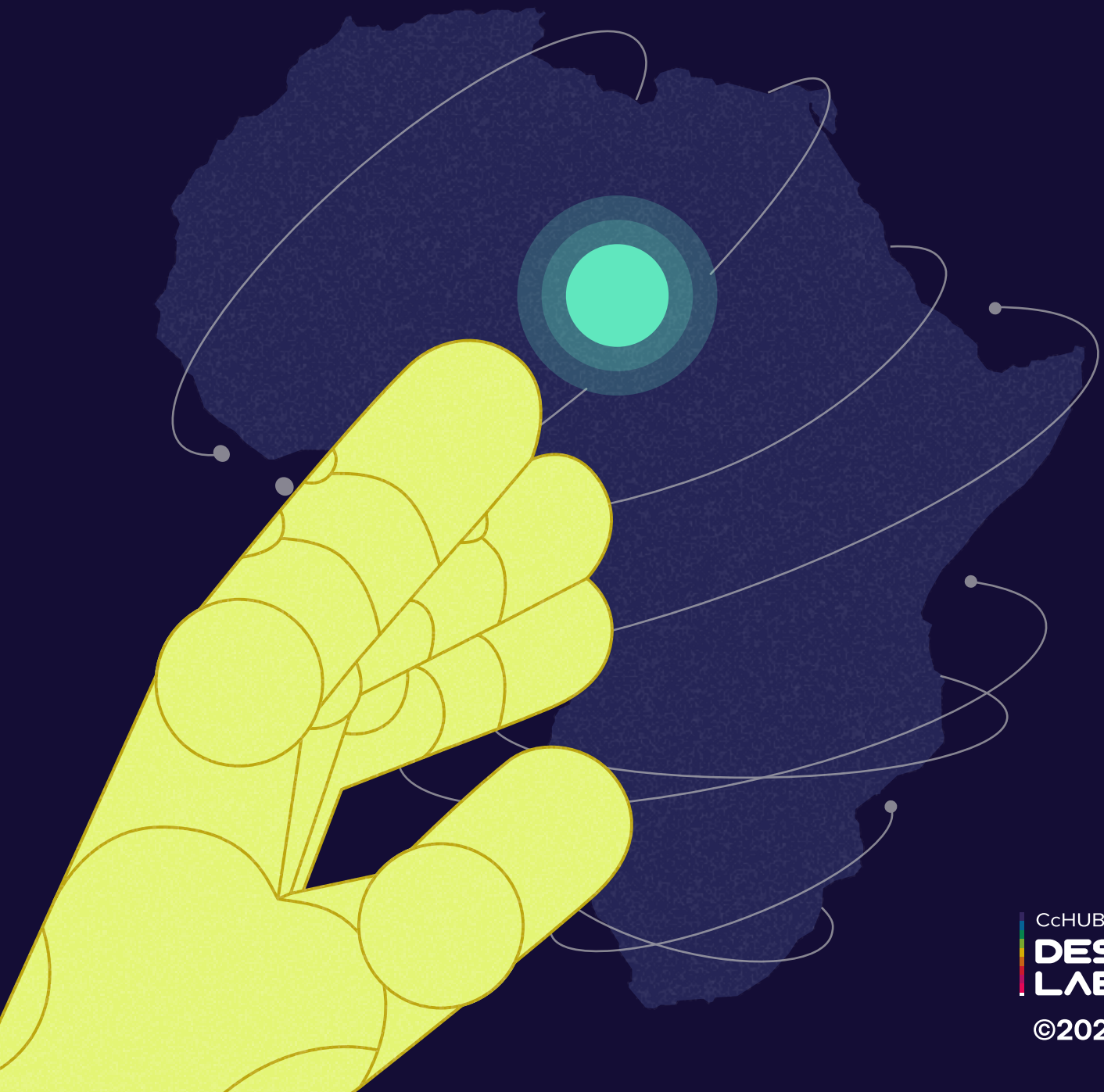
Bibliometric Analysis of Artificial Intelligence Publications in Africa

(1984-2023)



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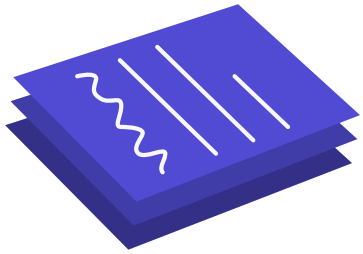
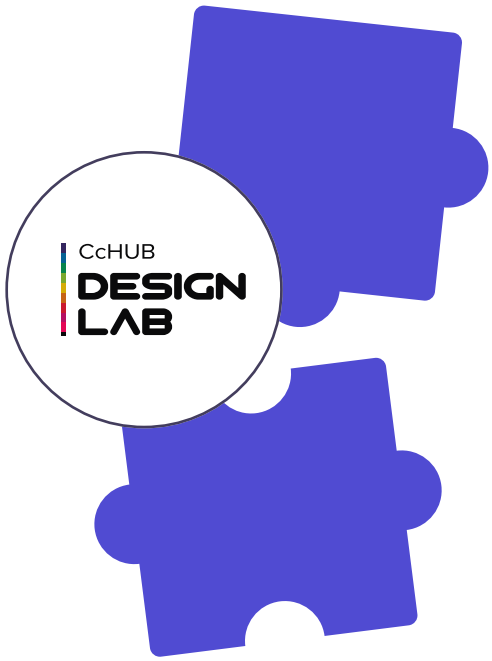


About the CcHub Design Lab

We are a research and development lab innovating for social impact. We collaborate with global stakeholders to explore the application of technology to **solve Africa's systemic problems** in Public Health, Education,Governance and the Private Sector.

At the core of our philosophy is the belief that people are the heart and soul of our work. We don't merely design for our users; we design alongside them. From brainstorming revolutionary ideas to testing and prototyping solutions, people aren't just recipients; they are our partners. We embrace a human-centric approach to problem-solving, channeling our efforts into creating tangible value for individuals and communities. Design excellence, for us, is a fusion of innovation and social impact. We select projects based on their potential to spark transformative change.



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Executive Summary

The report presented herein provides a comprehensive summary of 229 scholarly papers that discuss the topic of Artificial Intelligence (AI) in the context of Africa. These papers are authored by individuals who are either based in Africa and write about AI in Africa, African authors residing outside of Africa who contribute to the discourse on AI in Africa, or non-African authors who publish research specifically focused on AI in Africa.

The analysis places emphasis on various facets, including the ***yearly count of publications,*** *the journals that are most favored for publication, the patterns observed in co-authorship, and the countries with which authors are affiliated. The analysis commences by presenting the publication years, highlighting a significant change in the publications pertaining to the topic of artificial intelligence.*

Although there was a limited number of publications from 1984 to 2018, a notable and consistent increase in the number of papers can be observed starting from 2019, culminating in a peak of 58 papers in 2022. Additionally, we project AI publications will increase consistently in the next decade.

The present report explores citation statistics, revealing that 89% (n = 204) of the papers included in the study possess available citation data. The mean number of citations received per paper was 11, with a range spanning from 0 to a maximum of 284 citations. Moreover, the analysis includes a comprehensive ***breakdown of the quantity of published papers,*** *the average number of citations received, and the range of citations per year.*

This analysis confirms the observed pattern that older papers tend to accumulate a higher number of citations.

Executive Summary

Prominent scholarly articles are emphasized, encompassing pertinent details such as the authors' names, publication dates, titles, and the respective academic journals in which they were published. The report also ***highlights the prominent publishers*** *in the field of artificial intelligence, with MDPI AG being the frontrunner, followed by Elsevier BV, Springer Science and Business Media LLC, Frontiers Media SA, and various others. This study examines the patterns of co-authorship, revealing that a group of four individuals collaborated on multiple research papers. Arthur Gwagwa and Isaac Rutenberg have demonstrated a notable level of productivity as co-authors, while K. Pantserev and Maad M. Mijwil have also made significant contributions to this collaborative pattern.*

The authors' geographical information is delineated according to their institutional affiliations. Approximately 43% (n=98) of the papers examined in this study provided information regarding the countries of origin of the authors in the field of AI publications. It was observed that the majority of authors were affiliated with institutions located outside the African continent. ***South Africa, Nigeria, and Uganda*** *have emerged as noteworthy contributors, illustrating the dispersion of artificial intelligence research endeavors throughout the African continent*

Chapter 1

Introduction

Over the past few years, there has been a notable progression of Artificial Intelligence (AI) from a theoretical notion to a significant catalyst that is reshaping various industries, economies, and societies on a global scale. The expansion of AI development is not limited to well-established AI centers, but rather is proliferating worldwide, encompassing regions such as the African continent. In the face of distinctive obstacles, the African continent has experienced a notable surge in AI research and innovation, indicative of its **capacity to stimulate economic growth** and tackle indigenous issues.

The field of artificial intelligence (AI) research in Africa has been experiencing a gradual expansion. Academic institutions and research organizations are responding to the challenge by establishing specialized research centers and departments focused on artificial Intelligence (AI). The implementation of this proactive approach cultivates a **conducive environment** for the flourishing of innovation and the efficient dissemination of knowledge. In addition, the establishment of partnerships and initiatives with international counterparts has facilitated the transfer of technology and the development of expertise, thereby enhancing the progress of research in the field of artificial intelligence.

A comprehensive examination of academic publications pertaining to artificial intelligence originating from Africa indicates a **discernible upward trajectory** in terms of both volume and caliber. Although the outputs of these regions may not currently match those of established AI hubs like North America and Europe, they demonstrate a noticeable upward trend. Scholars are currently investigating a wide range of subjects, such as natural language processing, computer vision, data science, and machine learning applications specifically designed for localized environments.

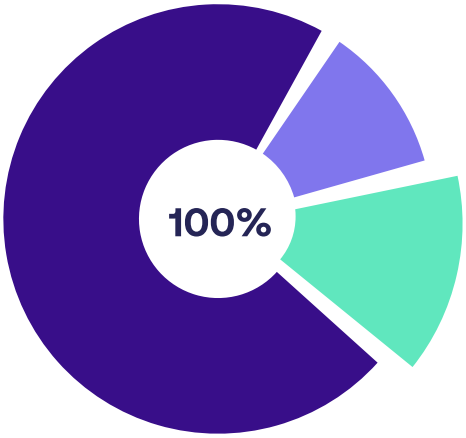
Introduction

Collaboration serves as a fundamental pillar in fostering the advancement of AI research within the African context. Researchers, institutions, and organizations are actively establishing collaborative relationships across national boundaries and disciplinary boundaries in order to capitalize on a wide range of expertise and resources. These networks not only improve the caliber of academic research **but also make valuable** contributions towards tackling challenges specific to Africa by utilizing AI-powered solutions.

Nevertheless, in the midst of this period of expansion, there are still persistent challenges that need to be addressed. The continent faces **significant challenges** in fully harnessing the potential of artificial intelligence due to constraints in resource availability, infrastructure development, financial support, and the availability of skilled professionals. However, these challenges also present opportunities for stakeholders to redirect their efforts toward enhancing their capabilities, facilitating the exchange of knowledge, and making specific investments in the development of AI education and research infrastructure. The present report provides a comprehensive overview of 229 papers related to artificial intelligence in Africa (AI), with a particular emphasis on analyzing the annual publication trends, the prominent journals utilized for disseminating research findings, the prevalence of co-authored papers, and the geographical distribution of publishing countries as determined by authors' affiliations.

Data Analysis Approach

This research employed a descriptive research approach and employed **data triangulation techniques** to extract insights from academic publications related to Artificial Intelligence (AI). The primary data sources utilized were the Scite and Elicit databases. Additionally, data regarding paper references, citations, and author affiliations was obtained through Application Programming Interface (API) calls and Wikipedia, respectively.



The descriptive analysis was applied to draw insights into several aspects, including the quantity of AI content focused papers published between 1984 and 2022, summaries of references and citations, details about publishers, co-authorship, and the geographic affiliations of authors. Furthermore, a **time series analysis** was conducted to forecast the anticipated number of AI-related publications for the upcoming decade. To analyze keywords, Natural Language Processing (NLP) techniques were employed to clean and extract keywords from the content of these publications

Chapter 2

Bibliometric Analysis Findings

Publishing Years

The line graph below depicts the quantity of public academic papers with a primary focus on artificial intelligence in Africa, spanning the time period from 1984 to 2022.

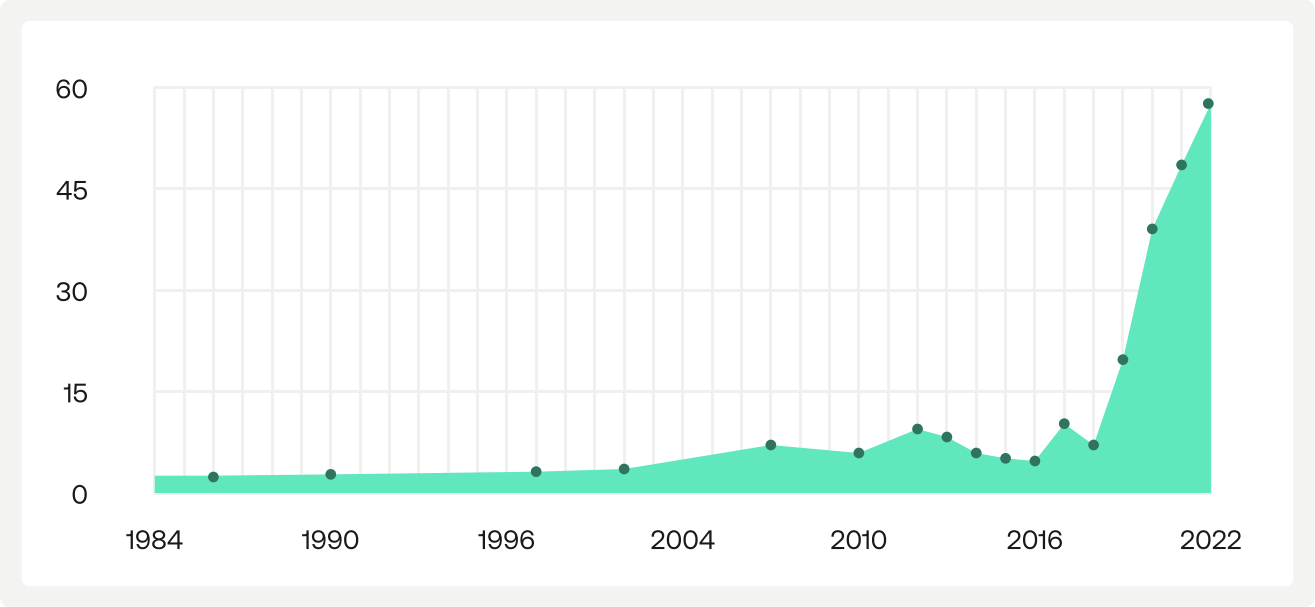


fig. 2.1 Quantity of academic papers published

Quantity of Academic Papers Published

The fig. 2.1 above illustrates a notable dearth of publications spanning the years 1984 to 2018. Since 2019, there has been a noticeable and consistent increase in the number of academic publications on artificial intelligence (AI) in Africa, reaching its highest point in 2022 with a total of 58 papers being published.

Bibliometric Analysis Findings

Publication Projections

Fig. 2.2 below showcases the estimated count of Africa AI focused research papers expected to be published over the next decade.

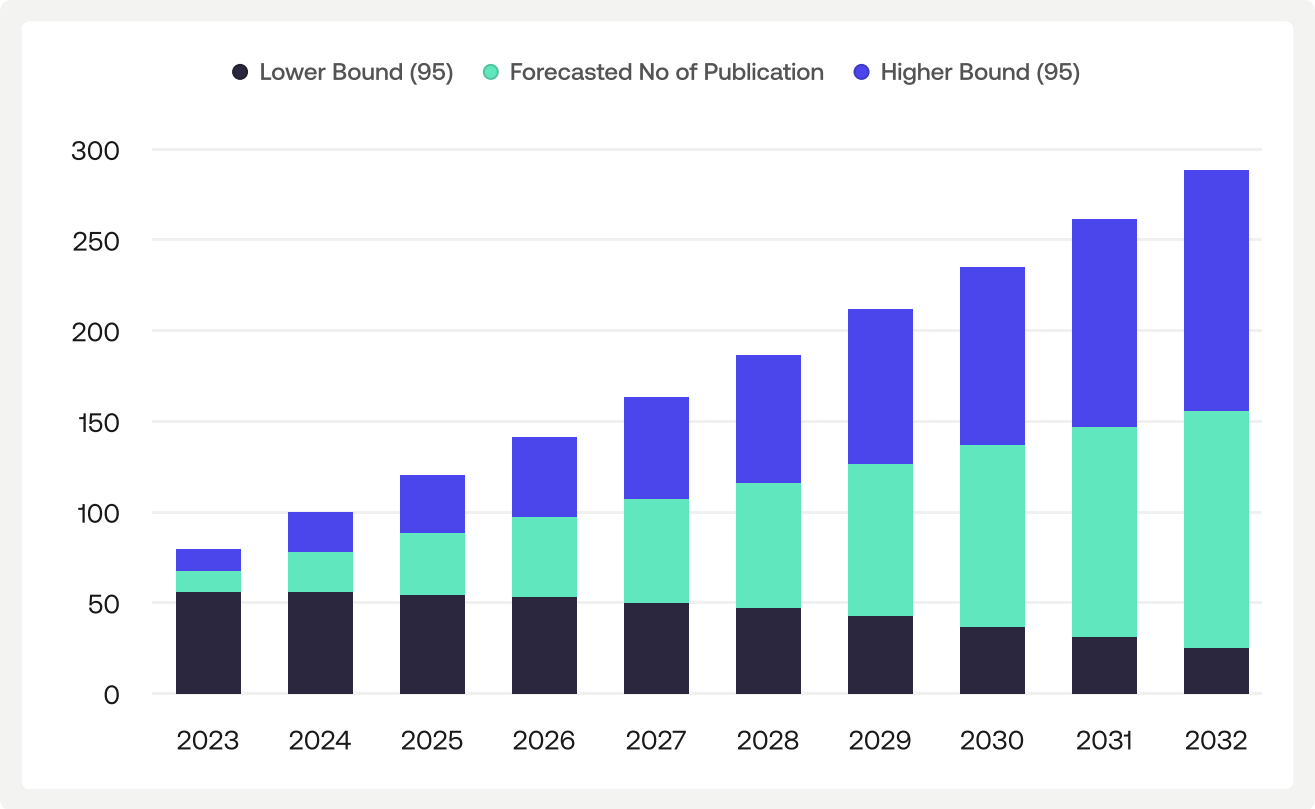


fig. 2.2 Forecasted quantity of academic papers

Utilizing a time-series analysis of 229 of Africa AI focused research papers, we anticipate a consistent growth pattern in publications over the next decade. Projections indicate a rise from 67 papers in 2023 to 150 papers by the year 2032.

Bibliometric Analysis Findings

Citations:

Citations Summary

The table provided below illustrates the citations for the research papers addressing AI issues and topics in Africa collected from a total of 229 published papers.

Total Number of Papers	Average Citations	Highest Citations	Lowest Citations
89% (n=204)	11	284	0

Table 2.1 Citations summary

Out of the total 229 papers, 89% (n=204) contained citation data. On average, each paper had 11 citations, with the highest being 284 citations and the lowest being zero citations per paper.

Detailed Citations Information

Table 2.2 below highlights detailed information on the number of published papers, average citations, and range of citations per year.

Publication Year	Number of Papers	Average Citations	Maximum Citations	MInimum Citations
1984	1	7% (n=58)	58	58
1986	1	5% (n=46)	46	46
1991	1	6% (n=50)	50	50
1997	1	34% (n=284)	284	284
2002	1	5% (n=42)	42	42

Table 2.2 Detailed Citation Information

Publication Year	Number of Papers	Average Citations	Maximum Citations	MInimum Citations
2007	2	3% (n=28)	46	10
2010	1	2% (n=13)	13	13
2012	3	6% (n=52)	151	0
2013	2	0% (n=4)	4	3
2014	1	2% (n=21)	21	21
2015	1	16% (n=136)	136	136
2016	1	4% (n=37)	37	37
2017	4	1% (n=6)	17	1
2018	4	4% (n=32)	120	0
2019	17	1% (n=10)	45	0
2020	43	2% (n=19)	167	0
2021	53	7% (n=3)	51	0
2022	58	7% (n=6)	51	0
2023	31	7% (n=0)	3	0

Table 2.2 Detailed citation information

General observations suggest that older papers are more likely to be cited over time, as they are often considered foundational or seminal works in their field.

Bibliometric Analysis Findings

Top Cited Papers

The table below summarizes the top cited papers in the field of artificial intelligence, including their authors, publication year, and journal.

Publication Year	Paper Title	Authors	Citations	Publisher/ Journal
1984	Artificial intelligence and its applicability to geographical problem-solving	Terence R. Smith	58	
1997	Artificial intelligence in geography	S. Openshaw, C. Openshaw	284	
2012	Artificial intelligence in civil engineering	Pengzhen Lu, Shengyong Chen, Yujun Zheng	151	
2015	Artificial intelligence and its application in different areas	A. Pannu, M. Student	136	
2018	Disruption of financial intermediation by fintech: a review on crowdfunding and blockchain	Cynthia Weiyi Cai	120	Wiley
2020	Artificial intelligence and the future of global health	Nina Schwalbe, Brian Wahl	167	Elsevier BV
2020	Decolonial ai: decolonial theory as sociotechnical foresight in artificial intelligence	Shakir Mohamed, Marie-Therese Png, William Isaac	110	ArXiv; Springer Science and Business Media LLC

Table 2.3 Top Cited papers

Publication Year	Paper Title	Authors	Citations	Publisher/ Journal
2020	Journal of intellectual capital: a review of emerging themes and future trends	Marco Bellucci, Giacomo Marzi, Beatrice Orlando, Francesco Ciampi	58	Emerald
2021	Artificial intelligence in the industry 4.0, and its impact on poverty, innovation, infrastructure development, and the sustainable development goals: lessons from emerging economies?	David Mhlanga	51	Sustainability; MDPI AG
2012	Omicron ba.2 (b.1.1.529.2) : high potential for becoming the next dominant variant	Jiahui Chen, Guo-Wei Wei	120	American Chemical Society (ACS)

Table 2.3 Top cited papers

References

The table below highlights the reference summaries

Total Number of Papers	Average References	Highest References	Lowest References
89% (n=204)	11	284	0

Table 2.4 References summary

Out of all the papers examined, 88% (n = 196) included reference data. Authors, on average, cited 55 sources when writing their AI subject focused papers. The range of references varied, with the highest being as many as 239 sources, while the lowest involved citing just a single source.

Bibliometric Analysis Findings

Key Words

The word cloud below highlights the primary focus areas that researchers addressed.

fig. 2.3 Academic papers keyword

The landscape of Artificial Intelligence (AI) research and its applications in Africa encompassed an extensive array of subjects, underscoring AI's capacity to confront numerous pivotal issues across the continent. The predominant themes explored in AI publications comprised AI's contributions to Sustainable Development, Healthcare, Economic Advancement, Mitigation of Climate Change, Educational Innovation, the Industrial Revolution, as well as its role in shaping Public Policy and conducting Risk Assessments

Bibliometric Analysis Findings

Publishers

Out of 200 papers, 87% (174 papers) had data on the journal that published them. There were 92 distinct publishers represented in these papers. Fig. 2.8 below shows the top 5 journals in AI subject focused publications

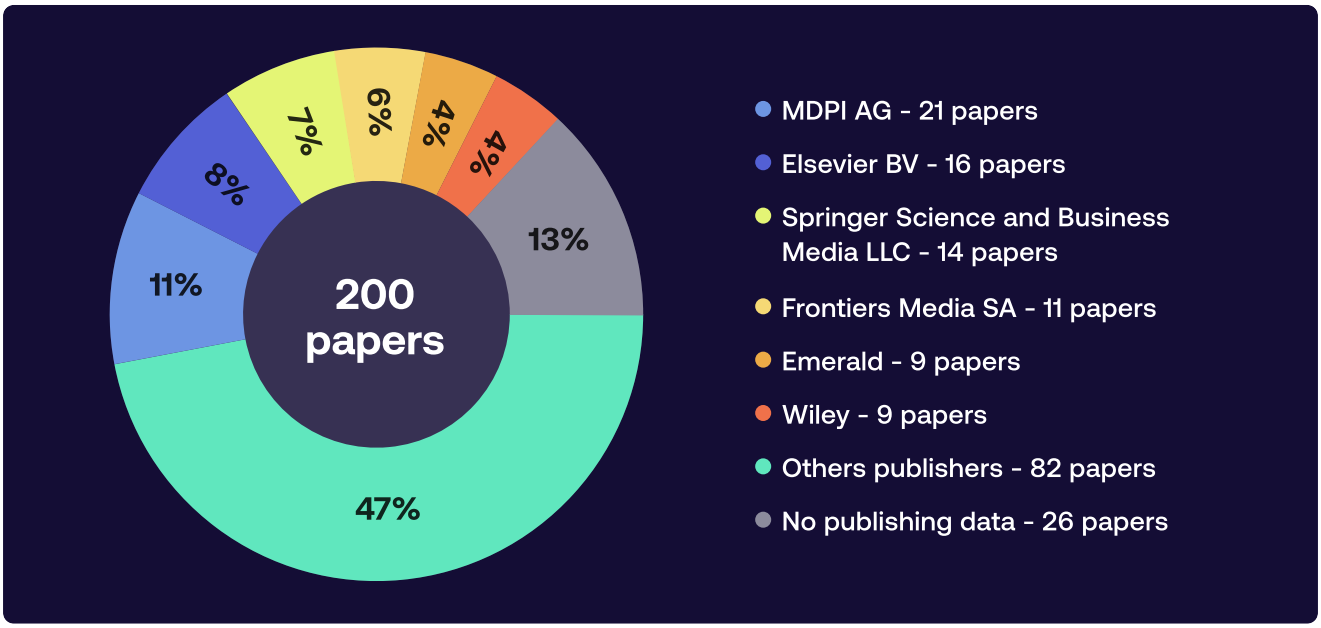


fig. 2.4 Top academic papers publishers

The MDPI AG journal held the highest position in paper publications, being utilized by 10% (n = 21) of the papers. It was trailed by Elsevier BV at 8% (n = 16), followed by Springer Science and Business Media LLC at 7% (n = 14). In the subsequent positions, Frontiers Media SA accounted for 6% (n = 11), while both Emerald and Wiley each accounted for 4% (n = 9) of the papers.

Bibliometric Analysis Findings

Co-authorship

The table below lists the authors who co-authored two or more papers.

Author	No of Papers Co-authored	Average Citations
Arthur Gwagwa	1.3% (n=3)	Use and Impact of Artificial Intelligence on Climate Change Adaptation in Africa; Road map for research on responsible artificial intelligence for development (AI4D) in African countries: The case study of agriculture; Artificial Intelligence (AI) Deployments in Africa: Benefits, Challenges and Policy Dimensions
Isaac Rutenberg	1.3% (n=3)	Use and Impact of Artificial Intelligence on Climate Change Adaptation in Africa; Artificial Intelligence (AI) Deployments in Africa: Benefits, Challenges and Policy Dimensions; AI in Africa: Framing AI through an African Lens
K. Pantserev	0.9% (n=2)	Malicious Use of Artificial Intelligence in Sub-Saharan Africa: Challenges for Pan-African Cybersecurity; Existing practice and risks of malicious use of artificial intelligence in Sub-Saharan Africa
Maad M. Mijwil	0.9% (n=2)	The Position of Artificial Intelligence in the Future of Education: An Overview; Artificial Intelligence: A Survey on Evolution and Future Trends

Table 2.5 Co-authors

The study found that only 4 persons co-authored the AI subject focused papers, with Arthur Gwagwa and Isaac Rutenberg being the most prolific co-authors, each co-authoring a maximum of 3 papers. Additionally, K. Pantserev and Maad M. Mijawil each co-authored 2 papers.

Bibliometric Analysis Findings

Authors' Countries

The subsequent table displays the geographical locations of authors, determined through affiliation data obtained from DOIs and other data sources. The extraction process involved referencing Wikipedia to ascertain the locations of the authors.

The AI publications analyzed were authored by individuals from a diverse range of countries, with 43%(n=98) of the papers having authors hailing from 28 different countries. Fig. *** below provides a summary of the authors' countries of origins

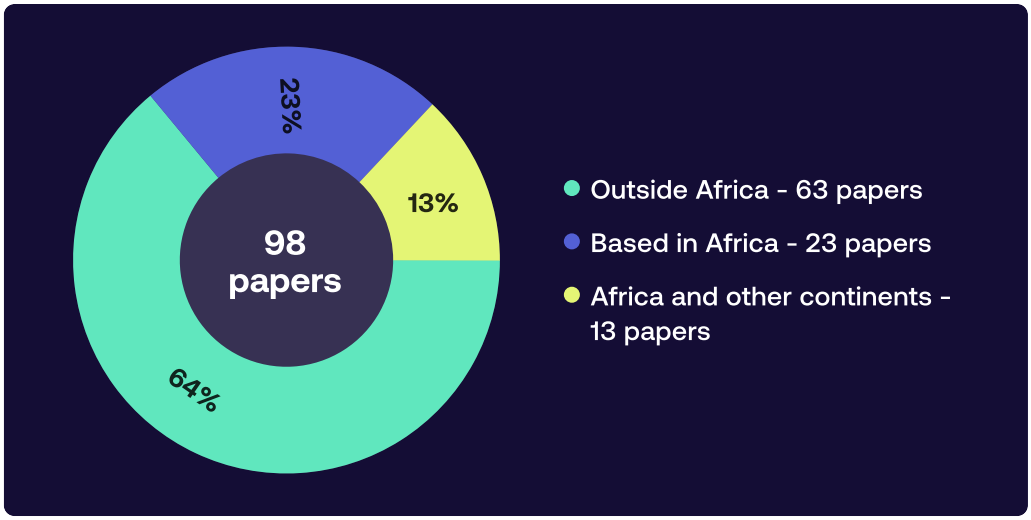


Fig. 2.5 Authors affiliation

The authors were from a diverse range of locations, with the majority 64% (n= 63) being based outside of Africa. 22% (n =22) of the authors were based in Africa, and 13% (n = 13) were based in both Africa and other continents.

Bibliometric Analysis Findings

Top Publishing African Countries

The table below indicates the summary of countries where authors are located.

South Africa is the leading country in Africa for AI research, with authors authoring 27.6% of the total AI subject focused papers. Nigeria and Uganda are in second and third place, respectively, with each country's authors authoring 4.1% of the papers. The remaining countries in Africa have each authored less than 2% of the papers.

Author	No of Papers
South Africa	27.6% (n=27)
Nigeria	4.1% (n=4)
Uganda	4.1% (n=4)
Ivory Coast	2.0% (n=2)
Kenya	2.0% (n=2)
Morocco	2.0% (n=2)
Tanzania	2.0% (n=2)
Botswana	1.0% (n=1)
Cameroon	1.0% (n=1)
Egypt	1.0% (n=1)
Ethiopia	1.0% (n=1)
Gambia	1.0% (n=1)

Table 2.6 Top publishing African countries

Author	No of Papers
Lesotho	1.0% (n=1)
Swaziland	1.0% (n=1)
Zambia	1.0% (n=1)

Table 2.6 Top publishing African countries

Other Countries

The table below highlights countries hosting authors publishing AI subject focused papers for Africa.

Author	No of Papers
Canada	5.1% (n=5)
United Kingdom	5.1% (n=5)
United States	3.1% (n=3)
Italy	2.0% (n=2)
Pakistan	2.0% (n=2)
Austria	1.0% (n=1)
Bahrain	1.0% (n=1)
Belgium	1.0% (n=1)
England	1.0% (n=1)
France	1.0% (n=1)
Netherlands	1.0% (n=1)
New Zealand	1.0% (n=1)
United Arab Emirates	1.0% (n=1)

Table 2.7 Authors outside African continent

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