

Research collaboration outputs between the European Union and Africa: the case of co-authored scientific articles between Finland and Africa

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 I analyzed co-authored international peer-reviewed scientific articles that resulted from research collaborations between scholars in the European Union (EU) and African countries, with a particular focus on the case of Finland. Among the 28 EU member states, Finland ranked 13th in terms of the quantity of co-authored scientific articles produced through these collaborations. I found that from 2015 to 2021, scholars from universities, research institutes, and other organizations in African countries and Finland co-authored more than 4,700 international peer-reviewed articles. Despite the doubling of co-authored Finland–Africa peer-reviewed scientific articles in international journals annually during this period, these articles accounted for less than one percent of all international peer-reviewed scientific articles in Africa, and their proportional share decreased over time. The most common fields of collaboration were medical sciences and natural science. Of Finland–Africa articles, almost 1,500 focused on Africa. The University of Helsinki and South African universities were the most active collaborators. Given these findings, it is crucial to address the implementation of the European Commission’s strategy for partnerships with Africa and Finland’s collaboration strategies with Africa to encourage more inclusive research collaboration among scholars from Finland, Europe, and Africa.

Keywords: Finland, Africa, European Union, scientific article, research collaboration, co-author

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Introduction

Over the recent years, collaboration and partnership with Africa in research, development and innovation (RDI) have gained significant attention in the European Union (EU), including Finland. Africa is a continent of great diversity, and its rapid changes increasingly impact the development, economy, and policies of the EU and its member states. In the 2020s, there is hope that Europe and Africa will engage in more symmetrical and equal partnerships (European Commission 2020; Köhler 2020), although some remain skeptical (Haastrup *et al.* 2021).

The focus of this study was on research collaboration between the EU and Africa, which is expected to increase the volume of international research and have research-driven positive impacts on both regions. Horizon Europe, the EU's primary funding instrument and research framework program, is providing significantly greater resources in 2021–2027 for research projects with African organizations (European Commission 2021).

Concrete examples of research collaboration with scientific results can be found in co-authored international peer-reviewed scientific articles published by universities, institutes, and scholars in esteemed international scientific journals. Obviously, article co-authorship does not encompass all forms of collaborations, and not all individuals involved in the preparation of an article are cited as co-authors. However, according to Glänzel and Schubert (2004), analyzing co-authorship provides valuable insights into the interactions between collaboration, scientific communication, and scientists' performance (Tahmooresnejad *et al.* 2021). Furthermore, the recent growth in scientific publications in Europe almost entirely rests on internationally co-authored publications (Kwiek 2021).

The Web of Science (WoS) database by Clarivate, owned by Thomson Reuters, is a commonly used source for quantitative studies of research collaboration. With more than 18,000 scientific journals and dozens of millions of publications from various disciplines, it provides a comprehensive resource. While other databases such as Scopus and Google Scholar contain more books, journals, and articles than WoS, the scientific impact of publications cited in WoS is generally greater than that of scientific publications solely quoted outside of it (Martín-Martín *et al.* 2018). In this study, I examined research collaboration between Finland and Africa by analyzing their co-authored articles from 2015 to 2021 in journals covered by WoS. Only articles in which at least one representative, typically a staff member from a university or research institute, from both an organization in Finland and another in Africa participated as writers were considered. Books and seminar publications were excluded from the analysis as their peer-review process is not necessarily rigorous. Among the 28 EU nations, Finland ranked 13th in terms of research collaboration with African countries.

My research questions were: How many Finland–Africa co-authored articles were published from 2015 to 2021? What were the primary research topics and areas covered in these articles? Who were the collaborators involved in these articles? What was the scientific impact of these articles?

Research collaboration strategies and partnerships with Africa, and the case of Finland

The internationalization of scientific collaboration is part of the expanding global geography of science (see Olechnicka *et al.* 2019). The development of advanced information and communication technologies, coupled with mobility restrictions resulting from the COVID-19 pandemic, has further accelerated research collaboration between geographically distant partners. In the 2010s, international research collaboration in African countries was already significantly higher compared to the rest of the world (Pouris & Ho 2014), partly due to research funding originating from outside of Africa. However, such research in Africa is often guided by donors' interests, follow their scientific paradigms, and is thus vulnerable to their changing priorities and preferences (Samoff & Bidemi 2004).

In the past, African researchers have faced persistent challenges in proper recognition and impact in international science (Tijssen 2007). In the production of knowledge, too often Africa has been relegated to the role of a mere research data source for Europe, perpetuating hierarchies in international research activities. There the Global North centers dominate with their epistemologies and methodologies, and scholars in the Global South peripheries need to follow these in research collaboration (see Marginson 2021; Jauhiainen 2023). African organizations have not been adequately involved in research design or publication of results, so empirical material was removed from Africa, and valuable knowledge was created elsewhere. This has hindered the development of engaged research practices originating and based in Africa, as well as the use of scientific results to promote more grounded development in society (Samoff & Bidemi 2004; Tijssen 2007; Seth 2009; Matunhu 2011; Cloete *et al.* 2018; Ndfirepi & Gwaravanda 2019; Bernard 2020).

International research collaboration has become increasingly common worldwide. As research topics have become more complex, international collaboration is often necessary due to the diversity

of phenomena studied or expertise required. Scientific outputs such as articles in international journals can be more easily facilitated by collaboration between researchers from different countries. Achieving a 'world class' status in global rankings (such as ShanghaiRanking Consultancy 2021; see Marginson 2021) indicates that a university is thriving. However, organizational support and individual scholars' willingness to collaborate internationally are also essential, as well as finding suitable partners (Lee & Bozeman 2005; Kwiek 2021). To understand the research collaboration between Finland and Africa, it is important to consider the context: What makes Finland an attractive partner for African scholars and institutions, and why is Africa an interesting collaborator for Finland?

From an African perspective, Finland may be considered a small country within the EU due to its population (5.5 million) and economy (GDP EUR249 billion), which represents 1.2% and 1.8% of the EU's population and GDP, respectively, and its distant location away from Africa. However, Finland is a leading nation in technology and innovations. Finland's commitment to economic competitiveness, RDI, carbon-free sustainability transition, people's welfare, and anticorruption measures has earned it a prominent global ranking (Schwab *et al.* 2020). Similar orientations are on the agenda of many African countries.

Finland's recent interest in intensifying research collaboration with Africa is driven by three overlapping issues. First, Finland's development policy toward Africa has changed. For many years, Finland has engaged in long-term development collaboration with several sub-Saharan African countries, including Tanzania, Namibia, and Kenya. Following political changes in South Africa during the 1990s, Finland expanded its intensive collaboration with the country. Previously, Finland's aid delivery was based on a traditional donor–receiver policy, with little expectation of economic returns. However, since the early 2000s, Finland has sought mutual economic interests with African countries, shifting away from pure altruism. The current policies have emphasized RDI, with a focus on private sector involvement as the government substantially reduced public development aid. Such shift is evident in recent development collaboration between many European countries and Africa (Jauhiainen & Hooli 2020).

Second, Finland, as a member state of the EU, is actively participating in new high-level initiatives aimed at fostering collaboration between Europe and Africa. In 2020, the European Commission (2020) published a comprehensive EU–Africa strategy, which outlines key objectives, such as preventing harmful climate change, promoting the green economy and the transition to it, creating sustainable growth and jobs, and supporting digitalization, democracy, equality, peace, and migration management. The strategy aims to establish strategic collaboration between Europeans, including the EU, and Africans, including the African Union, regional organizations, countries, businesses, and individuals in Africa. Finland's involvement in these partnerships has been facilitated by the appointment Mrs. Jutta Urpilainen, a Finn who is in the European Commission's commissioner in charge of international partnerships, including those with Africa. She belongs to the same political party as the Finnish prime minister who oversaw the launch of Finland's Africa strategy (Ministry for Foreign... 2021).

Africa's demographic growth, rapid urbanization, advancing digitalization, and geopolitical impacts are critical considerations for the European Commission's and Finland's Africa-related strategies. According to the United Nations (2022), half of the world's population growth between 2020 and 2050 is expected to occur in Africa, leading to a projected increase of 900 million inhabitants in Africa. However, the COVID-19 pandemic, related lockdowns, and declining business activities have exacerbated poverty in Africa, particularly for those who rely on daily hands-on income (Bargain & Aminjonov 2021). Climate change is also causing significant harm to many parts of Africa (United Nations 2020), contributing to aspirations among many Africans to migrate both within and beyond the continent.

The European Commission's strategy emphasizes its commitment with Africa. At the same time, there is a shift in the EU's narrative towards Africa to maximize the benefits of the green transition, minimize threats to the environment, enhance European economic competitiveness and support the securitization of the EU's geopolitical interests in Africa and beyond (European Commission 2020; Teevan *et al.* 2021). In Finland, however, African countries accounted for only 2.5 percent of the country's total exports in the late 2010s (Impiö *et al.* 2020), and thus, the Finnish government is keen to participate more in Africa's growing economy. However, Finnish nongovernmental development

organizations have criticized Finland's Africa-related collaboration strategy, arguing that it emphasizes the country's economic and political interests in Africa, while not sufficiently considering sustainable development, responsible business practices, or gender equality (Fingo 2021). Furthermore, the strategy had been criticized for not addressing transformative innovations in Africa's development and society (see Jauhiainen & Hooli 2020).

Third, the European Commission and the Finnish government prioritize creating *useful* knowledge with broader societal impacts. To this end, more funding will be available for African research organizations in the EU's research framework program (European Commission 2021). However, Finland has historically lacked significant Africa-related research funding. For example, the Academy of Finland, the country's primary research funding agency, supported research collaboration related to Africa with approximately EUR24 million from 2011 to 2019, which was well below one percent of the academy's total funding for research. Of the Africa-related funding, about half went towards development research and other projects jointly funded by the Academy of Finland and the South African National Research Foundation, and various EU–Africa multilateral donor collaboration networks (Lindfors 2021).

Finland's Ministry of Education and Culture has taken steps to enhance research and teaching collaborations with Africa by financing four global projects from 2021 to 2024, in which Africa is at least a part of it. All thirteen of Finland's universities and nineteen out of twenty-four Finnish universities of applied sciences are involved in these projects, aiming to internationalize Finnish higher education organizations, create RDI projects, attract and recruit international talent, especially in relation to Africa, boost networking in Finland and among African partners, and foster a positive image of Finland worldwide. The state budget *allocated* for this initiative is EUR 55.6 million (see Jääskeläinen 2021). In addition, the University of Helsinki, which leads in implementing Africa-related research and teaching, has developed its Africa program for 2021–2030. Its primary goals, which support the university's overall strategy, are to establish and nurture new interactive, useful, and equal partnerships; promote multidisciplinary research; and encourage open science, infrastructure, and sustainability (University of Helsinki 2020). While many other Finnish universities' internationalization strategies and objectives also mention Africa, the University of Helsinki places a greater emphasis on the continent.

Finland's Strategy for Africa recognizes the importance of Africa-related research in Finland to enhance understanding and knowledge of Africa's diversity (see Aroalho 2020). The strategy aims to support Finnish universities, research institutes, and think tanks to improve scholarly expertise, innovation, and sustainable development (Ministry for Foreign... 2021). They are encouraged to establish *useful* partnerships with their African counterparts and promote researcher exchanges between Finland and African countries, facilitated by EU funding such as Horizon Europe and Erasmus Mundus. The Finnish strategy aligns with the European Commission's strategy, encouraging scientific and research collaboration in green structural change and mechanisms to prevent harmful impacts of climate change, such as emigration from Africa. In addition, the strategy recognizes that Finnish scholars could benefit from African know-how, including in science and health (*ibid.*).

Changing knowledge creation practices to be fully inclusive regarding Africa in the EU will not be an easy task. The recent strategies of the European Commission and Finnish government did not adequately scrutinize the possible colonial practices in knowledge production concerning Africa (see Ezechukwu 2022). This includes the role of Africans, both in Africa and the diaspora, in implementing and benefitting from the strategies. The problematic history of Europeans in Africa casts a shadow over the construction of the current EU–Africa partnership. For centuries, knowledge produced about colonized Africa was gathered to directly benefit European states. Furthermore, modern scientific interests, techniques, and practices from Europe and the Global North were used to dictate what was scientifically relevant and proper to perform in Africa (Seth 2009). Academic collaboration is also about soft power in international relations. Although Finland never had colonies in Africa, its missions in Namibia stretch back to the nineteenth century. Namibia has also been a key recipient of Finland's development aid, and Finns are still involved in numerous higher education and research projects in the country.

Scholars engage in international scientific collaboration for various reasons, including enhancing academic prestige, gaining scientific recognition, and accessing research funding. These individual

motivations contribute to the accumulation of prestige in organizations, such as departments, institutes, universities, and countries, in which collaborators are present (Kwiek 2021). As a small nation, Finland requires strong international research collaboration for RDI. There is a strong parallelism between research expenditure per capita and research output (North *et al.* 2020). Finland, with its high tertiary enrollment rate, good quality universities, and mostly free-of-charge tertiary education, provides an excellent research collaboration choice for many scholars from Africa. The Finnish government's strategic idea to recruit talent from Africa to Finland could contribute to Africa's brain drain if talented African scholars do not return to Africa or continue engaging with African organizations and scholars. However, if they do return or continue to engage, it could positively influence 'brain circulation' (see Radwan & Sakr 2018; Doh & Jauhiainen 2021).

International peer-reviewed co-authored articles as empirical material and their quantitative methods

International peer-reviewed co-authored articles indicate that research collaboration between Finland and Africa got verifiable scientific results. The material of this study consists of scientific peer-reviewed articles or scientific review articles (here called Finland–Africa co-authored articles) between 2015 and 2021 published in journals indexed in the WoS database and involved at least one author from an organization in Finland and another from an organization in Africa, as indicated in the article's byline.

After screening the entire WoS database as of March 21, 2022, five datasets were identified: (1) all Finland–Africa co-authored articles (4,713 articles), (2) all Finland–Africa co-authored articles exclusively between organizations from Finland and Africa (i.e. not featuring any organizations from other countries, 746 articles), (3) all Finland–Africa co-authored social science articles exclusively from organizations from Finland and Africa (266 articles), (4) all Africa-topic Finland–Africa co-authored articles exclusively between organizations from Finland and Africa (169 articles), and (5) all Africa-topic articles in which the organization was from Finland (1,455 articles). As regards the latter, an article was considered to be in general about Africa when the article's title, summary or keyword created by the author or system (the WoS category 'Topic') mentioned the word 'Africa' or 'African', but not 'African American'.

I conducted a quantitative analysis of the materials primarily using descriptive statistics, with a focus on differences across the datasets. Firstly, I analyzed the volume of these articles and their proportion in relation to all international peer-reviewed articles in Finland and in Africa from 2015 to 2021. Secondly, I identified the most common research topics and geographical areas covered in the Finland–Africa co-authored articles using the VOSviewer (visualization of similarities) program and its algorithms to establish connections among the main topics, research areas, and organizations. Thirdly, I examined the articles' scientific impact, including their accessibility, publication venues, and citation counts.

Development of the number of Finland–Africa co-authored scientific articles

From 2015 to 2021, the WoS database contained 4,713 articles with at least one organization from Finland and one organization from Africa. In comparison, there were approximately 112,000 articles in WoS featuring a scholar in an organization in Finland and 518,000 articles featuring scholars in organizations from Africa during the same period. Finland–Africa co-authored articles accounted for 4.2 percent of Finland's research output and 0.9 percent of Africa's research output.

In Africa, 55.0% of articles published in WoS involved collaboration with non-African organizations. The most important research partners were organizations from the United States (13.8%), the United Kingdom (9.2%), France (8.2%), Germany (5.3%) and China (4.8%). Notably, highly prolific researchers in Africa, who produce more scientific publications and highly cited articles, tend to collaborate more frequently with non-African partners, particularly frontier universities, as noted by Confraria, Blanckenberg and Swart (2018).

Regarding Finland's research partners in Africa-related research (see Fig. 1), the quantitatively most significant partners (in terms of co-authored articles in WoS) were scholars in organizations from the United States (present in 17.7% of all articles), the United Kingdom (15.9%), Germany

(14.1%), and Sweden (13.4%). This trend aligns with broader academic trends where scholars from organizations in (quantitatively) leading countries are increasingly participating in international research, as discussed by Kwiek (2021).

France emerged as a leading partner in research collaborations with Africa, with 20,008 co-authored articles (3.9% of all international peer-reviewed articles from African organizations) originating from Africa collaborations; followed by 14,016 (2.7%) from the United Kingdom, and 6,684 articles (1.3%) from Germany. These countries also featured prominently in multi-partner research networks, with French scholars particularly active in French-speaking Africa. Finland’s contribution to bilateral research collaboration with Africa was very modest, with only 746 articles (0.1% of all WoS articles in which scholars in Africa participated) featuring exclusively authors both from Finland and one or more African countries. Norway and Denmark, countries with similar population sizes with Finland, have stronger research output with African partners, with 1,568 articles (0.3%) exclusively from Norwegian partners with Africa and 1,077 articles (0.2%) exclusively from Danish partners. Sweden, Norway and Denmark have stronger presence and tradition in Africa research, and they provide more funding for Africa research and Africa-related development policies.

The annual number of co-authored Finland–Africa publications doubled by 99% from 2015 to 2021. However, Finland’s overall share of articles related to Africa decreased. The growth rate for articles exclusively between Finnish and African partners was lower at 74%, compared to multi-partner international research collaborations. The government of Finland’s Africa strategy (Ministry for Foreign... 2021) and the internationalization program by Finland’s Ministry of Education and Culture (Jääskeläinen 2021) recommend intensifying Finland–Africa research collaboration.

In Africa, South Africa was the most frequent partner for co-authored publications with Finland, accounting for 2,061 (43.7%) of the articles. Of these articles, 89.2% also had a third partner. Egypt, with 1,456 articles (30.9%), was the next most common research partner for Finland in Africa, followed by Kenya (339; 7.2%), Nigeria (303; 6.5%), Ghana (281; 6.0%), Morocco (223; 4.8%), Ethiopia (213; 4.5%), Algeria (199; 4.3%), Tunisia (171; 3.6%), Tanzania (171; 3.6%), Malawi (141; 3.0%), and Cameroon (121; 2.5%). In all, scholars from organizations in Finland co-authored with scholars from 50 out of 54 African countries. However, in most countries, only a few co-authored articles were published, and Finland’s presence was often limited to being a partner in wider international research networks (Fig. 1).

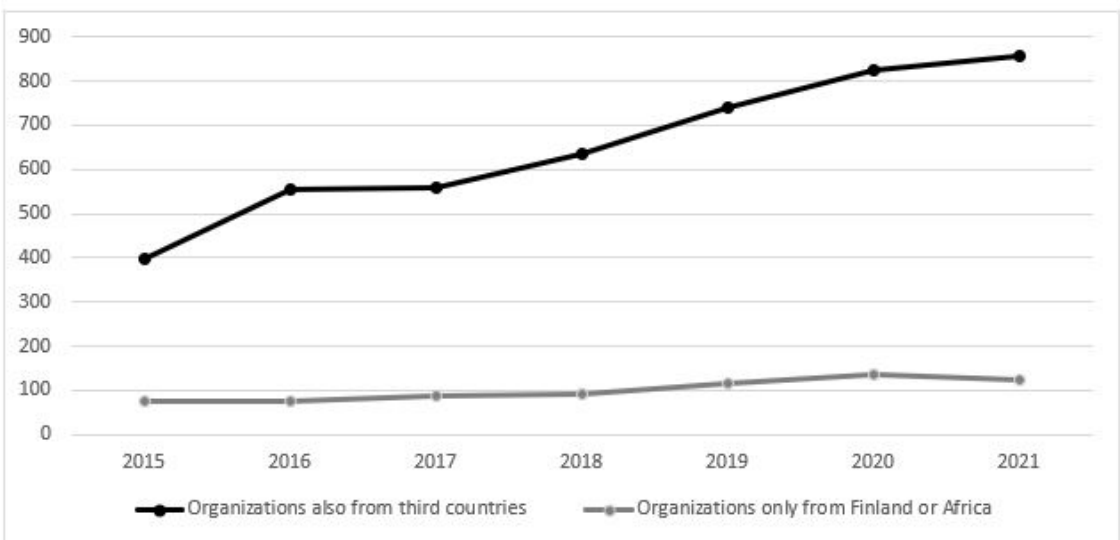


Fig. 1. International peer-reviewed scientific articles in Finland–Africa collaboration, 2015–2021. Source: Own calculation from Web of Science (2022).

Research topics of the Finland–Africa co-authored scientific articles

The large majority of Finland–Africa collaboration articles in WoS were from science subjects, with 78.9 percent indexed in the Science Citation Index Expanded (SCIE), and 10.2% indexed together with articles in Social Sciences Citation Index (SSCI). Of all Finland–Africa articles, 15.0 percent were from the SSCI (including those indexed together with SCIE). However, there were only a few articles from the Arts & Humanities Citation Index (0.3%) and the Emerging Sources Citation Index (5.0%). Compared to the entire WoS database, Finland–Africa co-authored articles appeared substantially more frequently in consolidated science journals (with 16.9 percent units more) and less often in emerging sources journals (with 16.5 percent units less). Themes and methods in medical science and science are more universal to publish than many social science themes that need to be contextualized for African contexts.

Collaborative scientific research between Finland and Africa covered a broad range of topics. In fact, of the 256 subcategories in WoS, 148 (58.3%) were mentioned at least once per year on average in the Finland–Africa co-authored articles from 2015 to 2021. The most frequent fields included physics particles, astronomy and astrophysics, nuclear physics, and environmental sciences (Table 1). Interestingly, research collaboration based exclusively on Finnish and African organizations was different. The most common fields included environmental sciences and ecology, education, electric engineering, and multidisciplinary sciences. In social science articles, the most common fields were education, business, tourism, and psychology. Furthermore, in exclusively bilateral Finland–Africa publications, the relative share of social science articles was more than double of all Finland–Africa articles, accounting for 38.1 percent of the total (Table 1). On the contrary, much of science-related publishing was conducted in international research networks with the presence of Finnish scholars.

Table 1. Research areas in Finland–Africa co-authored international scientific articles in 2015–2021. Source: Own calculation from Web of Science (2022).

All articles (n=4,713)			Articles with only Finland and Africa (n=746)		
Research area	n	%	Research area	n	%
Physics	1,079	22.9%	Environmental Sciences & Ecology	98	13.1%
Astronomy & Astrophysics	598	12.7%	Engineering	93	12.5%
Environmental Sciences & Ecology	471	10.0%	Chemistry	59	7.9%
Science & Technology other topics	325	6.9%	Science & Technology other topics	55	7.4%
Engineering	297	6.3%	Materials Science	47	6.3%
Chemistry	245	5.2%	Education & Educational Research	45	6.0%
Public, Environmental & Occupational Health	156	3.3%	Agriculture	30	4.0%
Materials Science	142	3.0%	Computer Science	30	4.0%
General & Internal Medicine	135	2.9%	Physics	30	4.0%
Computer Science	122	2.6%	Public, Environmental & Occupational Health	30	4.0%

Research topics among all Finland–Africa co-authored articles were closely linked to global research interests in medical sciences, ecology, and biology. The most common topics included nuclear structure, model, management, performance, health, and content management system (Fig. 2). In some articles, Africa (or a specific region within Africa) was used as a reference for comparison. Other articles focused on plants or animals, or on health conditions in Africa. However, broader multidisciplinary themes were less common, with sustainability being the key topic in only 1.9 percent and innovation in 1.6 percent of Finland–Africa articles. Among all Africa-topic articles in which a scholar in an organization in Finland was involved, the most common topics referred to evolution, nature conservation, biodiversity, management, and mortality (Fig. 3).

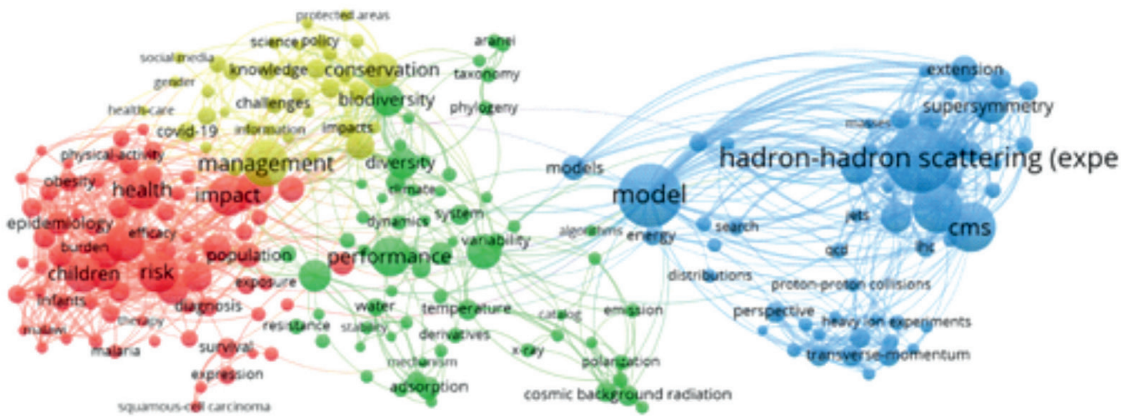


Fig. 2. Topics of international peer-reviewed scientific articles with involvement of organizations in Finland and Africa, 2015–2021 (n=4,713). Source: Own calculation from Web of Science (2022).

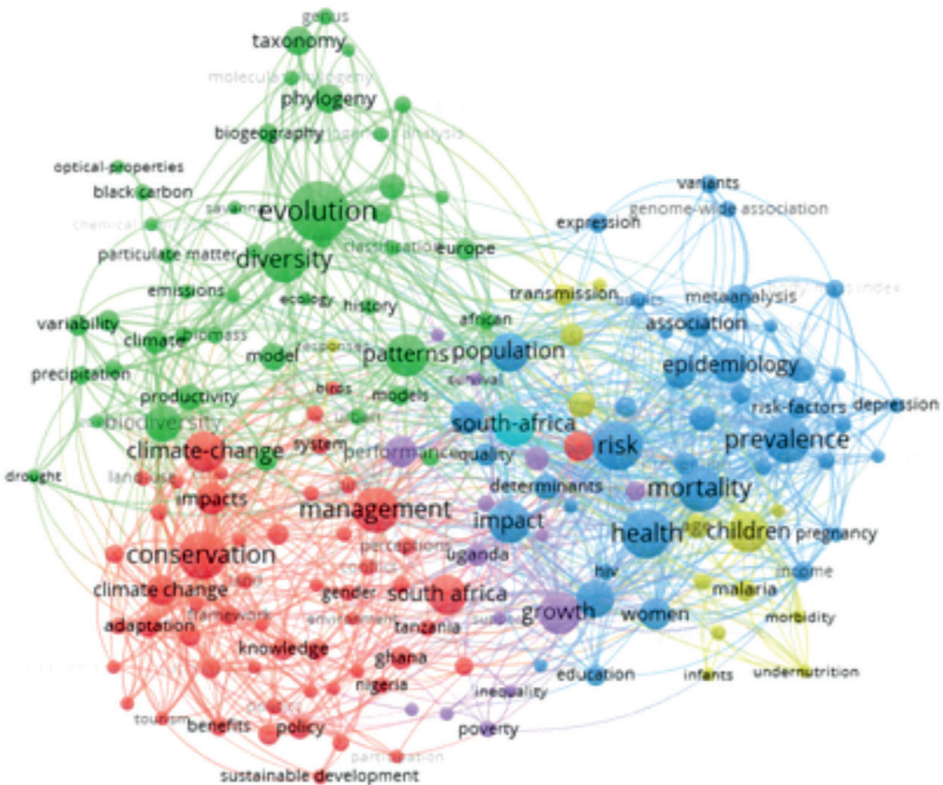


Fig. 3. Topics of international peer-reviewed Africa-topic scientific articles with involvement of organizations in Finland, 2015–2021 (n=1,455). Source: Own calculation from Web of Science (2022).

In terms of geographical focus of all Finland–Africa co-authored articles, South Africa was most frequently mentioned (8.7% of articles), followed by Kenya (1.7%) and Ghana (1.4%). Of 29 out of 54 African countries was published more than one article per year. However, French-speaking African regions were significantly less investigated in Finland–Africa articles compared to African regions where English is more commonly used. In co-authored articles exclusively between Finland and Africa, South Africa (7.9%), Tanzania (5.9%) and Ghana (3.9%) were the countries that appeared most frequently (Fig. 4).



Fig. 4. Geography of international peer-reviewed scientific articles with involvement of organizations exclusively in Finland and Africa, 2015–2021 (n=746). Source: Own calculation from Web of Science (2022).

Collaboration networks in Finland–Africa co-authored articles

The internationalization of research collaboration and funding has led to the production of peer-reviewed articles with numerous authors from various countries, particularly in the fields of science and medical sciences. External funding has played a critical role in fostering international collaboration, although its impact varies across different regions in Africa (Pouris & Ho 2014; Doh *et al.* 2021). An organization from outside Finland and Africa was involved in 84.5 percent of Finland–Africa co-authored articles from 2015 to 2021. Typically, these organizations based in the United States, United Kingdom, Sweden, or Germany. Many articles resulted from global research projects involving dozens of authors from the fields of medical science and natural science. Such knowledge is often not firmly grounded in the contexts from which the empirical material derives.

In Africa-related research collaborations funded by the Academy of Finland from 2011 to 2019, scholars in Finnish organizations collaborated with scholars in 22 African countries. The most frequent partners were from South Africa, Kenya, Tanzania, Ethiopia, and Uganda (Lindfors 2021). Among co-authored articles with organizations in Finland, South Africa was the most common African partner and fourth among all countries. Egypt ranked 15th and Kenya 61st as the next most common African partner countries.

In terms of research organizations, there were no African universities among the hundred most common collaboration partners in Finland–Africa co-authored articles. The top ten most frequently involved universities included three from Italy, two from the United States, two from France, and the rest from three other countries. However, in articles that exclusively included organizations from Finland and Africa, the top ten most common African universities featured seven from South Africa and three from Egypt – all top ranked universities within Africa.

The University of Helsinki is the main contributor to Finland–Africa research collaboration, accounting for almost half (46.0%) of all Finland–Africa co-authored articles. This collaboration is expected to increase with the implementation of its Africa program (University of Helsinki 2020). Of these co-authored articles, 86.0 percent involved third party collaborators, while 14.0 percent were exclusively with African partners. Compared to other Finnish universities, the University of Helsinki had broader networks involving most frequently collaboration partners from the United Kingdom, the United States, and South Africa. However, Finland–Africa co-authored articles represent only 1.2 percent of all international peer-reviewed articles indexed in the WoS database at the University of Helsinki between 2015 and 2021. Other universities in Finland that actively collaborated with partners in Africa were the Lappeenranta University of Technology (16.9%) and the University of Turku (12.2%) (Table 2).

Table 2. Most frequently appearing organizations in co-authored Finland–Africa peer reviewed international articles. Source: Web of Science (2022).

Finland			Africa			Global		
Name	Number of articles	ARWU rank	Name	Number of articles	ARWU rank	Name	Number of articles	ARWU rank
U of Helsinki	2,166	82	Egyptian knowledge bank	1,428	–	U of California System	1,429	–
Lappeenranta U Tech	796	> 1000	Egyptian network of HEP	704	–	CNRS	1,354	–
U of Turku	578	301–400	U of Cape Town	613	201–300	Helmholz Association	1,291	–
U of Oulu	505	401–500	U of Witwatersrand	462	301–400	Russian Academy of Sciences	1,229	–
U of Jyväskylä	445	701–800	Cairo U	419	401–500	U paris-Saclay	1,183	13
Tampere U	422	501–600	North West U	284	601–700	U of Padua	1,140	151–200
Aalto U	366	301–400	U of KwaZuluNatal	260	601–700	United States DoE	1,123	–
U of Eastern Finland	287	601–700	Stellenbosch U	234	401–500	Sapienza U	1,116	151–200
Finn Meteor Inst	108	–	U of Johannesburg	204	601–700	INFN	1,115	–
Nat Inst Health Welf	106	–	U of Pretoria	186	401–500	U of Bologna	1,090	201–300

Scientific impact of Africa-related articles

Assessing the scientific impact of Finland–Africa co-authored articles is a complex task that involves evaluating various factors such as article accessibility, publication venue prestige, and citation count. The number of articles in different research fields vary as well as the prestige of journals making it difficult to make meaningful comparisons.

Unfortunately, not all scientific results originating from Finland–Africa research collaboration are freely accessible to scholars in Africa and around the world. Only 36.1 percent of all Finland–Africa co-authored articles were fully accessible everywhere through the internet (Gold Access), but 80.6 percent followed some open access practices. For co-authored articles exclusively involving organizations from Finland and Africa, these shares were 28.0 percent and 60.5 percent, respectively, and for Africa-topic articles, 32.5 percent and 62.1 percent, respectively. Recently, the national

authorities in Finland reached an agreement with several international publishing houses to make articles from Finnish organizations open access.

Publishing articles in high-impact factor journal is considered a significant achievement for authors and organizations. Finland–Africa co-authored articles were published in 1,624 different serial publications. On average at least one article per year per publication venue appeared in 82 serial publications. International research networks involving multiple parties tended to publish more frequently in prestigious journals with higher impact factors (Table 3). These authors and organizations typically had more publications and higher citation rates. However, some of these journals collect article processing charges (APCs), which may be challenging for many African organizations to afford.

Table 3. Most common international journals of co-authored Finland–Africa articles. Source: Own calculation from Web of Science (2022).

Also third country organization(s)				Only Finland–Africa organization(s)			
Name	Number	Share	IF	Name	Number	Share	IF
Journal of High Energy Physics	299	6.4%	5.810	Plos One	18	2.4%	3.204
Physical Letters B	231	4.9%	4.771	Minerals Engineering	8	1.1%	4.765
European Physical Journal C	152	3.2%	4.843	Scientific Reports	8	1.1%	4.379
Astronomy Astrophysics	134	2.9%	5.802	Applied Sciences Basel	7	0.9%	2.679
Physical Review Letters	99	2.1%	9.227	Forests	7	0.9%	2.633
Physical Review	96	2.0%	5.296	IEEE Access	7	0.9%	4.098

Citations are a commonly used measure of the academic impact of articles. Articles in medical sciences and natural sciences usually receive more citations and more quickly than social sciences or humanities articles. Many of the studied articles were recent and had not yet accumulated citations. Out of the ten most cited Finland–Africa co-authored articles, eight were from medical sciences, and two were from astrophysics. The most frequently cited article was from astrophysics, with over 5,200 citations. The hundredth most cited Finland–Africa co-authored article received 388 citations, and the median citation count was nine. For co-authored articles exclusively written by scholars in organizations in Finland and Africa, the most cited had 151 citations, the hundredth had 18, and the median citation count was six.

Measuring academic relevance and impact can be done through various methods, including the share of highly cited articles that belong to the top one percent in each field per year. In the case of Finland–Africa co-authored articles in 2015–2021, a significantly higher share (6.9%) was highly cited compared to Finnish articles overall (1.8%) and to articles co-authored exclusively by scholars in organizations from Finland and Africa (1.4%). Mirzenami and Beaudry (2022) have shown that international collaboration positively impacts African scholars' research impacts, including citation and journal scores, and increases the likelihood of publishing a top-cited article. African scholars in international collaboration tend to perform better and have a longer-lasting impact than their non-collaborating counterparts. However, it is noteworthy that none of the twenty most prolific scholars in Finland–Africa articles had an African background or were from Africa or Finland.

Conclusions

The partnership with Africa is currently a priority on the agenda of the European Commission and Finland, with significant funding opportunities available for increased participation in EU–Africa research collaborations. Much focus is on useful knowledge that enhances EU's economic competitiveness and securitization (European Commission 2020; Ministry for Foreign... 2021).

Scientific articles represent a clear and legitimate scientific output of research collaboration between scholars in universities and research institutes in Finland and African countries. Finland with

4,713 articles is positioned in the middle range among EU member states with respect to the number of international peer-reviewed articles co-authored with scholars in an organization from one EU member state and at least one in Africa. While Finland–Africa articles more than doubled annually from 2015 to 2021, their relative share of all collaborative scientific articles in Africa decreased. Furthermore, co-authorship with organizations in Africa is growing at a faster pace among non-EU member states, with Brexit fostering such collaboration with the United Kingdom, and China is otherwise increasing its impact. These trends indicate that the global geography of science is expanding along different trajectories (see Olechnicka *et al.* 2019).

The scientific articles resulting from Finland–Africa research collaboration mostly concentrated in the fields of medical sciences and natural science, and those exclusively between Finland and Africa in environmental sciences and education as well as multidisciplinary. Africa was often used only as an empirical source or for international comparisons in globally relevant scientific themes, which primarily benefited the competitiveness of the Global North and Eastern research networks and their scholars. This resembles the practices of modern scientific research and colonialism in Africa and the academic hierarchies between the center and periphery (see Seth 2009; Ndlovu-Gatshen 2020; Jauhiainen 2023).

In the future, research collaborations related to Africa are likely to continue between key universities in the EU, United States, the United Kingdom, South Africa, and increasingly, Egypt, Nigeria, and Ghana. This should strive for collaborations *with* Africa, for more equal and symmetric long-term partnerships that involve a wider range of partners beyond the usual ones. Africans need to publish more in international peer-reviewed journals, and international research collaboration supports this. However, the research process should be redesigned to be more inclusive, from idea generation to openly accessible research outputs, and providing opportunities for science renewal being open to epistemologies and methodologies of African origin. This would enable mutual and respectful learning, and the resulting outputs could benefit academic partners, society, and communities in Africa and beyond for generations to come.

Future research on EU–Africa research collaboration could explore qualitative aspects of research partnership *with* Africa in practice, including how Africans in Africa and in the diaspora engage with these partnerships, and how research design, implementation, and outputs can be carried out together, including in co-authored international peer-reviewed articles. It is important to critically examine what ‘Africa’ means in these collaborations, and whether collaboration is truly mutual and respectful for all parties involved. Additionally, there is a need to scrutinize the Africa orientation of Horizon Europe—is it with Africa, about Africa, or without Africa?

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