UNIVERSITY OF NAIROBI

ARTIFICIAL INTELLIGENCE 4 Climate Resilience

AFRICA RESEARCH & IMPACT NETWORK

LEVERAGING ARTIFICIAL INTELLIGENCE FOR CLIMATE RESILIENCE IN AFRICA

Sensitization Webinar Report

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About ARIN

The Africa Research and Impact Network (ARIN) is a leading research and policy network committed to advancing sustainable development in Africa. With a focus on evidence-based solutions, ARIN brings together a diverse community of experts to address critical challenges facing the continent. ARIN's work on the "Leveraging Artificial Intelligence for Climate Resilience in Africa" project aligns with its broader mission of fostering a research-informed policy environment. By exploring the potential of AI in addressing climate change, ARIN aims to provide actionable insights and recommendations for policymakers and practitioners. This report, which synthesizes the key findings and discussions from the webinar, contributes to ARIN's ongoing efforts to promote the use of innovative technologies for sustainable development in Africa. More about ARIN here

Acknowledgements

The invaluable contributions of the following individuals and organizations made the "Leveraging AI for Climate Resilience in Africa" webinar successful.

Dr. Joanes Atela (Executive Director, ARIN) provided expert moderation and thoughtful guidance throughout the webinar, ensuring a smooth flow of discussions and participant engagement.

Ms. Loise Ochanda (Program Officer, Artificial Intelligence for Development-Africa) delivered a compelling opening address that set the tone for the event, providing a strong foundation for the insightful discussions that followed.

Prof. Daniel Olago (Director, the Institute for Climate Change and Adaptation (ICCA)) offered comprehensive closing remarks that highlighted the key takeaways from the webinar and charted a forward-looking vision for AI's role in climate resilience.

Dr. Humphrey Agevi (Research Associate & Coordinator, ARIN) presented an in-depth analysis of AI initiatives in Africa, offering a detailed overview of ongoing efforts, challenges, and opportunities for growth in the sector.

Dr. Rendani Mbuvha (School of Statistics and Actuarial Science, University of Wits) provided critical insights into the role of big data, AI, and machine learning algorithms in environmental data analysis, showcasing the transformative power of data-driven solutions.

Dr. Alex Munyole (ICT Officer, University of Nairobi) explored the role of higher education institutions in AI capacity building, offering practical insights and strategies for strengthening institutional capabilities in the AI space.

Dr. Francis Oloo (GeoPay Research) shared valuable perspectives on opportunities and challenges for capacity strengthening in AI for climate change, with a particular focus on the role of higher learning institutions in fostering innovation and capacity building.

The International Development Research Centre (IDRC) is sincerely appreciated for its generous financial support in the AI Project.

Special thanks are also extended to the University of Nairobi for its collaboration and support, which enriched the webinar's scope, relevance, and impact.

Gratitude is further extended to the technical support team for their seamless coordination and behind-the-scenes efforts that ensured the smooth and uninterrupted delivery of the event.

Finally, appreciation goes to all participants for their active engagement, thoughtful questions, and meaningful contributions, which created an interactive and enriching experience for all attendees.

List of Abbreviations and Acronyms

AfDB	The African Development Bank Group
AI	Artificial Intelligence
AI4D	Artificial Intelligence for Development
ARIN	Africa Research and Impact Network
ASALs	Arid and Semi-Arid Lands
ESA	European Space Agency
GHGs	Greenhouse Gases
IDRC	International Development Research Centre
STEM	Science, Technology, Engineering, and Mathematics

1.0 Introduction and Rationale

Climate change remains one of the most pressing global challenges, with far-reaching impacts on ecosystems, economies, and communities worldwide. Africa is disproportionately affected by these impacts despite contributing minimally to global greenhouse gas (GHG) emissions (AfDB, 2019). This heightened vulnerability is attributed to the continent's over-dependence on climate-sensitive sectors, coupled with limited institutional, technological, and financial capacities to reduce emissions and build climate resilience (Doku et al., 2021a, 2021b; Mekonnen et al., 2021; Phiri & Doku, 2024).

As climate risks intensify, there is a growing urgency for innovative, data-driven solutions. Artificial intelligence (AI) has emerged as a critical tool for developing and implementing climate resilience strategies (Ferrari, 2024). AI supports the design of models, forecasts, and decision-making systems essential for understanding, predicting, and mitigating climate risks. It strengthens climate information systems and predictive capabilities, enabling more effective resilience planning (Amiri et al., 2024).

AI's capacity for data analysis, prediction, and decision support underpins the development of early warning systems that alert communities to impending climate-related disasters. By analyzing large datasets from satellites, weather stations, and other sources, AI-powered systems can detect patterns and identify early signs of extreme weather events. This includes predicting changes in temperature and precipitation patterns, which are vital for planning in key sectors such as agriculture. The ability to deliver timely and accurate information supports critical planning efforts for farmers, communities, and governments (Jain et al., 2023; Weaver et al., 2022).

However, significant challenges hinder the potential of AI in climate resilience. Chief among them is the lack of adequate skills to deploy and interpret AI-driven climate modeling tools for resilience planning and resource allocation. This skills gap is driven by two main factors:

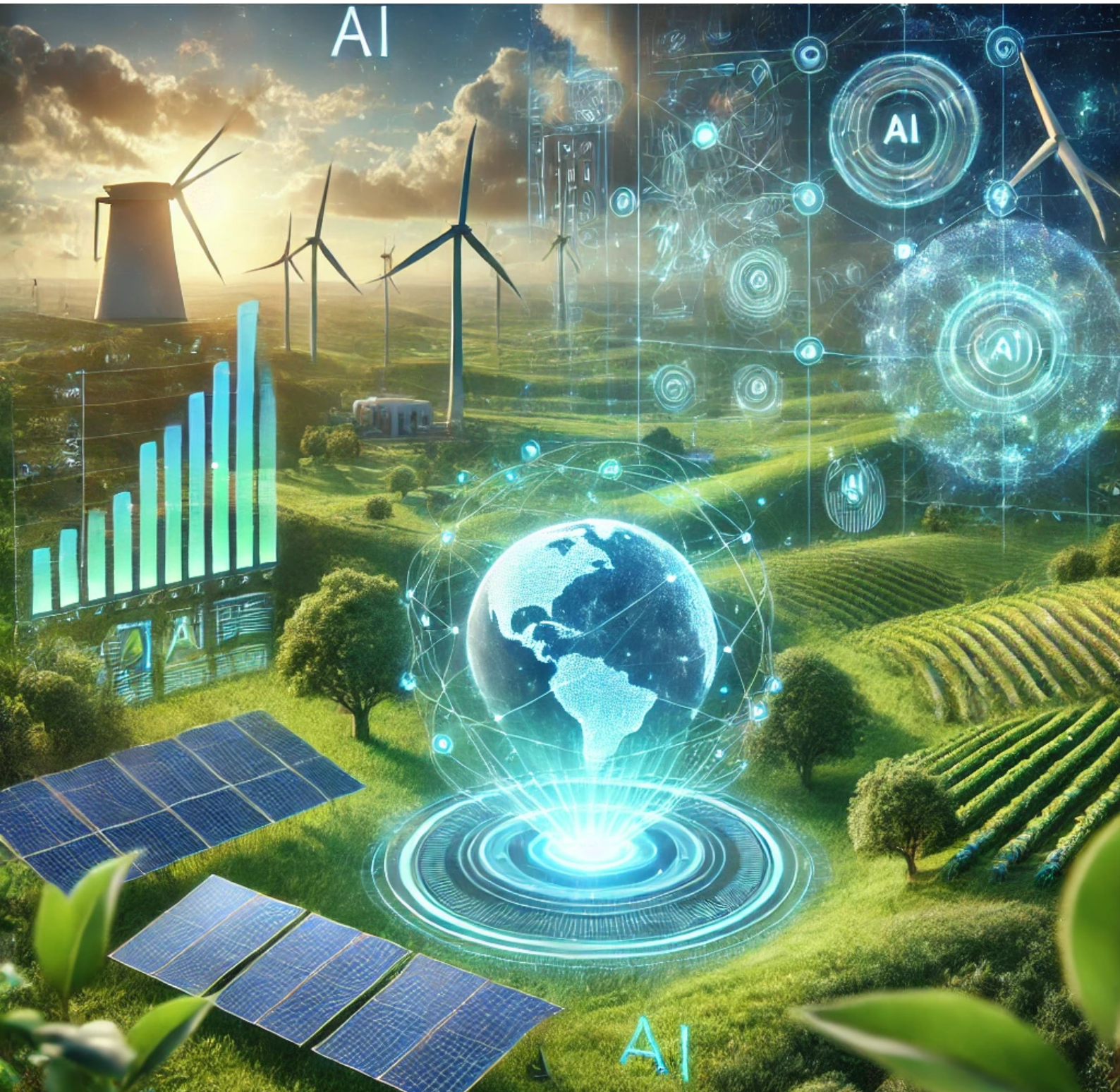
1. **Limited training opportunities** in AI-related Science, Technology, Engineering, and Mathematics (STEM) subjects within Africa.
2. **Persistent gender disparities** in AI fields, with a significantly low representation of women in academia and the AI workforce.

Addressing this capacity gap is critical, especially for early-career researchers and policymakers who play a vital role in climate action across Africa. Governments and stakeholders face challenges in adopting adequate and inclusive reporting frameworks for climate action. Enhancing AI expertise would improve Africa's capacity to strengthen resilience and facilitate evidence-based reporting on climate progress.

To address these challenges and harness the transformative potential of AI, the Africa Research and Impact Network (ARIN) hosted a sensitization webinar to bring together key stakeholders, including academics, policymakers, and industry experts. The webinar aimed to explore how AI and mathematical sciences could strengthen climate resilience across Africa.

The Director of ARIN opened the session by underscoring Africa's disproportionate vulnerability to climate change despite its minimal contribution to GHG emissions. He highlighted AI's transformative potential in enhancing resilience through improved financing mechanisms, early warning systems, and data-driven policy innovations. The Director also emphasized ARIN's ongoing efforts to support locally driven adaptation strategies, which are key to building climate resilience.

ARIN's initiatives in this area include the development of Africa-led resilience programs, the creation of locally led adaptation metrics, and policy fellowships designed to foster evidence-based climate resilience policies and practices. The webinar also featured findings from a landscape scoping of AI initiatives across Africa, which revealed the need for stronger institutional capacity, gender equity, and sustainable funding to develop and scale AI-driven climate solutions.



2.0 Objectives of the Webinar

1. Leverage the webinar as a platform to create widespread awareness of the IDRC-funded project on leveraging Artificial Intelligence (AI) for climate resilience in Africa.
2. Enhance participants' understanding of how mathematical models and AI-driven solutions can be applied to climate resilience, adaptation, and mitigation strategies, thereby fostering the adoption of data-driven approaches in climate action.
3. Highlight the potential of AI and mathematical sciences to contribute to sustainable and climate-resilient solutions. The aim is to engage a broader audience from academia, industry, and policy spheres in harnessing AI for climate resilience.

2.1 Organization of the Webinar

The webinar was organized as a 2-hour virtual event with the following key components:

1. **Keynote Presentations:** The keynote segment featured experts in mathematical sciences and AI, who shared valuable insights into cutting-edge research and innovative applications in the field of climate resilience.
2. **Panel Discussion:** A diverse panel of interdisciplinary experts engaged in a dynamic discussion, exploring the application of mathematical and AI-driven tools to address climate-related challenges. The session also identified opportunities for future collaborations to accelerate the development and deployment of AI-driven climate resilience solutions.
3. **Q&A Session:** This interactive segment allowed participants to engage directly with the speakers and panelists, facilitating deeper exploration of the topics discussed and providing clarification on key aspects of the presentations.

2.2 Expected Outcomes

1. Enhanced Collaboration between academia, government, and the private sector aimed at developing and implementing effective climate resilience solutions.
2. Strengthened Interdisciplinary Networks focused on tackling climate challenges through innovative, data-driven solutions across multiple sectors.

3.0 Synthesis of Key Insights

3.1 Opening Remarks

The Program Officer for Artificial Intelligence for Development from the International Development Research Centre (IDRC) delivered the opening remarks, providing an overview of the IDRC-funded initiative. The program focuses on capacity building for emerging scientists, promoting gender equality, and aligning research with industry needs. In partnership with ARIN, the University of Nairobi (UoN), Makerere University, and other regional institutions, the initiative aims to institutionalize AI skills, ensuring a sustainable and impactful contribution to Africa's climate resilience strategies. The importance of collaborative efforts in advancing AI's role in climate resilience across Africa was strongly emphasized.

3.2 Landscape of AI Initiatives in Africa

The scoping exercise mapped AI institutions across Africa, highlighting their names, numbers, and geographic distribution. This underscored the growing capacity of African institutions to leverage AI for development, innovation, and climate resilience. Key examples of AI capacity-building initiatives include programs such as AI4D Africa, Deep Learning Indaba, and Data Science in Nigeria, which offer grants, networking opportunities, and mentorship. Effective models for building AI capacity were identified, including university partnerships, professional certifications, and hands-on learning experiences through competitions and hackathons.

AI research labs, incubators, and innovation hubs—such as Google AI Ghana, IBM Research Africa, and the African Institute for Mathematical Sciences (AIMS)—were recognized for their contributions to strengthening AI capacity across the continent.

However, several barriers to AI capacity building were noted, including insufficient funding, a shortage of skilled professionals, brain drain, inadequate infrastructure, and the lack of locally relevant AI curricula. The slow development of AI policies and regulatory frameworks remains a challenge, although progress has been made in countries like Mauritius, Rwanda, and South Africa. Persistent challenges, such as limited resources, diverse legal systems, and skill gaps, continue to hinder progress, despite the existence of national strategies and regional initiatives.

Building AI capacity is essential for Africa's sustainable development. There is a call for sustained funding and collaboration to accelerate AI adoption and enhance climate resilience. ARIN's commitment to developing AI expertise is evident through its 'Leveraging Artificial Intelligence for Climate Resilience in Africa' project, which seeks to strengthen the capacities of early-career researchers in applying AI and mathematical sciences for climate action, institutionalize AI skills within African institutions, and nurture a new generation of AI specialists focused on climate resilience.**b) Opportunities for AI in Climate Resilience**

Despite these challenges, AI offers significant opportunities for enhancing climate resilience in Africa. Cloud-based data platforms, such as Google Earth Engine, provide access to vast datasets that can be leveraged for climate and agricultural mapping. These platforms, in combination with sensors from the European Space Agency (ESA), offer data at various resolution levels, supporting the development of climate models. Analysis-ready data, like the

"Fields of the World" dataset for agricultural land mapping, is also available, enabling precise mapping and climate modeling. Organizations such as Microsoft's AI for Good Lab and Google AI are making strides in driving AI learning and research, further supporting AI integration for climate resilience. Additionally, Meta (Facebook) offers high-resolution population datasets that could be instrumental in building more resilient communities in Africa.

c) Partnerships and Collaboration

There are emerging opportunities for AI research and collaboration through regional institutions across Africa. The growing trend of student and staff exchanges, along with the development of collaborative projects, presents new avenues for capacity building. The creation of AI-focused centers or laboratories within institutions is encouraged, as is the introduction of short, project-focused AI courses within faculties. AI integration into case studies within existing curricula, alongside the organization of innovation challenges aimed at addressing emerging climate-related issues, would foster a culture of collaborative learning and skills development. These initiatives are essential for systematically strengthening AI-related education and building the necessary skills for climate resilience in Africa.

3.3 The Critical Role of Big Data, AI, and Machine Learning Algorithms in Analyzing Large-scale Environmental Data to Predict Climate Trends, Enhance Disaster Preparedness, and Optimize Resource Use

Big data analytics plays a crucial role in understanding and addressing climate change. By collecting data from various sources such as satellites, weather sensors, and ground-based observations, it supports informed decision-making for climate change mitigation and adaptation strategies. Three key aspects of big data—volume, variety, and velocity—are essential for characterizing and harmonizing climate data, enabling the extraction of clear insights for decision-making. This is particularly important in sectors such as agriculture, where timely and accurate data can guide climate adaptation efforts.

Artificial intelligence (AI) and machine learning (ML) are increasingly integrated into our daily lives, especially through technologies like smartphones. However, their full potential to address climate change has yet to be fully explored. These technologies are evolving rapidly, with advancements in data collection and algorithm development significantly improving their predictive capabilities. The increasing complexity of AI and ML is critical for enhancing our understanding of climate change impacts and for developing effective, scalable solutions.

AI has already shown promise in real-time applications, such as flood mapping, where it can analyze vast amounts of data to assess climate-related risks. These applications highlight the transformative potential of AI and ML in climate resilience, providing tools that can predict and mitigate the impacts of climate change.

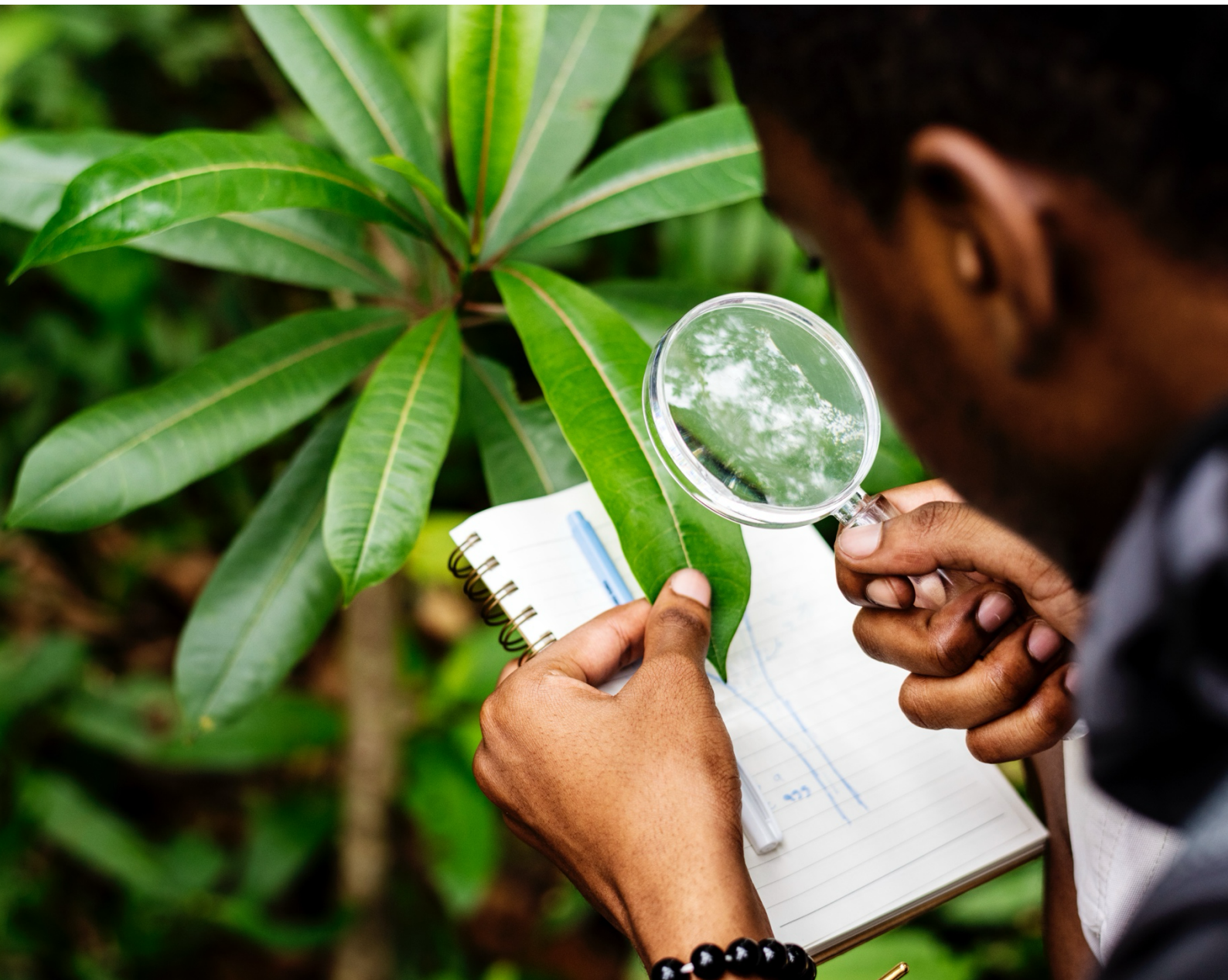
3.4 Opportunities, Challenges, and Emerging Trends in AI-driven Climate Research

As global temperatures rise, concerns about increased mortality rates, biodiversity loss, and risks to food production continue to mount. While advancements in weather forecasting have improved accuracy by approximately 10% since 1981, these improvements have been more significant in the Global North, highlighting regional disparities in forecasting capabilities. A

notable breakthrough in climate prediction is the Graphcast model, which uses graph neural network architecture to predict weather up to 14 days in advance, significantly enhancing forecasting accuracy. This model holds promise for addressing various climate-related challenges, though its effectiveness is still regionally uneven.

Africa faces a significant challenge in losing climate data due to the reduction of weather stations, which leads to inaccurate and unreliable forecasts. The lack of African data in global AI models exacerbates this issue, often resulting in misleading weather predictions. However, there are notable opportunities in AI-driven climate research to bridge these gaps. The Africa Climate AI initiative, for example, unites AI researchers and climate scientists from 24 countries to tackle climate data scarcity and promote skill-sharing. One of its key projects, Angalia, aims to create representative climate data sets for Africa, while the AFRI Net initiative is working to deploy low-cost weather stations across the continent. These efforts aim to improve the quality and accessibility of climate data, especially when integrated with indigenous knowledge systems for localized solutions.

Emerging trends in AI applications also include advancements in seed technology and climate financing. In biosciences, AI is being utilized to explore genetic modifications for developing climate-resilient crops, thus demonstrating the powerful intersection between technology and sustainable agriculture.



4.0 Panel Discussion Highlights

4.1 AI's Role in Climate Resilience AI has a crucial role to play in enhancing climate resilience by enabling the efficient processing and analysis of large-scale climate data. However, several challenges persist, including technical, knowledge, and policy-related barriers. Overcoming these challenges requires strengthened partnerships and collaborative learning, particularly among countries facing similar climate challenges. Networking and cooperation are key to advancing the development and deployment of AI technologies for climate resilience.

4.2 AI and Indigenous Knowledge Systems

Integrating AI with indigenous knowledge systems offers significant opportunities for climate mitigation. AI can help identify funding priorities and enhance climate resilience initiatives by learning from Indigenous narratives, languages, and art, particularly through natural language processing models like ChatGPT. However, challenges remain in developing databases that can convert local languages such as Luhya, Kalenjin, or Oromo into machine-readable formats. Bridging this gap requires considerable effort and investment in AI technologies that can process such data effectively.

4.3 AI in Promoting Climate-Resilient Water Management

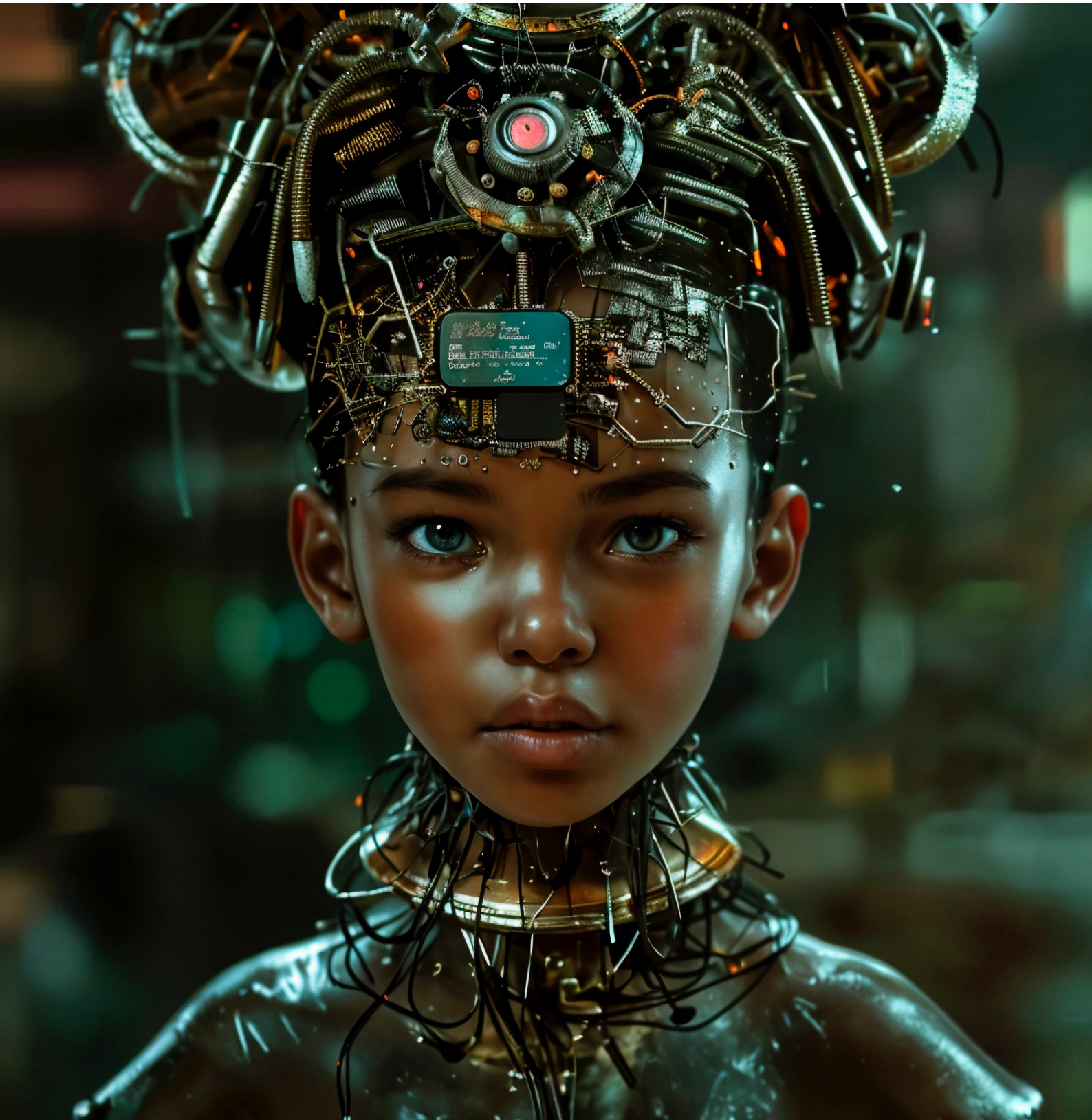
AI holds great potential in advancing climate-resilient water management, particularly in arid and semi-arid lands (ASALs). It can address challenges like genetic erosion in agriculture and water resource management. AI, combined with satellite technologies, can map land use, monitor water resources, and optimize irrigation systems. For example, AI has been used in regions like Sinanjing and Shanghai to enhance resource planning. By leveraging satellite imagery and sensor data, AI can monitor water distribution, identify risks such as scarcity or flooding, and optimize water usage. Additionally, AI can support the preservation of genetic diversity by analyzing genetic and environmental data to inform climate-resilient breeding programs. However, barriers such as limited access to data, infrastructure, and technology in Africa must be overcome through localized investments in AI and satellite technology to ensure sustainable resource management.

4.4 AI in Habitat Restoration

AI's ability to detect changes in land use over time makes it invaluable for effective land management, particularly in addressing habitat degradation. By processing satellite imagery, AI can identify and monitor events like wildfires and even detect smoke patterns automatically. The Open Buildings dataset, for instance, provides valuable insights into human settlement patterns across Africa and the globe, which helps assess the impacts of climate change and informs social and environmental strategies. This high-accuracy, automated detection highlights AI's critical role in supporting habitat restoration and land conservation efforts.

4.5 AI in Guiding Land Governance for Sustainable Climate Resilience

AI and big data are transforming land governance, which is essential for promoting sustainable climate resilience. Remote sensing data, when combined with AI, enhances the accuracy of land mapping, enabling effective land registration and management. For example, in Rwanda, AI has been used to digitize and segment land parcels, facilitating better governance and decision-making. This application not only improves policy formulation but also supports the adoption of sustainable land use practices. AI also holds promise in mitigating the health impacts of climate change by analyzing factors contributing to disease spread, predicting disease hotspots, and developing optimization models to guide targeted mitigation efforts.



5.0 Conclusion

Advancing AI initiatives across Africa requires enhanced coordination, capacity building, and institutional integration. Building sustainable AI ecosystems involves systematic skill development and embedding AI within existing structures while ensuring that these systems are decolonized to reflect the continent's unique needs and challenges. Addressing persistent issues such as gender inequality and land governance through AI presents transformative opportunities for Africa. Key actions for advancing AI in climate action include establishing AI-focused centers within institutions, offering short, project-based AI courses, and integrating AI case studies into curricula. Innovation challenges to address emerging issues and engaging experts to mentor students and early-career researchers are equally crucial. Participation in initiatives like Climate Change AI, EO Africa, and the Africa Climate AI community will strengthen collaboration and innovation. A unified, coordinated community of practice, as proposed by Joanes Atela, is essential for fostering AI development and effectively addressing Africa's unique challenges.

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