

Paper 3: African Women in Artificial Intelligence

Pivots, Perseverances & Pleasures

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POLLICY

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Executive Summary

This is the final report in Pollicy's three-part series on African Women in AI. Launched in 2021, this project frames analysis of the state of artificial intelligence (AI) in Africa through a gender lens by exploring the impact of AI on women. This project emerged out of the need to fill the visible gap in conversations surrounding the impact of AI in Africa on women and promoting the inclusion and representation of African women and the associated challenges.

In the first instalment, we mapped and outlined the structures propping up and hindering the development of AI in Africa. We then provided analysis of the racial, ethical, and gendered considerations which need to be considered by policymakers and developers, noting how African women could be significantly affected by AI deployments due to various intersecting identities. In our second report, we took a deep dive into some of the threats and benefits of Artificial Intelligence that African women face. This report highlighted the impact of colonialism, traditional and modern-day norms and institutions and factors such as religion and how their impact may be worsened with the introduction of AI systems.

These two papers highlighted some of the challenges with how African women interact, the first with ethics generally and the second with African women as users of this nascent technology. One very critical aspect of this relationship still needed to be explored: African women involved in the creation of AI-powered products and services.

Borrowing core elements of the field of feminist technoscience, which emphasise the proactive engagement of women in the design and development of technology, this third and final paper focuses on the lived experiences of African women working to shape various fields of AI, including academia, energy, climate change and education. As diversity amongst researchers is a major challenge in combating AI bias, this paper seeks to answer what the diversity problems and challenges are for Africa's female AI researchers. In this research, we ask the question of gender repeatedly, and frame what the pathways, challenges and solutions are from the specific viewpoints and perspectives of our respondents. We also specifically interrogate how AI is transformed and applied to the African context, particularly for women and gender overall.

As noted in our second report, biases in AI systems may set back, entrench or perpetuate the systemic harms and discrimination that African women already face. Worse, technology is often thought of and presented as a neutral and objective force for enabling development and growth. As a result, its harms, especially to minority groups, are understudied and insufficiently highlighted. The goal of this research is therefore to provide nuance and insight as more stakeholders awaken to the gaps and provide room for their resolution for the benefit of women in Africa.

Contents

- ii Executive Summary**
- iii Table of Contents**
- 01 Acronyms**
- 01 Definitions**
- 02 Introduction**
- 03 Literature Review**

- 08 Results**
 - Participants
 - Entering the field
 - Sectors that work with AI
 - Positive perceptions about AI
 - Challenges for women working in AI

- 22 Conclusion**
- 24 Works Cited**

- 06 Methodology**
 - Study area and study participants
 - Sampling method and selection of participants
 - Study Limitations and Lessons Learnt
 - Limitations in the literature review
 - Data collection methods and tools
 - Data analysis and management

- 17 Impact of the absence of women in AI**
 - To stakeholders
 - To men and broader society
 - To government stakeholders
 - To corporations, startups, accelerators and developers
 - To civil society

Acronyms

AI: Artificial Intelligence

ICT: Information Communication and Technology

IDI: In-Depth Interview

ITU: International Telecommunication Union

ML: Machine Learning

MT: Machine Translation

NLP: Natural Learning Processing

STEM: Science, Technology, Engineering, Mathematics

UNESCO: United Nations Educational Scientific and Cultural Organisation

Definitions

Artificial Intelligence: The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages

Machine Learning: Machine Learning is a subset of AI that makes use of algorithms and data to improve outcomes.

Natural Learning Processing: NLP is a field of artificial intelligence, where systems and computational algorithms are built that can automatically understand, analyse, manipulate, and potentially generate human language.

Introduction

The world has become more connected than ever, especially with the ongoing coronavirus (COVID-19) pandemic. Some statistics show that the number of global Internet users has climbed to 4.95 billion at the start of 2022, with Internet penetration now standing at 62.5 percent of the world's total population (Kemp, 2022). This development is nowhere near more apparent perhaps than in the visible gains reaped by global social media giants, with YouTube's ad reach increasing over eleven percent over the past year and Instagram's by twenty-one (DataReportal, 2022).

In spite of recorded growth in the uptake of digital technologies around the world, only thirty percent of individuals living in Sub-Saharan Africa use the Internet (World Bank, 2020). Additionally, there is a significant digital gender gap in access and Internet penetration in Africa. The digital gender gap refers to a digital manifestation of systemic discrimination affecting women and girls as a result of gender-based disparities in technology access and use (Alliance for Affordable Internet, 2021). For example, statistics by the International Telecommunication Union (ITU) published in 2019 revealed that in Africa, only twenty percent of women use the Internet in comparison with thirty-seven percent of men.

These statistics are important to bear in mind today. Despite the growing adoption of Artificial Intelligence worldwide, there is an extant gender gap amongst AI researchers. In Africa, women are similarly underrepresented in AI roles. To illustrate the challenge, a 2021 study conducted by the Centre for Intellectual Property and Information Technology (CIPIT) which surveyed 160 companies across 21 countries revealed women accounted for only twenty-nine percent of the AI workforce in Africa (Ondili, 2021). Linked to these gaps are a plethora of harms emerging and already visible in more AI-ready climes, such as biases in hiring, content moderation and language processing. It is clear that building representative and responsible AI in Africa will not be possible to achieve without the inclusion of women in the sector.

This paper sets out to study some of the underlying factors behind underrepresentation and the gender gap that African women face in AI. For the purposes of this paper, we surveyed women in the following eight African countries: Nigeria, Ghana, Cameroon, Tunisia, Rwanda, Kenya, Tanzania and Mauritius. Our respondents work in various AI fields, including Natural Language Processing (NLP), agriculture, academia, climate change, tourism and health.

In this research, our objectives are to understand the experiences of women working in AI in Africa, to highlight their challenges and to identify and promote mutually discovered recommendations necessary for resolving these challenges for use by necessary stakeholders in the sector.

Literature Review



Deliberations revolving around the subject of development by agencies such as the World Bank have been criticised for failing to consider a gendered analysis in policy making (Adams, 2021). Recently, the use of technology has gained prominence as a feature of development efforts in Africa, even as technology deployment efforts during and after colonialism have continued to sideline African women.

Ignoring the traditional, pre-colonial positions, roles of influence and privilege of African women has led to gender-blind impositions in the funding and integration of innovation in agriculture, nutrition, health and trade. Despite being originally dominated by African women in certain communities, the masculinisation of these sectors, through the introduction of technological innovations and aid from non-African stakeholders, has edged women out of these spaces. This trend is visible today in the digital gender divide.

Women are excluded from the processes through which technology is constructed and ideated as a neutral artefact. This is in addition to the failure to understand the underlying factors behind what has been described as intolerance, fear or reluctance on the part of women to experiment with new technologies (Ibrahim & Adamu, 2016). The failure to understand is fundamental to the exclusion of women in technological spaces today, as well as digital divides in uptake, adoption and design flaws (Zerai, 2019). State policies designed to solve the issue have also been criticised for lumping women of all demographics together (Olajide et al., 2019). The project approach, in particular, has been derided for marginalising rather than mainstreaming the involvement of women in development by characterising their interests as pet projects or hobbies (Adams, 2021).

All over Africa, women face hindrances to their participation in STEM courses and Information and Communication Technology (ICT) use and development due to individual, cultural and organisational barriers (Tharshini et al., 2016; Bimber, 2000). The low participation and involvement of women in STEM and ICT cannot be removed from the factors which have contributed generally to lower levels of education and literacy amongst women and girls in Africa (Schelenz & Schopp; 2018). This gap translates into the lower use and adoption of digital technologies and activities such as blogging and other forms of digital archiving and entertainment.

According to UNESCO (2021), there are more male than female students at the Bachelor's degree level, and even fewer female students at the Master's level in sub-Saharan Africa. At the Master's level, sub-Saharan Africa also had the lowest gender parity indicator globally. At the PhD level, a study conducted in seventeen African countries by Fisher and colleagues (2020) found that women in STEM PhD programs had, on average, one less paper accepted for publication than their male counterparts. They also took about half a year longer to finish their PhD training and that even fewer female graduates went on to work as researchers in their chosen fields (UNESCO 2019). According to UNESCO's 2019 report, sub-Saharan Africa has the lowest number of female instructors at the tertiary level (24%), a two percent decrease from earlier years. In addition, a report by Google (2022) reveals that only 15% of developers in Africa were women in 2021, 2.5% less than 2020. The gradual disappearance of women in STEM-related fields at points of transition has been described as a leaky pipeline (Ezeh, 2013; Olajide, et al. 2019). The leaky pipeline, proposed in 1983 by Sue Berryman, is a model that concisely and visually describes leakages of women scientists leaving the

pipeline, and the volume decreases which then lead to shortages in women's labour supply (Bennett, 2011).

Another contributory factor is societal fears that women might neglect gendered care duties or be promiscuous due to preoccupation with technology (Zerai, 2019). This also limits the access of women and girls to ICTs and further deepens the digital divide. A combination of these factors has often resulted in apathy towards the adoption of technology amongst women in favour of the need or obligation to attend to their assigned duties or gendered adoption which favours the execution of these roles. The gendered adoption of technology by women refers to how women use these devices only in furtherance of their gender roles. All of which, intriguingly, have led to the categorization of women as technophobic or disinterested (Schelenz & Schopp, 2018).

The majority of technology-focused studies conducted in Africa have examined the gender divide in ICT and STEM access in education, leaving a gender gap in Artificial Intelligence in Africa today. This is important because even though it must be noted that AI being a subset of the technology field itself makes it one worth exploring in-depth. Its disruptive significance across sectors has been labelled a general-purpose technology, and the potential it

offers due to its newness as a field, for improved diversity, career prestige, intellectual stimulation and innovation (Young et al., 2021). However, research into the gender gap in AI in and outside Africa is challenging due to these same factors. Results from available statistics are quite troubling. For instance, the 2021 Global Gender Gap Report revealed that female representation in AI and data-related roles was below parity, at about thirty-two percent globally (World Economic Forum, 2021). This is corroborated by ElementAI's 2020 Global AI Talent report that shows women only make up about fifteen percent of the global workforce.

In Africa, this challenge takes a different turn. While the historical contributions of women to the development of technology and computing in Europe and the United States can provide useful context for understanding the origins of the gender gap in ICT in those regions, the absence of such a history in Sub-Saharan Africa further complicates the analysis of the gender gap today in technology (Young, 2021; Schafer, n.d.; White House, n.d.).

This gap and the absence of research into the challenges of African women working specifically in AI provide context to the necessity of conducting the present study.

Methodology

The overarching purpose of this exploratory study was to understand the experiences of women working in the AI sector in Africa and the barriers they face.

Study Area and Study Participants

This research study was conducted with eleven women from eight African countries that are currently engaged in AI work, including Nigeria, Mauritius, Rwanda, Cameroon, Tanzania, Kenya, Tunisia and Ghana. These are women working with AI in different sectors, including health, agriculture, business / fintech, natural language processing, energy, education, climate change, academia and ethics and governance.

Study participants were selected from these countries due to the quality and quantity of technological innovation and startups present in them, supported by available research. For instance, the 2021 report by Artificial Intelligence for Development (AI4D), which explored the landscape and general state of AI in Africa, found a correlation between the positive rankings of certain African countries in global AI readiness rankings and leading African economies, including Tunisia, Ghana, Nigeria, Kenya and Mauritius. The report also noted that these countries have well-documented histories of strong technology development. Nigeria and South Africa have some of the highest levels of innovation and uptake of AI in the global South, with 42 and 38 use cases, respectively (AI4D, 2021). In addition, Mauritius, Kenya and Rwanda are ranked among the top five sub-Saharan African countries on the list. Tunisia and Mauritius are ranked above the world average in the 2020 Global Government AI Readiness Index (Oxford Insights, 2020).

Sampling Method and Selection of Participants

For this study, we used a systematic, purposive non-probability sampling method that allowed us to be selective regarding study participants. This type of sampling is selective in the population that we examine, since women who work in AI, in sub-Saharan Africa, is a small group to begin with. As a result, we intentionally selected women of African origin from different sectors and from selected countries that are working in AI. Sample size estimation was based on saturation of responses; we interviewed eleven women. We identified these women from peer networks, referrals from civil society, and public sector organisations that work with such women.

Study Limitations and Lessons Learnt

Survey Limitations

Due to sample size limitations, the survey was only able to reach a total of eleven women against the initial estimated sample size of 28 participants. As a result, we were only able to conduct eleven In-Depth Interviews (IDIs) in place of the planned eleven IDIs and two Focus Group Discussions (FGDs) with 6 – 8 participants.

Geographically, we were unable to interview any women from Southern Africa, though all other regions were covered. We were only able to interview participants working in nine of the sectors we had initially identified: health, agriculture, business/fintech, natural language processing, energy, education, climate change, research/academia, AI ethics/governance, energy, and public transportation.

These were due to a multiplicity of reasons. AI is still a new area of work in Africa, especially for women, and so there was a smaller pool of participants than we had initially anticipated. Sector-wise, there was a greater overrepresentation of participants in health and agriculture as opposed to energy and transportation in our initial sample size than we expected. This meant that we were unable to identify, and in cases where we successfully identified some women in AI in energy and transportation, we were either unable to connect with and contact them.

Geographically speaking, there were more participants from certain countries such as Nigeria. This created a situation where there were only respondents for certain sectors from these countries. Lastly, a number of our potential respondents also cited conflicting schedules which prevented them from being a part of the research.

Limitations in the literature review

The desk research for this report was limited due to the relatively novel nature of research into the gender gap in AI in Africa. The field of available data and research is still being developed.

Data Collection Methods and Tools

We used qualitative methods to collect data for this research study. An in-depth interview technique was used to collect data from participants as they gave detailed descriptions of their experiences working in Artificial Intelligence.

Data Analysis and Management

Data was downloaded from audio recordings, which were transcribed using Microsoft Word, and exported to Atlas 7 for content analysis and coding. Before coding, the researchers read and re-read through the transcripts to internalise the information.

Codes were developed according to the objectives of the study, and the code by list method of coding was used wherein codes were selected from a list of codes in the Hermeneutic Unit in Atlas 7, and assigned to chunks of data. Code labels were thus applied to segments of the transcripts that described and linked them to the highlighted text or quotation. A query report was then developed that consisted of quotations that formed themes in line with the research objectives.

Results



Participants

Eleven women from eight countries participated in this study. All participants use AI in their work across various sectors. These sectors include health, agriculture, business and fintech, natural language processing, education, climate change, research and innovation in AI, academia and AI ethics and governance.

Entering the field

Through this study, we wanted to understand how African women in AI or using AI for work began their careers in this field. Our results revealed that there were different entry points. For instance, some respondents already worked in ICT or AI-adjacent roles such as digital media. One participant began in digital media and design and then ventured towards cybersecurity and AI. This was able to happen solely because the fields are adjacent (*IDI_Mauritius*).

Others discovered the field due to a combination of interest and chance. Data science and technology were not always the first consideration as career options. Rather, participants noted that they fell upon data-related employment by chance through recruitment, job searching and application processes. A respondent from Nigeria began learning skills online, and did not stop. She said,

“ I thought it was interesting and something that I could give a shot. (*IDI_Nigeria*)

Regardless of age and experience, respondents revealed that summer schools, universities and online courses played a role in streamlining their interests towards AI. A Cameroonian respondent shared that they progressed from having a Bachelor’s degree in mathematics and computer science to a Master’s in software engineering, ending up with an African Master in Machine Intelligence in Ghana (*IDI_Cameroon*).

Women are also present in academia, working to advance the field of AI in research. A Tanzanian respondent was previously an academic for about 10 years and had worked in AI and data science since 2016. She was exposed to data science through a momentous summer school she attended at Makerere University in Uganda. She noted that even then, in 2016, there were only three women from her university who attended the summer school. That acted as a catalyst. She continued:

“ When we came back home, we were really inspired to work in this field. And it was a learning by doing process because by then, I was back to my academic duties as a lecturer. In fact, I said ‘I will learn data science, I will learn AI and learn and see how we can break the research in this field and at our institution’. (*IDI_Tanzania*)

Sectors that work with AI

Artificial Intelligence is described as a General Purpose Technology (GPT) due to its wide-ranging applications across various fields and sectors. This is reflected in the diversity of fields the participants in this study work in, by way of using AI in Africa.

The women interviewed for this study are involved in different institutions where they use Artificial Intelligence, including agriculture, health, business and trade, communication and academia. Many of the women work in intersecting fields and are not constrained to just one field. They were able to identify how AI could be useful as a tool in their current practice regardless of background. For example, one woman began work in clinical pharmacy, understanding that data science and AI are tools for any sector (*IDI_Nigeria*). One person leverages her STEM background to improve project management for AI projects. Her previous knowledge of AI and engineering has proven fundamental for effectively managing a broad portfolio of AI projects. This includes an AI hub focusing on capacity building and awareness-raising. She helps “raise awareness around the importance of AI to grow the economy” (*IDI_Tunisia*). All of this work empowers the ecosystem that AI works within.

Similarly, other participants also mentioned developing models using AI to improve and contribute to health research in their countries. Even though Mauritius is a growing and stable economy, one participant noted that projects that are present in other similar countries are not yet developed. This includes health research projects that use machine learning to make predictions on health outcomes. She elaborated:

“...you can predict the survival of breast cancer patients based on their genetic profile, that is which kind of mutations they have and which change, and then the stage of the cancer, the size of the lump that they have, the age, and all this. So you can use machine learning to make predictions, like survival. If somebody comes, there's like a genotyping they have a profile, and you look at the mutation profile of that patient, you can actually determine, if you have got a lot of data from past, you can train that based on the data, and you can say this patient can develop the cancer in so many years. (*IDI_Mauritius*)

A participant from Tanzania elaborated on how she used Artificial Intelligence to facilitate access to food by matching the demand for food to its supply using an e-commerce application. The application matches those who supply food products with potential areas of demand for this food like shopping stores, governments, small-medium enterprises as well as individuals. According to this participant, this application has helped to overcome the inefficiencies in the food demand and supply chain, including food loss and waste, and reducing competition among suppliers, among others. Reducing inefficiencies in food demand and supply has been identified as an essential requirement in achieving global food security. The same AI application is also used to predict crop yields as well as forecasting the supply of the crops and products.

A similar case of AI precision in agriculture was shared by a participant from Nigeria. This particular use case aimed at improved and sustainable agriculture and food security by providing farmers with effective information, timely and corrective strategies on crop diseases and pests, and crop yields. Additionally, she also mentioned the use of AI applications to monitor water access and use for both home consumption and agricultural production by locating the closest water areas to the community as well as those areas with limited water supply. Another Nigerian respondent used machine learning to collate satellite imagery and get accurate results on air quality, combining both software and hardware aspects of AI (*IDI_Nigeria*). Using technology to gather and analyse data more accurately is a boon for development in many sectors.

Another participant from Nigeria mentioned how their start-up is harnessing the power of AI to increase renewable energy use in communities that cannot access power from the main grid. They start by identifying areas with a limited supply of rooftop panel energy and linking them to benefit from solar panel systems. Such innovations can help local communities address food insecurity, ensure universal energy distribution and improve the sustainability of water supply systems. For example, in Nigeria, they developed an API to predict crop yield, where two kinds of crops can be detected and classified: rice and maize. The team can then analyse rain and temperature across the country and better predict waves of hunger. Similarly, they use AI to locate areas with limited water supply to identify those in need (*IDI_Nigeria*).

Other women shared their experiences as part of the Masakhane research group, a group of researchers from across the African continent collaborating on an open-source AI project to develop machine translation for African languages. Masakhane is involved in developing AI applications to translate local languages to English to help people access content online that is not published in local languages. One of the participants from Ghana, who is a member, elaborated on how she uses AI and machine learning to develop the Khaya app, which is a translation application for local languages in Ghana.

“ So in that sense, AI is helping people who do not understand our language to be able to have translations because when you go on Google, you don't see the Twi language. You don't see any of the Ghanaian languages. So in that sense, it is helping, and it has brought together a lot of researchers from Africa who are in AI. (*IDI_Ghana*)

Additionally, another participant who is also a member of Masakhane mentioned that her work utilises natural language processing to produce large sets of text available in the different African languages to facilitate the availability of information on the internet to the diverse and numerous linguistic populations.

Positive perceptions about AI

In addition to providing career opportunities, as explored at above, participants also found that the use of AI brought some satisfaction and pleasure in other ways.

Financial Independence

Participants shared with us that because of their work with AI, they are now able to conduct novel, groundbreaking research. The financial support improves their capacity to expand the field. One participant mentioned that AI and machine learning provides more opportunities, such as applying for grants and has successfully applied for a grant to use AI and machine learning to advance public health in Africa (*IDI_Mauritius*). Due to the topical nature of AI and its emergence as a distinct field of work, grants and associated funding for work and research are becoming more available. Recognising AI's value in combating high-level issues such as climate change and natural disaster is increasing attention to the value that related work can bring. As a result, women who work in the AI sector are exposed to more opportunities and consequently increased financial independence.

Career Opportunities

Participants recognised that learning about AI and its use within their work, regardless of what stage they are in their career, has opened up more opportunities. As a course of study, qualifications and certifications in AI have opened pathways for students to work with large organisations or go into research at the PhD and postdoctoral levels. One woman from Ghana has noticed that all women she knows from the African Institute for Mathematical Sciences (AIMS) have progressed to pursuing a PhD or working with big technology companies.

She continued,

“ So it's making a very good impact. And the women who have actually taken this AI seriously are benefitting a lot from it and they are growing. (*IDI_Ghana*)

Taking advantage of emerging fields of study and new types of work has allowed women to pursue and take up more space in STEM-related careers.

Networks and Communities

Through their work and studies in AI and by applying it in their work, some participants have found friends and communities invaluable for their wellbeing. Networks, community building and mentorship are all valuable tools to encourage women's entry and lasting participation in the AI sector. Multiple respondents emphasised the value of networks and community as ways of professional and personal development. A Tanzanian respondent noted that through AI, she was able to meet

“...people working at Google, working for Amazon, working at big universities abroad, because they all come towards building this capacity to offer so that we understand the knowledge and empower others and also so it's been a very close-knit community. And I'm really grateful that I made that decision to venture into this field. (IDI_Tanzania)

Productivity

According to participants, AI has given them an edge in their work. Automating work also means that effectiveness, efficiency and productivity are freed up, leaving them with more time to pursue other activities. With this free time, our participants mentioned that they can now spend more time with friends and family. In addition, time freed up due to automation lets employees develop other skills and move forward on tasks that previously consumed most of their working hours and avoid repetitive tasks. It makes work easier and opens up more time for interpretation and analysis, rather than spending time on manual data collection or translation (IDI_Nigeria). AI has afforded an edge to differentiate these professionals from competitors, as well as optimising and solving challenges in inefficiencies. As one participant noted, it may not be the same for all women, but at least AI is beginning to provide more freedom and opportunity for women in this nascent field (IDI_Rwanda).

Mentorship

As their careers and research have grown, participants have found that they are now also able to help young women seeking to enter STEM-related careers and academia. Some participants who are academics found that with their expertise in AI, they can provide supervision to undergraduate and postgraduate students. One participant has supervised PhD students and can assign more practical and relevant projects utilising AI to develop their skills and relevance in the field (IDI_Mauritius). Being a mentor and facilitating learning is crucial for expanding the opportunities and space available for women. Women who pursue academic careers relating to AI can leverage networks through conferences, both regionally and globally. They can expand their networks, seek mentorship and solicit funding in a way that they may not have been able to in other fields (IDI_Tanzania).

Challenges for women working in AI

Despite the many important benefits and opportunities, African women working in AI still face systemic challenges preventing them from flourishing as AI professionals. Some of these challenges faced by African women in AI directly mirror the general challenges of Africans working in AI and ICT, while others reflect global issues, such as gender roles and stereotypes which affect how a woman is perceived and treated in the workplace.

Patriarchy and social norms

A number of respondents noted that gender stereotypes, roles and biases rooted in African traditional roles hampered some of the progress they made at various stages of their careers. They noted the common belief that women could not code because they were lazy. One Tanzanian respondent had difficulties presenting her work because “*there’s that perception that someone else, a developer, has coded for you*” (IDI_Tanzania). Women face more scrutiny than their male counterparts due to preconceived notions about their capabilities. One academic noticed that

“ the students [I] supervise are scrutinised more compared to other students....they get very tough treatment, just because their supervisor [is a woman]. (IDI_Tanzania)

It is a cultural issue that is pervasive across the continent and is rooted in gender norms that have subjugated women to care duties rather than professional advancement.

Funding and employment opportunities are also skewed against women, either because they do not feel encouraged to apply or they are not aware of these opportunities. Gender-related bias and discrimination play a role in how women are accessing employment and advancing in the sector.

Work and life balance

Many women working in AI grapple with the challenge of balancing care duties at home with their careers. Moreover, because of the added responsibilities women have with their families, respondents noted that it could be challenging to merge career and home responsibilities. Because of these added responsibilities,

respondents noted that it could be challenging to merge career and personal responsibilities. A participant from Nigeria shared that at the beginning of her career, balancing chores and her work was challenging, and her parents needed time to understand her new career (IDI_Nigeria). Her parents did not fully realise that increased professional responsibilities translated into less availability for household chores. She mentioned that “*..there were times that I was in a meeting and cooking at the same time.*” The caring duties African women are expected to provide require a lot of skills in terms of organising and time management and are extremely time-consuming. Women are expected to manage a house and raise children while pursuing professional careers. Time management is a critical skill that many respondents touched upon when discussing the difficulty in balancing their work and personal lives (IDI_Cameroon). One participant, who is an academic with many years of experience, shared that having to care for her children while they were younger meant that she had to turn down travelling engagements and professional development opportunities, even when they were sponsored by her university.

Another participant observed that while married women were more burdened with homeschooling and increased caring duties during the ongoing COVID-19 pandemic, single women were also expected to pick up the slack as workplaces would assume that single or childless women would have more available time. However, this resulted in discrimination where these women were expected to do more work than others, ignoring that they may have competing priorities in their own personal lives (IDI_Mauritius).

Commonly, when women take time off from their careers to raise their children, there may be new developments in the field which they need to refamiliarise themselves with upon their return. This is particularly harmful to women in the STEM field, where advancements happen very rapidly. A woman who has taken maternity leave may need extra support or could end up behind other colleagues. A respondent from Mauritius noted that

“ ... once you’ve gone from the technology [field] for a long time, it’s difficult for you to come back and get a job back because so much has changed. (IDI_Mauritius)

Women returning from maternity leave in the AI field need to be supported with capacity building and refresher training to get back to work and up to speed.

Low representation and diversity

The absence of women representation in AI in Africa is yet another challenge that has proven to be a major deterrent to women in the field. Being a male-dominated field, women working in AI often feel the need to prove themselves to be twice as good as their male counterparts, resulting in imposter syndrome being a common feeling among women. One respondent from AI noted that only

“...about three percent of all funding that’s coming into the tech ecosystem goes to women. So there’s definitely a bias there. It’s not that there are few entrepreneurs. It’s just a bit harder. We are fewer, but even the few that are out there, you know, we have to work twice as hard just to raise the capital. (IDI_Rwanda)

The absence of gender diversity has also left many women feeling isolated and unable to express women-specific needs in the workplace. In workplaces where employers often prefer men over women and believe that men can deliver better than women, women are demotivated (IDI_Nigeria).

Similarly, women working in AI are faced with the uphill battle of getting others to listen and trust in what they do, regardless of the sector. Women do not always believe they are good enough, or qualified for the work that they are doing. One respondent noted that “...when I would have attended, say, meetings and conferences ... They were all always very male-oriented. So I needed to have very strong opinions so that I could be heard” (IDI_Mauritius). This involves facilitating trust within their work and expertise.

The male-dominated nature of the field, coupled with the low representation of women, also means that women are harder on themselves. In some cases, this is reflected in the job application process where women applicants choose not to apply for roles due to the perception that they are not qualified enough. Women prefer to be seen as perfect or experts before they call themselves data scientists or are confident to offer their services, which is a common problem (IDI_Nigeria). There are many well-paid roles in tech that women do not apply for due to fear and lack of awareness of their abilities.

Similarly, women are afraid to ask for help. One respondent mentioned that

“...if we look at our male counterparts, they would ask for help quicker than we would. So they use a lot of their own networks to navigate whatever challenges that have set out, you know, for them. (IDI_Mauritius)

In contrast, women tend to not ask for help. However, being open and relying on support in the workplace could help women better navigate the barriers they face in these male-dominated, stressful workplaces.

Mentorship and networking

A related impact of the absence of women in AI in Africa is the lack of mentorship for African women in the field. Some participants were committed to building communities and networks for other women due to the challenges they faced when they first joined the field. One woman in Ghana remembered that there were very few people to look up to when she started her career. There was no one working in AI that she could identify, and she had to start her journey alone and without support (IDI_Ghana). Women in this sector do not have many examples or mentors and similarly lack mechanisms that encourage their work. Without this, women are not as likely to stay in AI-related professions. Another respondent emphasised that

“...why they [women] underestimate themselves is because they don't see a lot of other women that are succeeding, or they don't have a lot of role models to follow. Because we only see a lot of men in the scene. (IDI_Tunisia)

It is hard for women to operate in a room dominated by men, let alone speak up or make decisions. They need more formal and informal systems of mentorship.

Brain drain and resource barriers

Amongst some of the more general barriers encountered by our participants were resource and infrastructure barriers. These challenges were described as usual fare for African professionals working in AI and related technology fields. These are often challenges related to education, data, internet connectivity, electricity and funding.

Gathering data is time-consuming and expensive, and even simply replicating a data set is difficult (IDI_Nigeria). Big algorithms may not have applicability to local contexts and have to be completely re-developed. Another respondent emphasised that without datasets, no work can occur. For example, machine translation and learning require engagement with linguistics, which is an additional layer of work.

If a model needs to be built, it is nothing without a dataset. She continued:

“...the main challenge in Africa right now is to get the dataset. Sometimes the dataset may be private, and sometimes, you will not see the dataset online; you have to collect the data set manually. (IDI_Cameroon)

Researchers consistently have to use manual processes, which may not be automated or even digitised (IDI_Ghana). Additionally, basic infrastructure such as connectivity and power reliability creates more barriers to work. Without reliable access to the Internet, AI professionals cannot produce work.

Having access to the Internet is the bare minimum needed for women seeking to work in AI. They can connect with people in the industry across Africa and globally and develop relevant skills in AI (IDI_Nigeria). This is paired with the difficulty of getting hardware, software and computer equipment. Components are expensive yet required for a lot of the work that these women do in AI-related fields (IDI_Nigeria). Women working in AI-related fields, particularly as entrepreneurs, also cannot access capital easily. Without funding or adequate salaries, women cannot invest in their companies, develop hard skills, or hire additional talent (IDI_Rwanda).

Minimal technology adoption

Paired with infrastructure and resource barriers is institutional policies that hinder digitisation. Our participants view that because a lot of research in AI is nascent and emerging, there are still analogue systems in place that need to be addressed. Datasets will not be publicly available or published online, and a researcher may have to collect the dataset manually, which is time-consuming (IDI_Cameroon). Rather than being able to access an open-source dataset, researchers find tasks such as hiring data collectors, translation and other processes to be time-consuming and not cost-effective.

Due to common issues in Africa, such as poor storage and the absence of data, AI professionals often have to do foundational research, which can be laborious. Programmes and algorithms that were introduced decades ago still do not have available data. Even though many of these problems have been solved in other parts of the world, African AI professionals in this part of the world often have to start from scratch, which is exhausting (*IDI_Nigeria*).

Another participant (*IDI_Ghana*) believed that large corporations, such as banks, and public institutions, prefer foreign solutions and neglect home-grown talent and solutions. Rather than investing in fintech in Africa, they outsourced software or human resources, which does not improve the working environment. Tech-focused companies could sponsor AI researchers to solve local problems rather than importing software from Europe or North America.

Education, visas, geography and language barriers

Many academic institutions also do not have courses in AI and Data Science or have outdated curricula, which participants found very unhelpful. With the exception of three, all participants developed their skills in AI through a combination of online and offline courses, groups, internships, workshops and boot camps.

The challenge of limited resources for learning and experience has spurred many of the study participants to travel beyond the borders of their home countries for work experience and education. However, acquiring visas to study abroad or to attend conferences is a problem both within Africa and globally. One Mauritian participant emphasised the disadvantages of the isolation of her island country for research and travel. An island nation is not well connected to the rest of the continent, and as a result, travel and accommodation become expensive and nearly inaccessible. Those working in the field of AI need to be able to meet and collaborate with others, and that is difficult to do within more isolated countries (*IDI_Mauritius*). Another participant saw no opportunity for a PhD in machine intelligence and thus had to look abroad for better opportunities (*IDI_Ghana*) which takes away the ability to bring opportunities to one's home country.

Additionally, due to resource barriers compelling immigration for education and work, African women in AI also contend with language barriers and cultural differences in their new environments. A French-speaking participant from Cameroon shared the difficulty she faced in studying for a Master's in Ghana, where English is the dominant language. Despite being qualified, studying in a new language represented an additional barrier to cross, a challenge she continues to face working in English-speaking countries (*IDI_Cameroon*). Women from Francophone countries (and vice versa) have to adapt their entire language to the work that they are doing.

Impact of the Absence of Women in AI

The impact of these challenges on the diversity and representation within AI is significant. Globally, lack of diversity and bias have been identified as some of the major reasons behind harmful AI products and employment. A participant believes that women bring diverse perspectives to the field, which might be overlooked in their absence. For example,

“ ...if we only leave the men to make the decision, sometimes they forget that there are other sides to problems. So women always complement the ideas that are put on the table. (IDI_Ghana)

Products and technology designed with only half of the population in mind are not always equitable nor accessible. Women’s input in decision-making can improve comprehension and relevance.

Another participant was of the view that women were more likely to be understanding and empathetic of the demands of motherhood and provide support to other women professionals. There are products that only women can think of due to unique experiences and challenges. Equity, diversity and inclusion in technology are critical to understanding others’ experiences and include that in products. In employment, employers need to consider the care duties that women may have, such as childcare, that they are put in charge of due to prevailing gender norms.

In addition to women’s valuable perspectives, which are often lost in the field, the absence of women also affects economic development and growth, especially since women make up around half of the population in many countries. At the end of the day, there are fewer women in specific careers because of the many hurdles that they may face. As a result, half of a country’s population is likely underutilised. As one respondent from Rwanda mentioned:

“ So imagine just missing out on what opportunities you could get out of fully deploying human capital, both male and female. (IDI_Rwanda)

Just as people from different countries have varying perspectives, men and women may look at things differently, which brings value to the work that they are able to do. Without women, the AI field is operating at only half capacity.

To stakeholders

Stakeholders, including governments, big tech, women’s groups, mentors and the greater technology community, have a role to play in supporting African women’s entry and participation in the AI sector. In the course of our research, participants shared with us who the responsible stakeholders were and proffered several recommendations on what these stakeholders should do to support and encourage women currently working in AI and those who are interested in joining.

Women's groups and networks

Many of our participants believed that, first and foremost, women need to be more confident and assertive to navigate many of the mentioned challenges. One participant from Mauritius stated that:

“As women, if we are facing issues, and we don't talk about it, or we don't do something about it, then I don't think anyone else will be doing it for us. So if we've identified that the AI technology is discriminating against women, then we need to do something about it. (IDI_Mauritius)

Finding solutions to these barriers is imperative to move forward. Women have a role to play in ensuring that systems, policies and operating environments have the capacity to change.

Participants similarly shared self-care methods they use when operating in toxic environments. One participant uses positive thinking to deal with barriers and confront mental health challenges (IDI_Tanzania). When women are abused, shut out or demeaned in this sector, having support systems and methods to preserve mental health is valuable.

Mentorships

Some participants also mentioned that women have a role in setting examples for other women. Women who have progressed in the field can support younger women or those just entering the sector and champion the increased involvement of women in AI. One respondent mentioned that: *“We're doing all these steps for them [women in AI] to see that it is also possible for them” (IDI_Cameroon)*. Women may be afraid of STEM-related careers because of all the associated challenges, but women can act as mentors to demystify these challenges and call potential mentees into their work.

Create communities and safe spaces

Many respondents emphasised the value of women mentorship groups. Safe communities were invaluable not just for career purposes but also for mentorship and network building. A Tanzanian participant underlined the value of surrounding oneself with a supportive community of women in the same field.

“You can check on colleagues in Uganda, check colleagues in the US, in Kenya, even here in Tanzania. The few that we are, we really hold on to each other and in giving each other more support to deliver. (IDI_Tanzania)

Supportive networks may mean the difference for a woman feeling confident to enter the field.

Co-developing learning and upskilling opportunities

Groups which respondents were a part of include Data Science Nigeria, Women in Machine Learning and Data Science (WiMLDS) and Deep Learning Indaba. These groups and collectives support women looking to get into the field. One way these groups provide support is by making learning a communal effort. In Ghana, one group organises conferences and invites women who are excelling in the AI field to talk to other women who are interested (IDI_Ghana). There are also plans to have collective enrollment in courses online, such as Coursera, and have the ability to solve problems as a group. It is daunting to take on a course or build skills by oneself; creating networks of women learning the same skill creates a welcoming environment for learning and skills development.

To men and broader society

Men have a role to play in supporting women in these fields. A participant believed that short-term solutions were not enough and could be even sabotaged if women were not supported by their partners, families and communities. Programmes focusing on encouraging women to join STEM or AI are a short-term fix but do not address deep-rooted social and gender norms that facilitate the challenges that arise for many women in technology-related work. The root cause needs to be addressed, which is educating and sensitising men about women's role and ability in the STEM field. The respondent continued:

“As you empower girls, you need to also sensitise the men to understand what it means for a woman to be empowered. Because I mean, I went through this, where you invest so much in supporting women, have coding programs, all these things going on, and the very people that are limiting them from succeeding are their fathers or their husbands. (IDI_Rwanda)

This falls in line with broader societal sensitisation on women's rights and their capacities to ensure that women are given those opportunities from a very early age, in line with boys and men. Another participant noted that a detriment for women in AI is African norms around men being superior to women. This needs to be confronted, and men need to understand that encouraging women to work in AI is all about giving everybody a fair opportunity and letting everybody be given an opportunity to deliver.

To government stakeholders

Participants believed that African governments have a primary role in eradicating the aforementioned challenges through several avenues outlined below.

Develop incentives for women in STEM

The absence of women in AI-related employment is a marker of the larger absence of women in STEM careers and academic pursuits. As a participant from Rwanda noted, the lack of women in this sector is not unique nor specific to AI. Systemic challenges in place across sub-Saharan Africa begin with girls' unequal access to primary, secondary and tertiary education and continue in the professional world. This translates into a small pool of girls who have access or interest in STEM education and, subsequently, women who then enter STEM-related careers (*IDI_Rwanda*). It is not specific to AI, however, AI as a niche area within the technology field represents the broader problems at play regarding gender parity in the science and technology sectors. Stakeholders such as governments that are in control of education systems and creating opportunities for girls have a responsibility to improve the enabling environment for STEM education and professional opportunity.

To address the AI gender gap, there needs to be more initiatives and incentives directed at encouraging women to join and remain in the STEM field. Our participants believe that there is a serious need to up-skill women in AI like any other field. The government has a duty to ensure that younger girls are encouraged to get into technology and that they can make careers through these skills. Government actors can cultivate this large pool of potential talent through research and development of approaches to reach girls at all school levels. They can then connect them directly through job placements into AI start-ups, accelerators and ecosystems. These activities can considerably help flatten this curve of knowledge that has undermined women's access and penetration within this field.

Update curriculum

Similarly, young people who learn AI skills often do not do so in the formal education system. Rather, they are learning through offline and online courses, workshops and boot camps. Upskilling initiatives, particularly in sub-Saharan Africa, are funded by tech giants such as Google or international institutions like UNESCO to contribute to capacity building. Google has sponsored its Google Hustle Academy as a boot camp programme for young African entrepreneurs in Kenya, Nigeria and South Africa. UNESCO has similarly hosted AI and Robotics boot camps, most recently at the Africa Engineering Week. Educational institutions, both public and private, have an opportunity to expand their learning repertoire to adapt to technology advancements.

A participant (*IDI_Ghana*) noted that many countries do not have universities offering undergraduate or postgraduate courses in AI or Machine Learning and that the absence of resources has led to young people immigrating to other countries where they can get the qualifications and knowledge they need. This brain drain will ultimately reduce African countries' ability to harness the potential of AI and other technologies without offering more incentives and updated skill building for its students and professionals.

These challenges spell out the need for an updated curriculum across all levels of education, including at the primary and secondary school levels. Doing so would introduce both boys and girls to the field at an early age. An expanded, updated curriculum would reflect the growing needs of AI professionals and, by its very nature, be inclusive of the diverse sectors which contribute to AI development and innovation and not be limited to purely STEM courses.

Funding

According to our participants, governments have a duty to set apart funds and create budgets for technology advancement. Government budgets earmarked for technology could greatly eliminate the bottlenecks involved in accessing funding for innovation. Strict compliance and oversight mechanisms will also be needed to monitor access to these funding, and how they are used so they are not mismanaged. Additional grants for women in AI or technology-related fields could increase the number of women pursuing such studies at the tertiary level.

Support innovation, research, travel and digitisation policies

Governments at the national, regional and continental levels have a role to play to encourage the free flow of information, research, innovation and travel across the continent. Promoting and supporting African talent through patronage and enabling policies can go a long way in ensuring that talent is retained and cared for. In addition, participants noted that while sometimes there is available data, certain factors might limit access to it, such as privatisation or non-machine readable formats. One participant suggested simple policies, such as adding CSV formats could lower these barriers. Simplifying and demystifying processes related to technology encourages broader uptake, investment and awareness (*IDI_Nigeria*).

To corporations, startups, accelerators and developers

Tech companies are important stakeholders in these conversations by virtue of the work they do in this space as employers and creators and vendors of products and services, whether business to business (B2B) or business to customer (B2C). Our participants shared their thoughts on how these businesses can contribute to eradicating the challenges for women in AI on the continent.

Reduce hiring discrimination

AI developers need to address deep-rooted stereotypes that affect the hiring of women as well as minority groups in this sector. Certain tropes often affect hiring practices and lead to tokenisation which can, in turn, further complicate, create and contribute to harmful perceptions surrounding women's competence. During the conversation, a participant shared with us that many companies only appear to hire women co-founders merely for the optics. The hiring of women is not based on expertise, but rather the publicity and the reputation that is paired with having more women on their staff (*IDI_Nigeria*). This use of "diversity hires" creates a false front for potential employees; a workplace that seems inclusive may not be so in actuality. There is a need for these companies to create respectful, hiring practices that reflect the expertise of the women in AI. This may include hiring quotas, having women on hiring committees, and amending recruitment practices to draw in unlikely candidates.

Provide internship and learning opportunities

The overall gender gap in the field cannot be overlooked. Participants believe that organisations have a duty to create learning and employment opportunities for women. A participant noted that through facilitating internships at her organisation, she was able to support a number of women who have gone on to become leaders in the company and subsequently the field. In a cohort of five interns, four were women. The participant noted that she was able to encourage at least three of them to continue work in the organisation (*IDI_Nigeria*). Having mentorship and skill-building opportunities for women early in their careers enables several things. Internships can bolster a participant's confidence and ensure them that they belong in a competitive sector. The more women that work in organisations accepting interns, the more likely interns who are women will feel more empowered to succeed at their work.

To civil society

While civil society and related organisations are not representative in this piece of research, we can extrapolate some of our findings to recommend actions on behalf of civil society actors that focus on technology development in Africa. The first order of action to progress this nascent field is to encourage additional research projects on the role of gender in the AI sector, particularly in Sub-Saharan Africa. Understanding contextual factors helps further shape the sector to be more equitable in hiring practices, product development and management of its workers. Larger, international organisation bodies such as UNESCO could repeat and continue research, such as its Artificial Intelligence needs assessment survey in Africa, which was conducted in 2019.

Secondly, civil society organisations should use collective action and organising power to advocate for improved funding and focus on equitable access and employment in AI, to make technology work better for women but also make women employees have better opportunities. This can happen by amplifying voices. Civil society organisations focused on AI should also include women in leadership and decision making positions for well-informed policy and advocacy.

Conclusion



There is a direct connection between the low numbers of women working in AI and absurd gender-biased algorithms that treat men as the standard and women as the exception. From this research, the barriers faced by women working in AI are shown to be twofold. Some are general while there are others that are unique to women. Men and women face similar barriers in accessing data sets and funding for AI research and development. However, women experience some degree of marginalisation due to their identity as female in this field in addition to being African.

Breaking the gender divide in AI and tech will go a long way to support women working in the industry as well as those seeking to break into it. Other mechanisms will also create a more inclusive environment, such as increased support for women to work in AI, including the promotion of STEM education among women and girls and mentorship of women working in AI. Feminist movements in Africa need to create and implement needed interventions to transform contemporary AI structures that can shape the positionality of women in the fourth industrial revolution. Educational grants, mentoring programmes and sensitisation in industry professionals all can shape the environment that will let women thrive in the AI sector. Feminist responses will need to be multi-pronged and focus on building and mobilising a feminist movement with a progressive critique, building that critique into a powerful feminist movement, and securing interventions that will transform the access and control of AI resources by women.

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