

The fate of Sudanese refugee scientists in times of war: impact, experiences, challenges and prospects

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An editorial on this article can be found here:

Sobh et al. ASFI Research Journal. 2024;1(1): e14296.
<https://doi.org/10.70040/asfirj-k1ps-t6gv>

ABSTRACT

The ongoing war in Sudan, which erupted in April 2023, has had devastating effects on the country's scientific community, leading to widespread destruction of academic and research institutions, mass displacement of scientists, and severe disruptions in research activities. Significant damages have been inflicted on approximately 100 universities with a complete halt in academic and research activities. This paper explored the fate of Sudanese scientists who were displaced by the war and are taking refuge in other countries, focusing on the impact, experiences, challenges and prospects amidst the conflict.

Through interviews with several displaced Sudanese scientists, the study reveals both the hardships endured and the resilience exhibited by these individuals. With displacement, multiple Sudanese scientists have lost the economic stability, resources for conducting research along with access to the common social network and community structure that facilitated their work in Sudan. Notably, mental health issues, loss of stability and resources, adaptability to new contexts and funding disruption represents some of the major difficulties for Sudanese scientists. In contrast, the conflict has unexpectedly provided opportunities of growth for some Sudanese scientists. Forced displacement has increased exposure to new cultural and social contexts that have helped foster research perspectives and innovation for some scientists. Despite hardships, this adversity has strengthened resilience and opened new possibilities for advancing scientific research.

As the conflict continues, the pressure on the academic sector intensifies, further jeopardizing Sudan's research capabilities. Addressing these issues is crucial for mitigating long-term damage to Sudan's academic and scientific infrastructure.

KEYWORDS:

Academic facilities, Conflict, Researchers, Sudanese Refugee Scientists, Sudanese Researchers, Scientific Research, Sudan, Universities.

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INTRODUCTION

Amidst the fires of conflict that continuously erupt in various regions around the world, the extent of damage and consequences remain strikingly similar. Notably, wars and armed conflicts continue to impose profound impacts on both local and global sustainable development of a country.¹ War devastates a country by causing loss of life and injury, economic challenges, infrastructure damage, and deterioration of services including healthcare and education.² The effects of war also extend beyond national borders, triggering global crises, such as refugee displacement and geopolitical instability.²

Sudan, located in North-Eastern Africa, has become a notorious battlefield for the escalating clashes between the Sudanese Armed Forces (SAF) and paramilitary Rapid Support Forces (RSF) since the 15th of April 2023. Initially, the conflict erupted in the country's capital city- Khartoum but quickly spread to other Sudanese states, including Gezira, Kordofan, and Darfur, among others.³ With each Sudanese state that was affected by the war came a rapid escalation of war-related devastation. Notably, significant mass displacements, war-related atrocities, including sexual violence, widespread theft, direct damage to infrastructure, and the impending collapse of the healthcare system, all provide an overview of the intricacies of the war in Sudan.^{4, 5} The impact of war on Sudan's scientific community remains an under-explored area, with challenges similar to those faced by scientific communities in other conflict-affected regions, such as Syria, Yemen, Gaza, and Ukraine.^{6,7,8} In these countries, mass displacement, the breakdown of academic institutions, and the disruption of research activities have become recurring themes in global, political and developmental discourse. Sudan is now witnessing similar disruptions as the ongoing war continues to devastate the nation's research infrastructure and intellectual resources.

In this paper, we sought to explore the question: "How has the war impacted the scientific community and researchers in Sudan since April 2023?" by providing holistic viewpoints from the perspectives of Sudanese scientists who have been affected by the war. Particularly, the paper aimed to highlight the

experiences and challenges faced by Sudanese scientists who were forcibly displaced to other countries following the eruption of the war in April 2023.

METHODS

This perspective paper synthesized data from multiple sources to explore the impact of war on Sudanese scientists following the conflict. The methods involved both secondary and primary sources. The secondary sources were obtained from existing literature related to the topic. For primary sources, qualitative data were collected to ensure a comprehensive understanding of the impact, challenges, experiences and opportunities faced by displaced scientists.

Data sources and collection

The data for this study was collected from various sources, including academic literature, reports from international organizations, and interviews with displaced Sudanese scientists. The experiences and challenges of eight Sudanese scientists who were forcibly displaced after the outbreak of war in April 2023 were captured through remotely conducted interviews. These scientists were selected based on their active participation in research at a Sudanese university or research institution prior to the conflict and their subsequent displacement outside Sudan.

Rationale for methodology

The use of interviews was chosen because qualitative methods are particularly suited for exploring personal experiences in depth.⁹ Interviews allow for detailed accounts of the challenges faced by displaced scientists, including the psychological, professional, and logistical impacts of the war on their work. Remote interviews were conducted due to the logistical constraints imposed by the ongoing conflict, which limited the ability for in-person data collection. In addition, thematic analysis was employed to identify common patterns and themes across the interviews.

Data Synthesis and Analysis

The data collected from the interviews were combined with the secondary data obtained from literature, such as academic literature and reports from international organizations, to provide a broader context for the findings.

Ethical approval and consent:

Informed consent was obtained from all interview participants prior to their participation and each participant was informed about the study's objectives. Participants were assured that their responses would be anonymized and kept confidential to protect their identities. All data collected during the interviews were stored securely and used exclusively for this research.

Literature Review and Findings

The relationship between conflict and scientific progress has long been documented, with wars significantly disrupting academic and research activities across the globe. In many conflict-affected countries, scientific communities have faced multiple challenges ranging from damaged infrastructure to the displacement of intellectual resources. This literature review explores the impact of war on scientific communities in countries such as Syria, Ukraine, Gaza and Yemen, and draws on similarities to the current situation in Sudan.

In Syria, years of ongoing conflict have devastated the educational and research infrastructure. Universities were militarized, research facilities destroyed, and scientists displaced. A study reported that scientific output in Syria dropped dramatically as the war continued, leaving the country with a diminished scientific community⁶. The destruction of research centers and the migration of scientists has led to a near-collapse of Syria's once-thriving scientific environment.

Similarly, in Ukraine, the 2022 war caused significant disruption to research institutions, particularly in eastern regions where much of the conflict occurred. Ukrainian scientists faced forced displacement and a severe reduction in research output. According to Ganguli and Waldinger, almost half of the displaced Ukrainian scientists reported a complete cessation of scientific activities, primarily due to loss of infrastructure and resources.⁷

The conflict in Gaza has led to a similar fate for its scientific community. Prolonged warfare and unrest have resulted in the destruction of universities and research institutes. As a result, the country has witnessed a sharp decline in scientific productivity, and

devastating implications were imposed on the educational infrastructure and landscape.⁸

Sudan now faces similar challenges. The ongoing conflict has caused widespread damage to universities and research centers, halting research activities across the country. More than 100 universities have been affected, including some of Sudan's most prestigious institutions.¹⁰ The destruction is not limited to physical infrastructure; many Sudanese scientists have been displaced, leading to significant brain drain. As documented in other countries, the loss of scientists due to forced migration could result in long-term damage to Sudan's scientific landscape.

Impact of war on Academic and Research Institutions, Human Capital and Brain Drain

The impact of the war in Sudan can be examined from multiple viewpoints. Firstly, the war has adversely affected the infrastructure of academic and research institutions essential for sustained research output. According to the Sudan's Ministry of Higher Education and Scientific Research, the ongoing conflict between the two army factions has caused significant damage to over 100 universities, through looting or complete destruction. This has brought teaching and research activities to a halt in many higher education institutions in the country.¹⁰

Despite the lack of access to verifiable data in this context, it is evident that the educational landscape in Sudan has come to a standstill in many academic institutions¹¹. The war has also drastically limited funding allocated to higher education, further straining the ability of public universities and colleges to continue their operations and pursue academic and research endeavours.¹¹

Historically, several institutions, including the University of Khartoum, Omdurman Islamic University, University of Gezira, and Al Neelain University, have contributed significantly to scientific research, technological advancement, and sustainable development. However, the ongoing conflict has severely disrupted these universities, halting their research and educational activities, and diminishing their ability to contribute to national and regional progress.¹² In addition to academic institutions,

research centres in Sudan were not spared, with the Mycetoma Research Center, being the only WHO-collaborating research centre in the region, being subjected to damage and a complete halt in its activities.¹³

One of the main highlights of the war in Sudan is the mass displacement, with almost 11.1 million people being internally displaced making it one of the worst humanitarian crises in the current dispensation.¹⁴ The International Organization for Migration Displacement Tracking Matrix (IOM DTM) reports that about 2.1 million people fled Sudan and crossed borders since 15 April 2023.¹⁵ Neighbouring countries, including the Central African Republic (CAR), Chad, Egypt, Ethiopia and South Sudan received the highest number of Sudanese refugees. Among the displaced are notable scientists and researchers, representing a significant loss for the country's intellectual and academic community.

A notable scientist who fled to Rwanda after April 2023 eloquently commented on the current situation of the Sudanese scientific community, stating that: “Sudan is currently suffering from the phenomena of brain drain. If it continues, it will mean the loss of a generation of trained scientists and researchers and, ultimately, the loss of our intellectual capital forever”. The phenomenon of brain drain was well known in Sudan even before the eruption of war. Prior to the war, the economic constraints along with political instability contributed to a substantial brain drain of Sudanese scientists. As of 2016, it was reported that 2158 university staff have fled the country. Notably, between 2002 and 2014, Sudan lost more than 3000 junior and senior researchers due to migration.¹⁶ It is well documented that the loss of scientists to migration and forced displacement greatly impedes the country's development along with the disruption to training and mentorship for young researchers.⁷ The brain drain of scientists is evidently increasing after April 2023 as a result of the war.

Experiences of Sudanese Scientists Displaced as a Result of the War

The experiences of displaced Sudanese scientists during the ongoing conflict reveal the immense personal and professional challenges they face, as well as the unexpected opportunities that have emerged.

Through interviews with several Sudanese scientists, this section captures the lived realities of those who have been forced to leave the country and have adapted to entirely new circumstances.

Loss of Research Infrastructure

One of the most significant experiences shared by Sudanese scientists is the loss of access to vital research infrastructure. Many reported that the universities and research centers where they once worked were either looted or destroyed during the conflict. For example, a mechanical engineering researcher who was working at Sudan University of Science and Technology explained, “The research center where I conducted my work was heavily impacted by explosions, imposing a major hindrance to research progress.” Similarly, a veterinary medicine researcher now based in Egypt noted, “Looting of the university and research laboratories where we worked was a major setback, resulting in an inability to continue research that was started prior to the outbreak of war.”

Forced Displacement and Adaptation

Displacement has led to profound personal and professional changes for Sudanese scientists. Being uprooted from their homes and research environments has introduced numerous difficulties, including cultural adaptation and the loss of professional networks. One researcher displaced to Rwanda reflected, “The transition to a new country was incredibly challenging. Apart from the logistical barriers, such as securing accommodation, there were significant cultural barriers that took time to overcome.”

Despite these hardships, some scientists were able to adapt to their new environments by building new networks and seeking out opportunities for collaboration. A pharmacist who fled to Qatar shared how she found solace in continuing her research: “Despite the psychological instability of displacement, I dedicated myself to healthcare research initiatives that allowed me to regain a sense of purpose and contribute to scientific knowledge.”

Career Disruption and Financial Struggles

The conflict also caused severe disruptions to the careers and financial stability of Sudanese researchers,

many of whom face overwhelming obstacles in continuing their scientific work.

A researcher from Sudan University of Science and Technology described the compounded challenges brought by displacement: “Although financial difficulties due to the conflict have severely limited our resources, the displacement from Sudan created additional challenges and obstacles, including the loss of research resources, team members, and opportunities in the new location.” For many, displacement has meant not only the loss of their research environment but also the disintegration of academic teams, making it nearly impossible to continue ongoing projects.

Another researcher displaced outside Sudan emphasized the difficulty of maintaining an academic career in a foreign country. “Continuing my job in academia became nearly impossible. The salary was insufficient to cover living expenses, housing, and medical care, forcing me to seek alternative employment,” she explained. Despite these financial constraints, she continues to pursue scientific research and writing, though she highlighted the extreme difficulty in securing funding under such circumstances.

These challenges are not unique to established scientists. A young researcher affiliated with the Mycetoma Research Center expressed her initial excitement after securing a grant to start her PhD project focused on Mycetoma and Neglected Diseases in Sudan. However, the war and widespread destruction forced her grant to be put on hold. “I was so excited to start my PhD, but the war and the widespread destruction put my grant on hold, temporarily obliterating my aspirations for pursuing a PhD,” she said, highlighting the uncertainty faced by young researchers as well.

Emotional and Psychological Impact

Many scientists have also reported feeling the psychological weight of displacement, compounded by the trauma of war. The emotional toll has been significant, with scientists struggling to maintain their focus on research amidst personal loss. One research coordinator at a Sudanese university remarked, “I have

had to relive the tragedies of war through my students, many of whom have lost family members or been displaced themselves. Supervising them during such devastating times has been the most difficult part of my journey.”

Opportunities for Growth and Resilience

Interestingly, some scientists viewed the displacement as an opportunity for growth. Exposure to new cultural contexts and research environments provided them with fresh perspectives on their work. A community medicine researcher who relocated to Rwanda noted, “The entire experience has given me new insights. Access to different populations and environments has greatly improved the quality of my research, pushing me to adopt more comprehensive methods.” For many, these experiences have fostered resilience and innovation, allowing them to push beyond conventional research boundaries and grow professionally despite the circumstances.

Challenges faced by Sudanese Scientists due to the War

In addition to the direct impact of the war in Sudan on the research infrastructure and human capital, multiple other challenges facing individual scientists also significantly impede the intellectual and research output resulting in strained development. Although no accurate figures exist to date, a large number of Sudanese scientists were forcibly displaced to other countries following the war. Forced displacement is defined as the phenomena where individuals and communities have been forced or obliged to flee or to leave their homes or places of habitual residence as a result of or in order to avoid the effects of events or situations such as armed conflict, generalized violence, human rights abuses, natural or man-made disasters, and/or development projects.¹⁷ The impact of war on scientists is undeniable, as demonstrated by a study conducted in Ukraine to assess the ability of Ukrainian researchers to engage and contribute to research during times of war.¹⁸ The study revealed that scientific efficiency and output were significantly influenced by the researchers' location. Among scientists displaced abroad, 55.6% reported a decrease in scientific activity, while 27.7% indicated a complete absence of scientific activity.

Essentially, the primary difficulty of forced displacement to a new country, coupled with the uncertainty of the situation, brings a significant toll. With displacement, multiple Sudanese scientists have lost the economic stability, resources for conducting research along with access to the common social network and community structure that facilitated their work in Sudan. Notably, mental health, loss of stability and resources, adaptability to new contexts and funding disruption represent some of the major difficulties for Sudanese scientists. Similar patterns and challenges have been identified in other regions, where factors such as lack of funding, changes in scientific connections, destruction of laboratory sites and equipment, and psychological distress serve as primary barriers to scientific progress.^{18, 19}

Prospects of Sudanese Scientists Displaced by the War

While the war in Sudan has undoubtedly brought significant challenges to the country's scientific community, it has also opened unexpected opportunities for some displaced scientists. Forced to adapt to new environments, some researchers have found ways to grow beyond conventional boundaries, developing resilience and expanding their research capabilities.

Displacement has exposed Sudanese scientists to new cultural and social contexts, fostering their professional growth. This enhanced exposure has provided them with opportunities to collaborate with international institutions, explore diverse research methodologies, and gain access to previously unavailable resources. As a result, their perspectives have been broadened, and in many cases, the quality of their research has improved.

For example, researchers in exile have been able to broaden their networks and build international connections, allowing them to share their findings with a global audience. By tapping into these new opportunities, they have diversified their approaches to scientific inquiry, enhancing the robustness of their work. The displacement, while challenging, has therefore offered a platform for innovation that some researchers may not have encountered otherwise.

Moreover, the experiences of working in different contexts and dealing with the adversities of war have made these scientists more adaptable and resourceful. While they continue to face numerous obstacles, including financial struggles and the loss of traditional support systems, their ability to persevere has fostered new research pathways and opportunities for growth.

Although the war has imposed profound hardships, it has also catalyzed resilience and innovation among several Sudanese scientists. By navigating the complexities of displacement and finding ways to thrive in new environments, these scientists are demonstrating that adversity can sometimes lead to unforeseen possibilities for advancing scientific research.

DISCUSSION

The ongoing conflict in Sudan has significantly disrupted the scientific community, and the future implications of war on scientific research in Sudan are profound. Beyond the immediate effects of displacement and challenges faced by Sudanese scientists, the long-term consequences of direct damage to research infrastructure, loss of resources, and lack of funding would further strain the Sudanese scientific community. Similar scenarios have been observed in other conflict-ridden countries such as Syria, Ukraine, and Gaza, where wars led to the destruction of academic institutions, displacement of scientists, and a brain drain, further hampering research activities.^{6, 7, 8} These parallels suggest that Sudan's scientific community may face similar long-term challenges, underscoring the importance of developing strategies that can support the recovery and advancement of scientific research in Sudan.

With the direct damage inflicted upon academic and research institutions in Sudan coupled with massive displacement, numerous scientists lack the adequate resources or funding to continue their research. This halt in research will mean a significant loss of literature for Sudan. The continuous brain drain of Sudanese scientists seeking safety and stability in other countries presents an additional threat to scientific research in Sudan. Among the main implications, and apart from the direct psychological trauma imposed by war, the

Sudanese scientists are at risk of isolation from global opportunities and collaborations. This isolation compounds the problem of contributing effectively to research and significantly disrupts their academic and research prospects. A 2021 report by UNESCO emphasized the substantial benefits conferred by the inclusion of displaced and refugee scientists in their new contexts. The integration of displaced scientists not only supports the continuity of their careers but also leads to significant contributions to both home and host countries, enriching local scientific expertise and fostering international collaboration. Furthermore, their inclusion strengthens the global scientific community by bringing diverse perspectives and innovative approaches to problem-solving, despite the significant challenges posed by displacement.²⁰

Efforts to rebuild the scientific infrastructure in Sudan will require substantial investment, endorsement for supportive governmental policies, and international aid. However, immediate strategies focused on supporting the Sudanese scientific community will facilitate a smoother transition towards sustainable scientific development. According to the Council for At-Risk Academics (CARA), an organization that supports academics and scholars at risk, the number of applications received by Sudanese scientists has doubled since the onset of the war.²¹ This provides an insight into the catastrophic situation facing Sudanese scientists. Policies that promote the initiation of collaborative research programs would notably facilitate the inclusion of Sudanese scientists in exile within international universities and research institutions, enabling them to stay abreast of scientific advances. Additionally, fostering global partnerships and collaborations will surely improve the access of Sudanese scientists to resources, grants, and opportunities that facilitate capacity building.

Moreover, the maintenance of ties and exchange of knowledge between the Sudanese scientific communities would substantially assist in cultivating resilience, adaptability and inclusion for multiple Sudanese scientists. An alliance of displaced scientists would surely help in mitigating some of the negative emotional and social effects imposed by the war and displacement.

CONCLUSION

The ongoing war in Sudan has cast a long shadow over the Sudanese scientific community, threatening to hinder years of progress and intellectual capital. Among the various challenges noted by forcibly displaced Sudanese scientists, financial and economic challenges, loss of research opportunities and psychological impact were among the main constraints. However, within this turmoil lies an opportunity for resilience. By fostering global collaborations and supporting displaced scientists, the crisis can be turned into a catalyst for innovation, ensuring that Sudanese scientists not only survives but thrives in the face of adversity.

While further comprehensive research is needed to determine the specific needs of displaced Sudanese scientists, this paper provides an overview of the impact of the war on scientific prospects in Sudan along with challenges faced by displaced scientists. Longitudinal and cross-sectional studies focusing on these issues will be essential for developing targeted interventions and strategies that support the long-term recovery and growth of Sudan's scientific community.

ACKNOWLEDGMENTS

We would like to express our gratitude to the editor in chief of ASFI Research Journal for inviting us to contribute to this perspective article to the journal. We are grateful to the African Science Frontiers Initiatives for the invitation given to Sudanese scientists to join all activities of the organization in 2024 free of charge, including free membership and attendance to all its capacity building courses. We would also like to extend our thanks to the scholars and scientists who shared their stories and experiences with us.

CONFLICT OF INTEREST

The authors declare that they have no competing interests related to this work.

FUNDING

No funds or other support was received.

AUTHORS' CONTRIBUTIONS

All authors conceptualized the research and wrote the main manuscript. All the authors reviewed the manuscript.

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