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RESEARCH

Revitalising Sudan's Gum Arabic Sector: Post-Conflict Challenges and Sustainable Solutions

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ABSTRACT

PURPOSE: This paper assesses the impact of the Sudanese war on the supply and value chains of gum Arabic (GA) and proposes urgent and sustainable solutions for revitalisation in the post-war period.

DESIGN/METHODOLOGY/APPROACH: A multidisciplinary approach using a suitable framework was employed for this paper, integrating diverse knowledge, primary data, and expert judgement.

FINDINGS: The conflict has led to the deforestation of GA trees, the forced displacement of producers, security unrest, and looting at GA markets, warehouses, and factories, as well as smuggling and disruption of GA trade.

RESEARCH LIMITATIONS/IMPLICATIONS: Strengthening political will and community engagement is essential to support this roadmap and develop effective GA strategies.

PRACTICAL IMPLICATIONS: In line with Sustainable Development Goals (SDGs) 1, 7, 16 and 17, this paper presents solutions to revitalise Sudan's gum Arabic sector, focusing on building consensus to support producers and other actors.

KEYWORDS: *Sudan; Gum Arabic; Supply and Value Chains; Deforestation; Post-Conflict Recovery; Sustainable Development Goals; SDGs.*

INTRODUCTION

The Joint Committee on Food Additives (JCFA), a joint initiative of the Food and Agriculture Organisation of the United Nations (FAO) and the World Health Organization (WHO), defines gum Arabic (GA) as the dried exudate from Acacia senegal (Hashab) and Acacia seyal (Talha) trees (Mahmoud *et al.*, 2017). Sudan has a strong position in the production and international trade of GA, particularly in Hashab, due to its historical dominance and established infrastructure (Mahmoud *et al.*, 2017). However, this position has been weakened by insecurity and conflict (Kusters *et al.*, 2022). The ongoing conflict between the Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF) has disrupted both national and global supply chains for GA.

The impacts of the conflict affect all levels of the industry, from extraction and production to marketing and exports. Downstream actors face ethical dilemmas and a lack of transparency, while producers often receive unfair prices, endure high transportation costs, and encounter illicit fees and exploitation. This paper aims to analyse these challenges and propose urgent, sustainable solutions for rebuilding the GA supply chain in Sudan, with a focus on post-war recovery and sustainable development.

METHODOLOGY

To fulfil the purpose of this paper, a multidisciplinary approach, combined with an appropriate conceptual framework, was developed, incorporating diverse knowledge and perspectives alongside expert judgement. The information needed for this document includes both primary and secondary data sources. The primary data were collected via virtual interviews conducted through the Google Forms application. Virtual interviews were conducted with 48 key informants, including experts and stakeholders who were directly or indirectly involved in the GA business. The questions were designed in light of the adopted conceptual framework to examine the consequences of conflict-prone and conflict-affected contexts; these include conditions characterised by insecurity and violent conflict, following the outbreak of civil war in Sudan on 15 April 2023. The inquiries aim to elucidate the most significant impacts of the conflict on GA production, local marketing, the industry, and exports. The secondary data were identified and gathered from the most relevant information and literature, as well as a recent report in Sudan.

CONCEPTUAL FRAMEWORK

To select the appropriate conceptual framework for this paper, conflict-prone and conflict-affected contexts were utilised and adapted (FAO, 2023, Kusters *et al.*, 2023). Conflict is defined as the incompatibility of interests, values, and goals, with ideological conflicts often becoming malicious (Berger and Luckman, 1966). These contexts refer to regions experiencing or at risk of violence. Fragility combines risk exposure with inadequate coping capacity (OECD, 2020).

Interactions between value chains and conflict-prone or conflict-affected contexts can be categorised as follows (FAO, 2024; Neven, 2014):

1. the impact of the context on the value chain;
2. the impact of the value chain on the context;
3. conflicts within the value chain.

Fragility exposes value chains to various risks that can hinder their ability to deliver food and value sustainably. These risks arise from shocks or stressors in six spheres (see Figure 1): political, social, human, security, economic, and environmental (Bujones *et al.*, 2013; FAO, 2024; OECD, 2022).

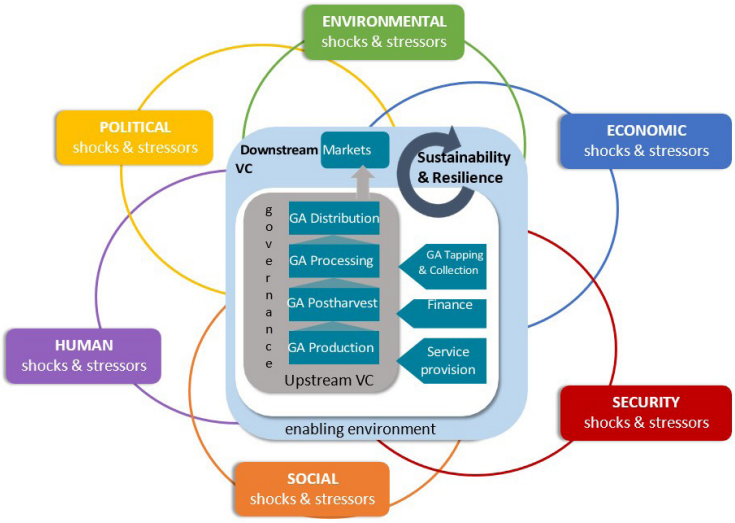

Figure 1: The Six Spheres of Risks Affecting Value Chains in Conflict-Prone/Affected Contexts
Source: Modified from FAO, 2023

FINDINGS AND DISCUSSION

Overview of Survey Respondents' Affiliation

Figure 2 shows that participants in online interviews about the war's impact on Sudan's GA sector included 23% academicians and researchers, 18% representatives from trading, processing, and exporting companies, 11% GA producers, and 8% staff from the Forests National Corporation (FNC).

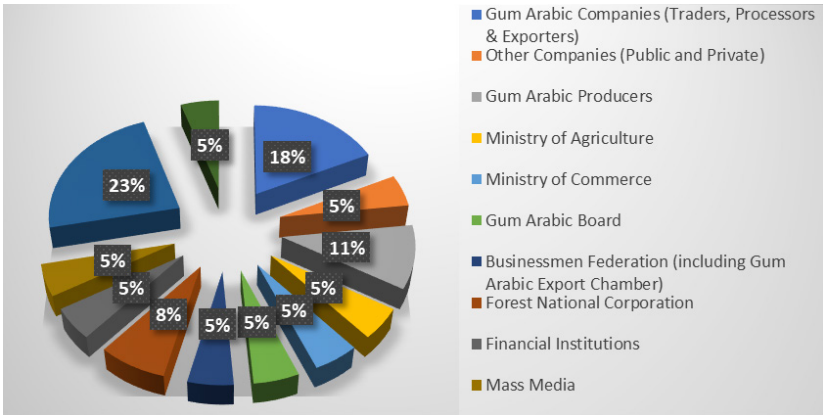

Figure 2: Overview of the Affiliations of Respondents to the Online Survey
Source: Constructed by authors

The diverse affiliations of respondents enhance the survey's strength, offering a multidimensional view of the war's effects. The significant presence of academicians ensures analytical insights, while direct stakeholders, such as trading companies and producers, provide practical experiences. FNC staff contribute a governmental perspective, leading to a comprehensive understanding of the sector's challenges. However, the online format may exclude voices from areas with limited Internet access, potentially under-representing vulnerable producers and local communities affected by conflict.

Effects of Conflict on Gum Arabic Production

Almost all respondents (95%) noted that the conflict that began on 15 April 2023 has significantly harmed GA production in many regions of Sudan's GA belt (see Figure 3).

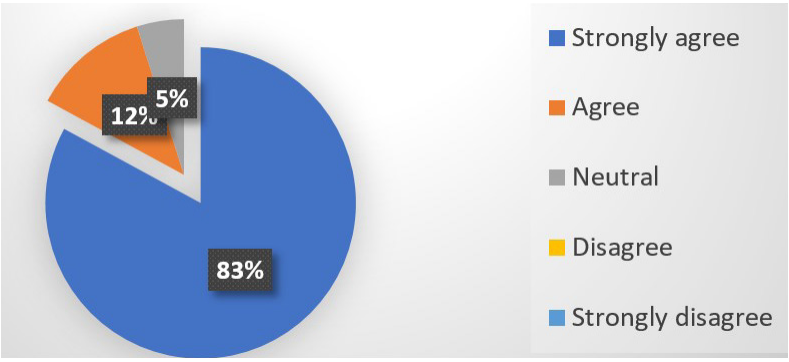

Figure 3: Effects of Conflict on GA Production, as Stated by the Respondents

Source: Constructed by authors

Nearly half the respondents (41%) estimated the annual decline in GA production due to the conflict to be 51% to 75%, while a third (33%) reported it to be 26% to 50% (see Figure 4).

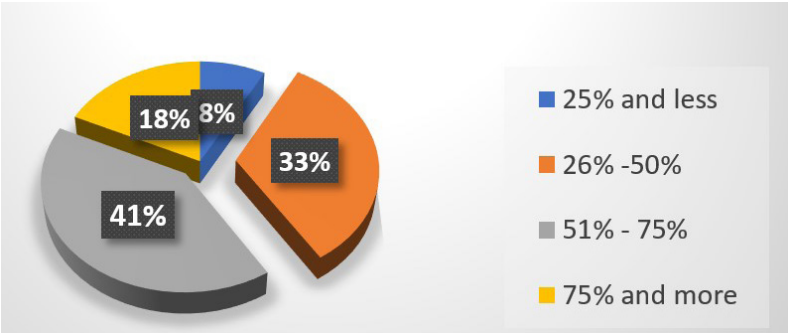

Figure 4: Percentages of Losses in GA Production due to the Conflict, Based on the Respondents' Views

Source: Constructed by authors

The most significant repercussions of the conflict on GA production are illustrated in Figure 5. These consequences include:

- security unrest at GA producers' sites (21%);
- forced displacement of producers (18%);
- poor services and infrastructure (17%);
- indiscriminate felling of GA trees (10%);
- high taxes, fees, and transportation costs (10%);
- armed robbery on roads (7%);
- market disruptions (6%);
- limited access to funding (6%);
- other factors (5%).

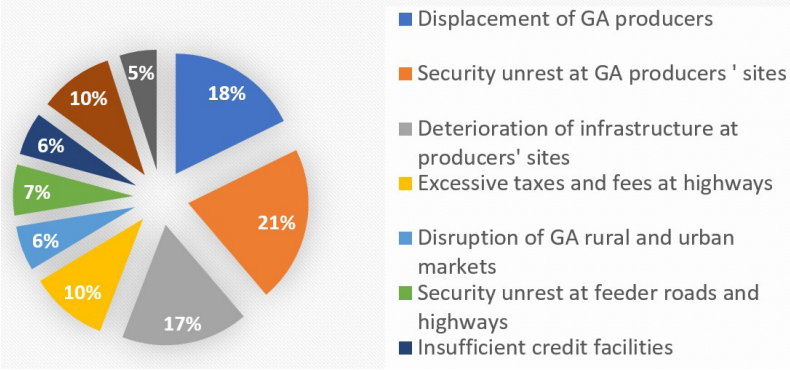

Figure 5: The Causes and Repercussions of Losses in GA Production, Based on the Percentages

Source: Constructed by authors

The assessment revealed that the conflict had a significant impact on GA production in Sudan, particularly in Darfur and Kordofan, where 77.7% of respondents reported the most significant impact (see Figure 6). These regions supply over 60% of the country's GA production (Mahmoud *et al.*, 2017; Kusters *et al.*, 2023).

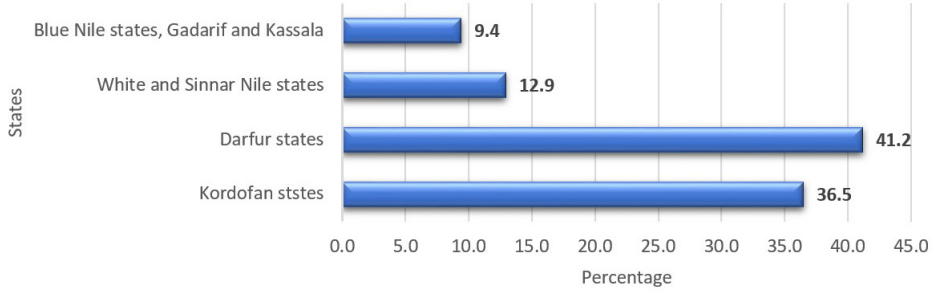

Figure 6: The Most Vulnerable States Regarding the GA Production Losses due to the Conflict

Source: Constructed by authors

The widespread consensus on the conflict's impact on GA production highlights a severe crisis. Reports indicate nearly half estimate a 51-75% decline in production, while a third cite a 26-50% drop, threatening a vital source of income for millions in Sudan. The consequences of the violence, including "security unrest" and "forced displacement", disrupt livelihoods and gum collection. Additionally, deteriorating services and infrastructure complicate production efforts, while the indiscriminate felling of GA trees for energy leads to long-term environmental degradation. Exorbitant taxes, rising transportation costs, armed robberies, and market disruptions further undermine economic viability. Darfur and Kordofan, that account for over 60% of Sudan's GA production (Kusters *et al.*, 2023), are the most severely affected, underscoring the need for targeted recovery efforts focused on security and livelihood restoration in these regions.

Effects of War (Conflict) on the Production of Field Crops and Livestock

The conflict has significantly impacted field crop and livestock production in the GA belt of Sudan, with all respondents (100%) reporting a decline in both quantity and quality (see Figure 7). The most affected crops include millet, sorghum, sesame, groundnuts, and watermelon seeds. Livestock, such as sheep, goats, cattle, and camels, has also experienced a considerable decline.

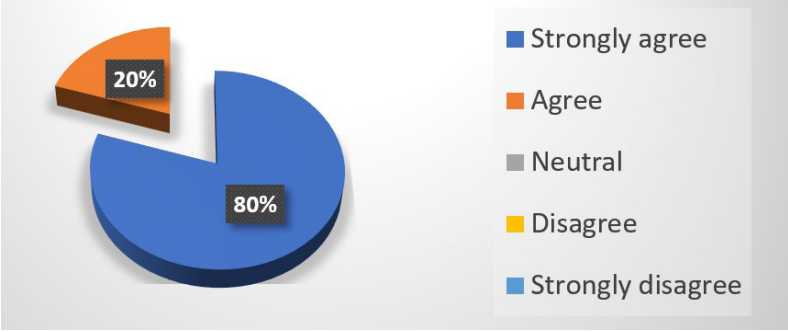

Figure 7: Effects of Conflict on Crop and Livestock Production due to the Conflict, as Stated by the Respondents

Source: Constructed by authors

A unanimous consensus among all respondents indicates a significant decline in both the quantity and quality of field crops and livestock production in the GA belt. This situation signifies a systemic crisis in a region essential for various agricultural activities, including GA tapping and collection, field crop cultivation, and livestock rearing. The ongoing conflict impacts these interconnected sectors, threatening food security and exacerbating humanitarian needs. The decline in food crops and livestock undermines community livelihoods and income, underscoring the need for integrated interventions in the GA sector as part of a broader rural development and humanitarian response.

Effect of the Conflict on the Gum Arabic Local Marketing

Approximately 85% of respondents stated that the conflict has affected all GA marketing operations, resulting in fewer dealers, contracts, and transactions, as well as a decline in GA supply (see Figure 8). Challenges remain in cleaning, sorting, grading, storage, and transportation services.

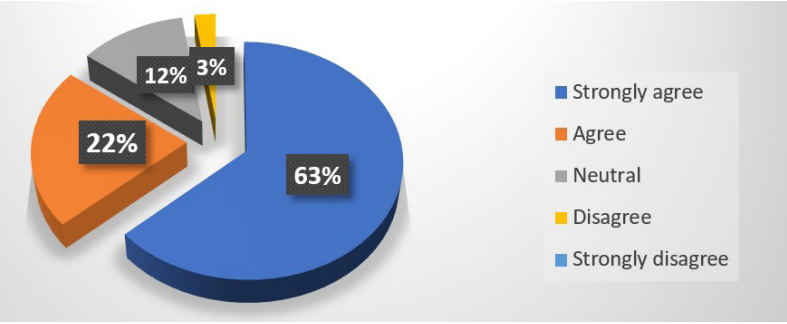

Figure 8: Effect of the Conflict on Local GA Marketing, as Reported by Respondents

Source: Constructed by authors

Over half of respondents (54%) estimated a 51% to 75% reduction in GA at central markets due to the conflict, while 34% estimated a reduction of 26% to 50% (see Figure 9).

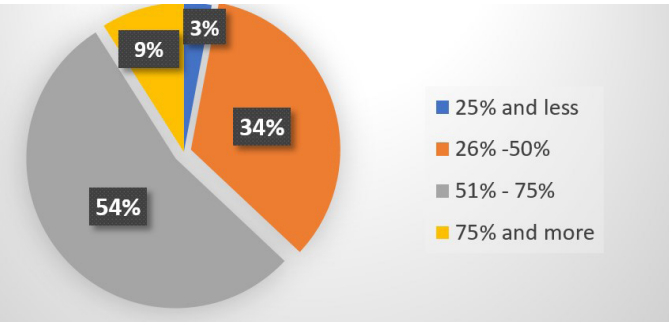

Figure 9: Percentage of Losses in GA Local Marketing due to Conflict, Based on Respondents' Views

Source: Constructed by authors

The decline in local GA marketing highlights severe disruptions in the domestic value chain, with reduced quantities reaching central markets, indicating breakdowns in trade networks. Essential post-harvest services, such as cleaning and transportation, have worsened, compromising quality and logistics. This decline threatens Sudan's reputation as a reliable and high-quality supplier, shifting trade towards informal, unregulated channels.

The Impact of Conflict on Gum Arabic Processing and Industry

Nearly all respondents (97%) noted the significant impact of the conflict on GA warehouses and the industry, as the area is most heavily affected by the war. These include destruction, looting, and the seizure of machinery, equipment, raw materials, and finished GA products. Approximately 70% of respondents estimated that the losses in GA processing and manufacturing range from 51% to 75% (see Figures 10 and 11).

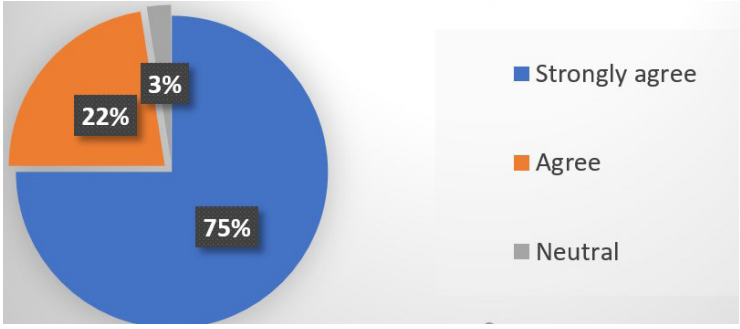

Figure 10: Effects of Conflict on GA Warehouses, Processing Units, and Factories, as Perceived by the Respondents

Source: Constructed by authors

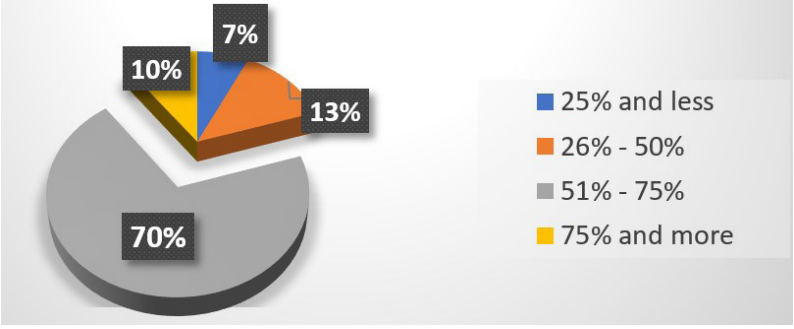

Figure 11: Percentage of Losses in GA Processing due to Conflict, Based on Respondents' Views

Source: Constructed by authors

Effect of the Conflict on Gum Arabic Exports

The conflict in Sudan has had a severe impact on GA exports, resulting in increased smuggling and a decline in official export figures. Nearly 93% of respondents reported being affected by this disruption, with 48% estimating a drop in exports of between 51% and 75% (see Figures 12 and 13). This situation highlights the significant consequences of the conflict on both local and global trade in GA, a commodity that Sudan has traditionally dominated.

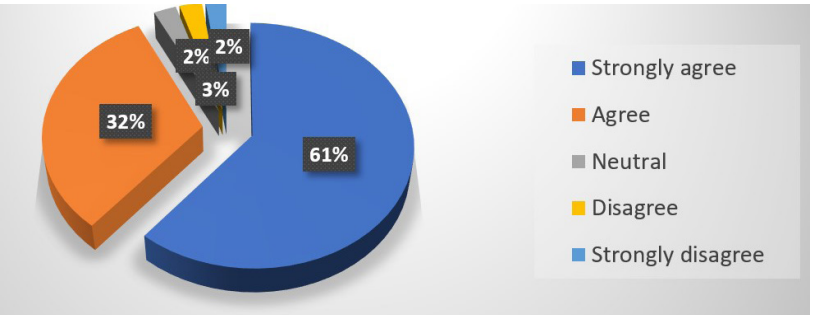

Figure 12: Losses in GA Exports due to the Conflict, Based on the Respondents' Views
Source: Constructed by authors

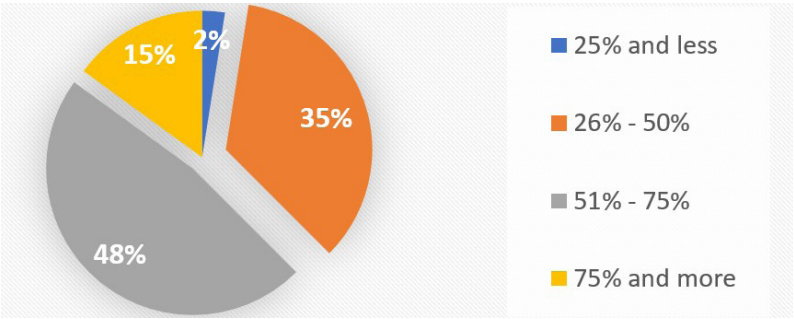

Figure 13: Percentage of Losses in GA Exports due to Conflict, Based on Respondents' Views
Source: Constructed by authors

A recent report (World Bank, 2025) reveals that Sudan's trade balance has been in severe deficit since 2023, leading to the bankruptcy of many companies exporting GA. UN investigators estimate that the conflict has resulted in a loss of at least 90,000 tonnes of Arabic gum, valued at US$200 million; this significantly affects Sudan's export basket, previously comprising around 15% of gum Arabic (MEE, 2025). The increase in smuggling, due to the breakdown of formal trade channels, deprives the Sudanese state of revenue and poses ethical and quality challenges for international buyers. This situation not only affects the current economy but also poses a threat to long-term foreign exchange and development prospects.

Other Distortions of the Conflict in the Gum Arabic Sector

Additionally, the conflict has significantly distorted the GA sector in other ways, such as the emergence of new local export outlets in Sudan that lack quality control and efficient storage for global markets. Key locations include Rabak, Dongola, Ed'aein and Kassala. Regionally, ports and cities such as N'Djamena, Douala, Kufra, Juba, and Mombasa have also emerged as hubs for re-

exporting GA, but most fail to meet quality standards. Additionally, looted and smuggled GA often enters global markets at low prices due to inadequate storage and essential processing steps. This situation, compounded by high transportation costs and low global prices, has led to many exporters closing their businesses and a delay in export transactions, resulting in a shortage of state proceeds from GA (see Figure 14).

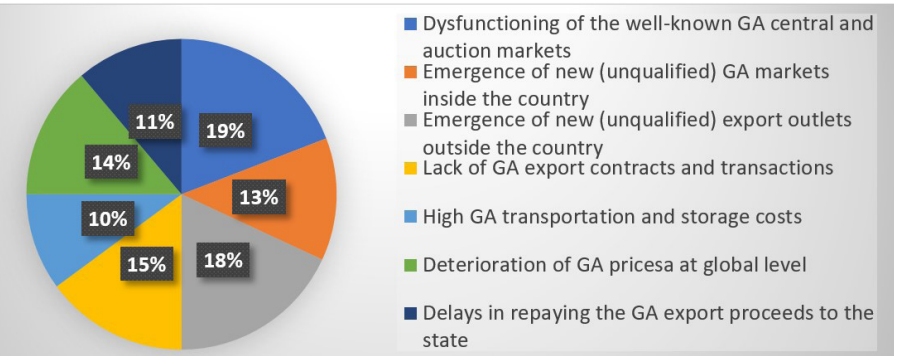

Figure 14: Other Distortions and Side Effects on the GA Sector due to the Conflict, Based on the Respondents' Views

Source: Constructed by authors

The emergence of unregulated local and regional export outlets is a significant consequence of the conflict. This situation has appeared due to the collapse of formal trade routes and the urgent need to move products. These outlets have become temporary solutions for exporting gum from Sudan. However, these outlets present serious challenges. Key deficiencies include a lack of quality control, inadequate warehousing, and the absence of essential processes such as cleaning, drying, sorting, and grading. As a result, GA from these outlets often lacks quality, harming Sudan's reputation as a premium supplier.

Additionally, a substantial amount of looted and smuggled GA enters global markets at unfair prices through these channels, fostering illicit trade and undermining legitimate businesses. High transportation costs and depressed prices for "conflict gum" are pushing legitimate exporters out of the market, which consolidates informal and illegal trade. This situation also negatively impacts state revenue, exacerbating Sudan's financial crisis and hindering post-conflict recovery. Consequently, international buyers face ethical dilemmas, risking inadvertent support for conflict or illicit networks.

Gum Arabic Trade and Importer Concerns

The Flow of "Stolen Gum"

The RSF has gained substantial control over GA production in Sudan, especially in Kordofan and Darfur, since late 2023. This has enabled them to influence trade and engage in various illicit activities (Naidu and Abdelaziz, 2025):

- A recent report (MEE, 2025) indicates that large quantities of GA were looted and seized from warehouses in areas controlled by the RSF, including a significant amount valued at US$75 million in Kordofan, involving over 400 lorries.
- As traditional trade routes are disrupted, GA is being smuggled from RSF-controlled areas into countries such as South Sudan and Chad, thereby circumventing legal certification processes.
- The RSF imposes fees on traders for "protection" and has banned exports to certain countries, such as Egypt, complicating legitimate trade and driving it into informal channels.
- This control over GA exports by the RSF has had a direct impact on the prices received by Sudanese GA producers. The RSF's dominance over production areas and trade routes has forced these producers to sell their products at lower prices or pay steep fees, limiting their ability to negotiate fair market rates.
- The smuggled quantities of GA often lack proper certifications, making it difficult for importers to verify their origin, handling, and quality. This poses significant risks to companies that depend on specific quality standards for their products, such as those in the food, pharmaceutical, and cosmetic industries. Without formal oversight, there are no guarantees regarding how the gum is collected, stored, or transported. This can lead to contamination, degradation, or adulteration, consequently affecting its purity and functionality.
- The volatile nature of the conflict and reliance on informal routes means that the availability of GA can be highly unpredictable, making it challenging for importers to maintain consistent supply chains.
- Moreover, the lack of transparency in the supply chain makes it difficult to ensure that the gum is "conflict-free". Some buyers have explicitly refused to purchase gum without proper Sedex certification due to these concerns.

THE WAY FORWARD

Rehabilitating Sudan's GA sector following the devastating war demands a comprehensive and strategic approach. Based on the identified urgent needs, the following solutions are essential for the recovery and sustainable development of the GA sector in the post-conflict phase:

Restoring Security and Infrastructure

- **Establish and Maintain Peace:** Prioritise fostering lasting peace and co-existence among GA producers in all production zones to ensure a safe working environment.
- **Secure Trade Routes:** Reopen and secure critical feeder roads and major highways to facilitate the safe movement of goods and people.
- **Reactivate Markets:** Ensure the safe reopening and sustained security of all GA markets, from rural collection points to urban and central hubs.
- **Upgrade Infrastructure:** Invest in significant improvements to basic infrastructure and essential services within the GA production areas. This includes enhancing facilities at all levels of the GA markets and upgrading storage facilities to minimise losses.
- **Improve Transportation:** Provide and modernise transportation facilities to efficiently move GA from production sites to markets and processing centres.

Empowering Gum Arabic Producers

- **Foster Lasting Peace and Co-existence:** Prioritise creating a peaceful and co-operative environment among GA producers in all production areas to ensure a safe working atmosphere.
- **Reopen and Secure Roadways:** Restore and secure vital feeder roads and major highways to enable the safe transport of goods and people.
- **Ensure Market Security:** Guarantee the safe reopening and ongoing security of all GA markets, ranging from rural collection points to urban and central hubs.
- **Invest in Infrastructure:** Make significant improvements to basic infrastructure and essential services in GA production areas. This includes enhancing facilities at all levels of GA markets and upgrading storage locations to minimise losses.
- **Modernise Transportation:** Provide and upgrade transportation facilities for the efficient movement of GA produce from production sites to markets and processing centres.
- **Implement Legal Frameworks:** Establish laws and mechanisms to address disputes related to natural resource exploitation in Sudan, specifically those concerning land tenure and land use systems.
- **Empower GA Producers:** Support, consolidate, and enhance the capacities of GA producers' associations by disseminating best practices across all states in the belt. Focus on developing their skills in pre-harvest and post-harvest practices, including storage, packaging, loading, mass transportation, product display, advertising, and promotion.

Promotion of the Gum Arabic Supply Chain alongside Other Natural Gums and Resins

- Develop a national investment map for sustainable land use in Sudan that considers environmental balance and promotes equitable economic growth across all productive sectors, including GA.
- Boost the competitiveness of GA in various markets to enhance gross domestic product (GDP), create jobs, and diversify income sources.
- Establish a research network for gums and resins, connecting it to regional networks such as the African Natural Gums and Resins Network, while collaborating with international research centres and institutions.
- Develop new protocols for the country's lesser-known natural gums and resins, including *Talha, Kakamut, Tartar,* Frankincense, and Guar gum. Integrate these gums into the global trade system and establish distinct global specifications for each type, based on a well-defined strategic plan.
- Create a national financing institution through legislation and procedures established by the Central Bank to support GA and other natural gums, as well as non-timber forest products.
- Establish a strategic buffer stock for GA to ensure a stable supply, stabilise prices, and improve the prices received by producers
- Create protocols for rehabilitation and adherence to storage, cleaning, sorting, grading, and repackaging processes for GA in all rural, urban, and central markets.

Using Remote Sensing and GIS for Gum Arabic Belt Rehabilitation

- Geographic Information Systems (GIS) and remote sensing can be utilised to assess the damage to the GA resource base resulting from the ongoing war in Sudan. This study revealed that GA trees in the western and eastern regions of the gum belt have been extensively cleared for military purposes and to meet energy needs, primarily due to power outages.
- This assessment will aid in rehabilitating the most affected areas of the GA belt. By analysing satellite imagery with advanced technologies, the conditions of GA trees can be analysed and compared using pre- and post-war imagery.
- This data will help authorities and stakeholders make informed decisions to enhance GA production practices and conserve forest resources.

Rehabilitation of the Gum Belt

- Establish a concept of a 'Social Fence' to safeguard the GA belt and natural resources by actively engaging local communities and Civil Society Organisations.
- Promoting afforestation, reforestation, and the establishment of thriving gum orchards, vibrant community forests, and diverse tree formations will invigorate all thirteen states of the GA Belt. This initiative is crucial for fostering sustainable ecosystems, enhancing biodiversity, and securing the future of our natural resources (Elfadul *et al.*, 2020).
- Expand renewable energy use in the GA belt, including biomass from charcoal cubes, improved stoves, ethanol, solar, wind, natural gas, and biogas.
- Some initiatives for restoring the GA belt in the Kordofan region with local communities using price incentives have always been successful (Elfadul *et al.*, 2020).

This comprehensive approach aims not only to address the immediate challenges but also to lay a strong foundation for a more resilient and prosperous GA sector in post-war Sudan.

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BIOGRAPHY

Professor Tarig Elsheikh Mahmoud is a full professor in Natural Resources Economics and Agribusiness at Kordofan University, Sudan and has been affiliated with Kampala International University, Uganda since 2025. He obtained his PhD in Natural Resource Economics from Dresden University of Technology, Germany (2004), his MSc (1994) and BSc (1991) from the University of Khartoum, Sudan. Over the past 28 years, he has engaged in teaching, research, innovation, training, and consulting for Kordofan University and various national and international institutions and organisations, including the FNC, HCNER, GAB, FAO, UNDP, GCF, and the World Bank. Much of his work has focused on GA development, together with other aspects related to natural and environmental resources. The Sudanese Council of Ministers appointed him as Secretary-General of the Sudanese GA Board, 2019 to 2022. He has published approximately 75 papers, articles, and scientific books.

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Dr Hassan Ibrahim Ali Mofadel has worked at the Kenana Sugar Company (KSC), Sudan since 2012. He began as R&D Manager in the Department of Strategic Planning, and is currently Business Development General Manager, where he oversees innovations and studies related to energy and food. He has a BSc in Agriculture from Zagazig University, Egypt and an MSc from the University of Khartoum, Sudan. He has a PhD in Environmental Stress Physiology from Universiti Putra Malaysia (UPM), 2005, with a focus on low agronomic manipulations. Dr Mofadel also serves as General Manager of KIAS, a subsidiary of KSC that has been delivering agricultural solutions, services, and additional inputs to farms since 2020, leading projects aimed at improving the sugarcane model adopted by KSC. One of his recent initiatives involves converting ethanol spent mash (Vinasse) into biogas for direct use in boilers, while recycling water for forestry and horticulture production. Dr Mofadel has been actively engaged in research since 2000 and has published 50 scientific papers in peer-reviewed journals.

Dr Muneer Elyas Siddig Eltahir is a Senior Researcher at the Institute of Gum Arabic Research and Desertification Studies, University of Kordofan, Sudan. He earned his MSc in Forestry from the University of Khartoum, Sudan, in 2009, and a second MSc in Tropical Forestry and Management from the Technical University of Dresden, Germany, 2011. In 2017, he received his PhD in Silviculture from the University of Khartoum. Dr Eltahir is actively involved in lecturing, research, training, and serving on various scientific committees. He specialises in Agroforestry and GA, having worked with the International Fund for Agricultural Development (IFAD) and the FAO from 2020 to 2025. Dr Eltahir has published 60 scientific papers in peer-reviewed journals, as well as a chapter in a book. In addition to his regular duties, he also teaches at other colleges and conducts training in specialised centres in El Obied.