female scientists [Internet]. Paris: UNESCO;Available from: https://www.unesco.org/en/articles/celebrating-african-most-talented-young-female-scientists
27. UNICEF. Taking the field forward: investing in knowledge to end child marriage [Internet]. New York: UNICEF. 2021. Available from: https://www.unicef.org/media/122856/file/Child-marriage-publication-catalogue-2020-2021.pdf
28. Gurib-Fakim A. Medicinal plants: traditions of yesterday and drugs of tomorrow. Mol Aspects Med. 2006 Feb 1;27(1):1-93.
29. Chandratreya A. Partnering with families and local communities: enhancing the learning environment. In: Patel AM, et al., editors. Education across borders: A global call for diversity. [Place unknown]: A2Z EduLearningHub LLP; 2024.
30. United Nations Office of the Special Adviser on Africa. Francisca Nneka Okeke [Internet]. New York: UN-OSAA. Available from: https://www.un.org/osaa/content/francisca-nneka-okeke
31. Okeke FN. 45th Inaugural lecture [Internet]. Nsukka: University of Nigeria; 2015. Available from: https://www.unn.edu.ng/wp-content/uploads/2015/09/45th-Lecture.pdf
32. World Medical Association. Welcome President-Elect Dr. Munghere [Internet]. Ferney-Voltaire: WMA. Available from: https://www.wma.net/blog-post/welcome-president-elect-dr-mungherera/
33. Torres-Ramos S, Fajardo-Robledo NS, Pérez-Carrillo LA, Castillo-Cruz C, Retamoza-Vega PD, Rodríguez-Betancourtt VM, et al. Mentors as female role models in STEM disciplines and their benefits. Sustainability. 2021 Nov 23;13(23):12938.
34. Thelma CC, Ngulube L. Women in leadership: Examining barriers to women's advancement in leadership positions. Asian J Adv Res Rep. 2024;18(6):273-90.
35. Reilly EC. Rwandan women in higher education: Progress, successes, and challenges. Front Educ. 2021 Aug 25;6:561508.
36. Ntombela B, Ramabodu MS, Moloi K. Strategies for empowering and retaining women in science, technology, engineering, and mathematics (STEM) fields: A systematic literature review. Seybold Rep. 2025 Jan 9;20(1).
37. Hassan E, Groot W, Volante L. Education funding and learning outcomes in Sub-Saharan Africa: A review of reviews. Int J Educ Res Open. 2022 Jan 1;3:100181.
38. Jang IC. Digital literacy evangelists in Rwanda: A case study of the Digital Ambassador Programme. Dev Policy Rev. 2025 Jul;43(4):e70013.
39. African Women in Agricultural Research and Development. Nairobi: AWARD; c2024. Available from: https://awardfellowships.org/
40. African Union Development Agency. Heightening participation of African women in science, technology, engineering and mathematics. Midrand: AUDA-NEPAD. Available from: https://www.nepad.org/blog/heightening-

participation-of-african-women-science-technology-engineering-and-mathematics