
A Toxic Time Bomb: The Messy Handling of Cyanide and Thiourea in Sudan

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The cover photo shows a site where miners use cyanide in large quantities in Northern State, 2020.

When STPT visited the factory site again after a few months, the Qur'an was transmitted throughout the place through loudspeakers. The factory owners believed that there was a devil (*jinn*) present, as anyone who approached the cyanide dump experienced a sensation of suffocation. They interpreted this as demonic possession. They did not address the cyanide leakage, the source of the danger, so everyone called it the *jinn* company.

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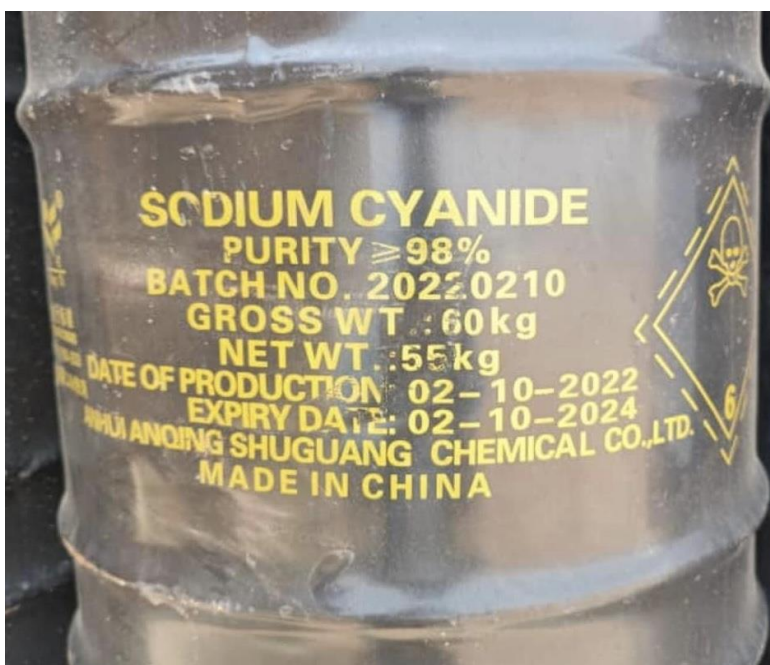
List of Acronyms

ASGM	Artisanal and Small-Scale Gold Mining
CIC	Carbon-in-column
CIL	Carbon-in-leach
GDES	General Department of Environment and Safety at SMRC
GIS	General Intelligence Services
HCENR	The Higher Council for the Environment and Natural Resources
ICMR	International Cyanide Management Regulation
MoM	The Ministry of Minerals
RSF	Rapid Support Forces
SAF	Sudan Armed Forces
SMRC	The Sudanese Mineral Resources Company
STPT	Sudan Transparency and Policy Tracker

Preface

On 15 April war broke out in Sudan. Everyone realizes its high cost, as lives have been lost and millions of citizens have been internally displaced or forced to seek refuge in neighboring countries. The violence committed by the two warring parties has destroyed the infrastructure and small industrial base of Sudan. The war has also led to the collapse of law enforcement agencies, including the police and judiciary, which foretells an imminent collapse of the state unless this devastating war is put to an end. Amid this chaos, environmental specialists and human rights activists have expressed deep concern about the growing environmental risks facing the country. Gold mining is the most prominent source of such risks. These risks existed before the war, indeed, Sudan Transparency and Policy Tracker (STPT) was planning to publish this paper on the day the war broke out, but we delayed publication to include an assessment of the effects and shifts of the war on the artisanal gold mining sector.

The war led to loss of control of highly toxic chemicals used in mining, including cyanide and thiourea, whose stockpiles are under no protection. While public attention has been drawn to ongoing battles, shipments of cyanide and thiourea trade have moved freely among the states that were not affected by the war, including in east Sudan (the Red Sea, Kassala, and Gedaref states) and the two states most



As an example of trading cyanide on social media outlets, this advertisement was seen on Facebook:

For sale. Cyanide in black barrel 55 kg # Delivery in Atbara

active in artisanal gold mining, Northern and River Nile states. The highly toxic chemicals are sold on social media¹ without any control. For example, it is easier to access cyanide, thiourea, and mercury in Atbara, a mining service center in central Sudan, than cement or basic building materials, according to the testimonies of activists. It is easier to illegally secure treatment basins for tailings, known locally as *karta*, than to rent a room if you are newly displaced. This access, coupled with the total collapse of regulatory bodies in the gold mining sector is a serious concern. Sudan faces catastrophic environmental risks with serious impacts on the lives and livelihoods of its citizens.

¹ The Taadeen (mining) Group on Facebook, read [here](#).

Introduction

Cyanide: from the Nazi genocide to disastrous misuse in Sudan

Until the outbreak of the war between the Sudan Armed Forces (SAF) and the Rapid Support Forces (RSF), the policies of their joint government allowed the company Sudamin, a governmental company affiliated with the Sudan Ministry of Minerals (MoM), to monopolize the provision of highly toxic chemicals related to gold mining. Sudamin transformed this monopoly into a commodity, selling the rights to provide chemicals to companies and individuals providing them with legal cover and the necessary authorizations. This practice contributed to the expansion of illegal activities in the pre-war period, especially those carried out by, or with the protection of, military entities. This worsened the risks of chemical use as mining activities carried out by the military and armed forces, which enjoy a large degree of security protection, expanded.

Cyanide, which was used in the extermination of millions in Nazi Germany, has harmed communities in the mining areas of Sudan. Those communities have fought a war hardly noticed by the world against state policies and greedy gold traders for the past decade. The ongoing war and lawlessness in Sudan make increased use of these deadly materials without observance of safety standards or technical knowledge possible, including in residential areas and farms on the banks of the Nile. These chemicals could be used as lethal weapons in the ongoing war. This requires the urgent and effective intervention of all concerned parties.

The inaugural paper of STPT's "Sudan's Gold Curse" series unearthed the scale and gravity of environmental damage and health threats due to the use of mercury in artisanal and small-scale gold mining areas (ASGM). That paper highlighted a range of ill-considered practices by Sudamin, including flooding mining markets with mercury imports without enforcing necessary oversight and controls. Sudamin and its sister company, the Sudanese Mineral Resources Company (SMRC), are responsible for setting and enforcing strict controls on mercury, a dangerous substance, until its use is completely prohibited.² Due to the laxity of these two government companies in carrying out their oversight, control, and preventive roles, practices which amount to criminal negligence, Sudan has plunged into a grave health crisis that could soon become a full-blown catastrophe with a tragic rise in the rates of diseases caused by exposure to mercury and cyanide including fetal malformations, miscarriage, kidney failure, respiratory and nervous system diseases, and cancer.

Building on the previous paper's investigation of damage caused by mercury, this paper will address the risks of cyanide and thiourea. These are among the deadliest substances used in gold mining and endanger the lives of those who handle them, their families, and their local environment. After a brief review of the cyanide's properties and potentially lethal effects, the paper discusses the common uses of cyanide and thiourea in extracting gold from artisanal mining tailings saturated with high levels of mercury. The paper will then review the ramifications of the leakage of cyanide, thiourea, and untreated mercury residues into drinking water sources (both surface and groundwater) and soil.

As a result of leakage, particles of these substances accumulate in the surrounding environment. They gradually enter the food chain, through plant and animal products, such as vegetables, fruits, meat, and dairy which provide food for humans and other animals. Polluted food products reach the tables of consumers and slowly poison them. This unfortunate scenario took place in Minamata village, Japan.³

² Abdelrahman, M. Salah, "How Mercury is Poisoning a Nation" Sudan's Gold Curse: Briefing Paper No. 1, Sudan Transparency and Policy Tracker, October 2022, available [here](#).

³ Very Well Health, "An Overview of Minamata disease," available [here](#).

Legal and regulatory frameworks related to the import and distribution of cyanide in Sudan are afflicted with a plethora of gaps, including conflicting jurisdictions and powers assigned to agencies in charge of monitoring compliance with internationally recognized safety protocols. As for thiourea, a factory used to produce and distribute it locally, although it is legally prohibited. The continuation of the manufacture, import, and smuggling of thiourea despite the ban attests to a collapsing state that fails to take minimum preventive measures to protect its citizens from grave but avoidable health risks.

Increased use of thiourea was accompanied by a surge in cyanide imports by private businesses, authorized by Sudamin. This dynamic has increased the use of cyanide. Sudamin issued required transfer permits for artisanal mining, further increasing cyanide use. This expansion, in the absence of control, especially in informal artisanal mining areas operating in cooperation with, and under the protection of, uniformed forces and paramilitary increases health and environmental risks.

Consequently, Sudan has become one of the countries importing and consuming the highest quantities of cyanide. There are even indications that Sudan is re-exporting cyanide to other countries in the region, with the Republic of Ghana topping the list of importers. All actors interested in the safety of the environment must therefore address this trans-national danger.

What is cyanide?

Cyanide is a lethal substance that kills expeditiously. The substance is infamy for its association with the Nazi's genocidal scheme during World War II. Hydrogen cyanide gas killed millions in Nazi Germany, most of whom were Jewish, Roma, and Russian prisoners of war in the 1940s. Moreover, cyanide is considered one of the quickest substances used in murder and suicide. In the mining sector, its use in extracting minerals from ore, especially gold, has increased steadily, despite the growing number of leakages causing environmental pollution and health hazards for humans, animals, and the other living components of the ecosystem.

Cyanide is known for its ability to efficiently extract gold and a number of other heavy metals, depending on the metal's electronegativity. The higher the electronegativity, the greater the metal's ability to bind to cyanide. Cyanide is a compound made of the union of two elements, carbon and nitrogen, in the formula (C≡N⁻). The degree of toxicity of cyanide is so high that an amount the size of a grain of rice is sufficient to kill a person, under certain conditions. The toxicity of cyanide lies in its ability to inhibit cellular use of oxygen to produce energy. Deprived of oxygen, heart muscle, and nerve cells quickly lose energy and begin to die. Once a large number of important cells die, death occurs.⁴ Exposure to small levels of cyanide over time can cause many complications, including miscarriage, liver and kidney damage, thyroid issues, and partial or complete paralysis.

The use of cyanide in mining

Cyanide is used in mining in dilutions of 100 to 500 ppm.⁵ One study estimated the quantities of cyanide at 500 ppm per cubic meter (500 grams of cyanide per cubic meter). The danger arises from the improper disposal of waste that carries quantities of cyanide ranging from 50 to 100 grams per ton, although the standards required by the Sudanese authorities limit the quantity to 0.05 grams of cyanide

⁴ For more details see the valuable study by Salah Sharafedin, "Cyanide or the Industry of Murder", The Six-Member Committee, March 2017, available [here](#).

⁵ Vella Heidi, "Should cyanide still be used in modern-day mining?" *Mining Technology*, March 7, 2016, available [here](#).



Treatment using cyanide, River Nile State, 2022.

per ton. In fact, companies don't treat cyanide residues, which represents a major source of risk.⁶ Cyanide can decompose in various ways, including exposure to sunlight. However, this should be managed within a controlled environment and closely and continuously supervised to prevent the formation of the highly toxic hydrogen cyanide gas that can spread over long distances, and causes most cases of poisoning.⁷

Cyanide leakage in mining areas has caused many major disasters. The Baia Mare incident in Romania in 2000 was one of these. 100,000 cubic meters of cyanide was leaked from tailings from mining operations. The impact reached the waters of the Someş River and spread down to the Danube River, which is

more than 40 kilometers away. The spill killed many fish and 80% of other aquatic life. At the time, this incident was considered one of the worst environmental disasters since Chernobyl.⁸

As a direct response to this incident and others associated with the uncontrolled use of cyanide, and because of the fear of the use of cyanide as a tool for extermination, the International Cyanide Management Regulation (ICMC) was drafted. ICMC contains strict controls for dealing with cyanide at all stages, from manufacturing to transportation, preservation, use, and disposal.⁹

Despite the development of the ICMC as an internationally binding set of regulations, and the rush of the largest mining companies to sign and declare full commitment to it, dangerous cyanide leaks continued to happen. Leakage accidents were, by and large, related to the collapse of reservoirs containing tailings mixed with mercury and cyanide residues. This is exactly what happened in September 2015, when more than a million liters of water mixed with cyanide flowed from a gold mine in the province of San Juan, Argentina run by the Canadian Barrick Gold Corporation, one of the world's largest gold mining corporations. The polluted water mixed with the waters of the adjacent rivers, which provided drinking water to nearby cities. A local court ordered the suspension of work in the mine until an investigation of the causes of the leak was completed. Later, the court imposed a fine of USD 9.5 million on the Canadian corporation for negligence.¹⁰ The local authorities conducted periodic checks of the residents in the area to ensure they were not affected by cyanide. This incident shows the possibilities for risk management in a state that hosts global investments and acts to ensure the safety of its citizens and the protection of their resources. The accident also confirmed the responsibility of the companies causing pollution to compensate those affected and the host country for the damage resulting from their negligence in adherence to the law.

⁶Abdelrahman, M. Salah, "Gold Rush: Environmental and social cost of mining", Gezirat Al Ward Publishers: Cairo, 2018.

⁷ For more detail about the methods of decomposing cyanides see: Kuyucak, N., & Akcil, A, Cyanide and removal options from effluents in gold mining and metallurgical processes, *Minerals Engineering*, 50, 2013, 13-29. Available [here](#); Also, for simplified account read [here](#).

⁸ Reliefweb, "The Baia Mare Gold Mine Cyanide Spill: Causes, Impacts and Liability," April 2000, available [here](#).

⁹ "Should cyanide still be used in modern-day mining?" *Mining Technology*, 7 March 2016, available [here](#).

¹⁰ "Argentine Mine Accident Spills Cyanide Into Rivers," *Chemistry World*, 30 September 2015, available at [here](#).

On the other hand, the increased knowledge at local level about dozens of serious incidents of cyanide leaks in mining areas inside Sudan and around the world, has increased fear among local communities of such accidents. This has sparked protests in various parts of Sudan against the use of cyanide (See STPT's brief on the community protests in the gold mining sector in Sudan¹¹).

However, observers note in contrast that low awareness or willful ignorance of the most serious risks of mercury seems to be widespread in the artisanal mining areas, despite the great risks involved. A local activist in Al-Ebeidiya market attributed this to the surrender of artisanal miners to this reality, as they have no other business opportunity available to them if they quit artisanal mining.¹²

Legal and regulatory framework and Practice

Several laws emphasize the right to a healthy environment, foremost of which are:

- The Environmental Protection Law of 2001, amended in 2020, requires the conduct of environmental impact studies as a condition for approving investment and development projects. However, this requirement wasn't met by most private and government-owned companies or governmental agencies starting mining works. Even when studies are conducted, the recommendations are rarely implemented. This is due to a structural problem as studies are required to be approved by the Higher Council for the Environment (HCENR), while implementation is followed up by the SMRC. This creates a conflict of interest as SMRC has dual roles as a regulator and developer, increasing production and the government of Sudan's share, which leads it to prioritize increasing production over applying sound environmental procedures as stipulated by law.
- The Civil Procedures Law of 1984 characterizes environmental pollution as a crime punishable by law and prioritizes agriculture over other economic activities. This law clearly requires community approval to allocate land, usually through a certificate of "Absence of Conflict". This requirement was not met in high-risk mining operations.¹³
- Articles 26, 27, and 28 of the Mineral Resources Law 2015 stresses environmental conservation, especially protection from mining waste requiring that authorities coordinate to prevent violations.¹⁴
- Based on the Mineral Resources Law 2015, Minerals Exploitation Regulations 2016 were formulated, setting conditions for control of operations and granting those affected by damage or violations the right to compensation by operating companies. However, no awards of such compensation have been recorded so far. Moreover, despite a legal stipulation that ore should be processed at a distance of at least 10 km from riverbeds, companies are granted permission to work 1.5 and 2 kilometers away from rivers. Some companies carry out treatment operations as close as about 500 meters from rivers and residential and agricultural areas. These violations highlight the lack of compliance with regulations and the failure to apply the standards of safe distance from rivers and agricultural, grazing, and residential areas.

¹¹ Baldo, Suliman, "Community Protests in Sudan's Gold Mining Sector: Peaceful Resistance and Repressive Responses," Sudan Transparency and Policy Tracker, STPT, January 2023, available [here](#).

¹² See Abdelrahman, M. Salah, "How Mercury is Poisoning a Nation and gross mismanagement is aggravating the problem", Sudan's Gold Curse Briefing Paper No. 1, STPT, October 2022, available [here](#).

¹³ For more information See Daoud, Muhammad Othman Ahmed, "Mining in Halfa and Dalgo Localities; Issues and solutions", Attahrir- Huna Assudan, May 2017 (in Arabic), available [here](#).

¹⁴ Abdelrahman, M. Salah, "The gold rush: Environmental and social cost of mining, Gezirat Alward Publishers, Cairo, 2018 (in Arabic).

Although clear legal texts are in place, the limited oversight powers of the Ministry of Minerals (represented by SMRC) have undermined enforcement. At the same time, the lack of accountability for serious environmental pollution has led many private companies, foreign investors, and government agencies to continue practices that amount to dangerous recklessness and/or criminal negligence. Legal documents regulating the gold production cycle do not ban the use of cyanide. However, SMRC issued environmental and safety controls in 2017¹⁵ which set a limit on the concentration of cyanide in waste at 0.05 ppm and standards for other substances, the SMRC as an oversight body does not apply them, perhaps due lack of technical capacity and knowledge to monitor the concentration of cyanide in the residue. This is defeated by the very production model authorized by the same body, as CIL, CIC, and VAT production systems all produce residues of a minimum of 50 grams to 100 grams per ton of residue. Further, as mentioned above, contradictions among SMRC's roles make it more likely to prioritize revenues than environmental preservation. This makes the government complicit in the violations committed by companies.

Although mining is an emerging activity in Mauritania, the use of cyanide in mining operations was prohibited due to popular pressure and concern about environmental damage. Local communities are involved in authorities' allocation of mining sites where companies operate. Cyanide is not used, and sites are set to be more than 180 kilometers away from residential villages.¹⁶

Despite the Council of Ministers' decision to ban the use of cyanide and mercury due to problems of misuse and catastrophic health effects which fueled a growing popular outrage,¹⁷ mining companies still rely on cyanide to process gold ore, with the approval and supervision of the Sudanese government. In November 2022, the Minister of Minerals ordered a review of all mining markets¹⁸ and the application of safe distance precautions as stipulated in the 2016 regulations where necessary in Decision No. 65. Although positive, this decision hasn't been implemented and safe distance precautions are ignored by most companies and artisanal miners although officially codified.

Expressions meant to downplay the crisis have recently surfaced, namely, the claim that "cyanide is only used to process and dispose of mercury." This attempt to legitimize the use of cyanide is baseless. Tailings processing companies do not dispose of mercury upon completion of treatment processes, they only extract gold and leave behind the waste which includes mercury, to which cyanide is added. The interaction of cyanide with mercury results in mercury cyanide compounds (and other heavy metal cyanides such as lead, cadmium, and copper cyanides). These are highly toxic and the safe processing of each gram costs more than USD 500. This shows that gold waste treatment processes inflict environmental damage that costs multiple times the value of the gold produced.

In addition, the detailed guidance of the ICMC is not respected in practice.¹⁹ Cyanide shipment operators seem to adhere to these rules until they reach Sudanese ports. Upon arrival in Sudan, adherence to ICMC is lacking in transportation, storage, use, and disposal. Although importing companies sign End User Certificates, they don't comply with their conditions although the SMRC

¹⁵ SMRC- Ministry of Minerals, "Guide of occupational safety and health requirements", 2017, on file with author.

¹⁶ Moritania Today, "Renewal of protests in Azweirat against the use of the toxic substance cyanide," October 18, 2020, in Arabic, available [here](#).

¹⁷ Skynews Arabia, "Sudan decides to end the use of mercury and cyanide in mining", October 2019, available [here](#).

¹⁸ The "gold market" a walled area where necessary supplies and services for traditional miners are provided. The market includes water mill complexes, goldsmith shops, gold dealers, groceries, restaurants, and entertainment video clubs. SMRC establishes its offices in these markets to collect royalties, taxes and fees from gold producers.

¹⁹ The Cyanide Code, available [here](#).

considers them binding.²⁰ The SMRC doesn't take responsibility for enforcement due to the conflict of interest between its two irreconcilable roles as a supervisory and revenue-generating body.

The SMRC has a General Department of Environment and Safety (GDES). This department presented a report on its achievements in 2022 related to organized mining carried out by concession and private tailings treatment companies. According to the SMRC webpage, these achievements are summarized in "monitoring environmental controls and requirements to regulate the industry," through:

- Periodic inspections: covering 23 companies in different geographical sectors (Eastern, Northern, and Middle),
- Follow-up corrective measures in concession and private tailing treatment companies to comply with environmental and safety requirements,
- Issuance of violation reports according to the Minerals Regulations to prevent their persistence.²¹

It is noted that the achievement report did not mention any administrative or legal follow-up steps taken by GDES in response to violations of environmental regulations and safety precautions.

As for artisanal mining, GDES carried out information campaigns in five states, participated in campaigns in others to remove thiourea mixers, filed police reports against their owners for non-compliance with environmental controls and standards, and followed up on police reports. It is obvious that the SMRC handles violations committed by artisanal miners with rigor, especially those tackling the uncontrolled spread of thiourea mixers. These mixers enable traditional miners to extract gold directly from tailings without having to sell it to tailing companies or give it away for free to the owners of water mixers. This represents a direct threat to the interests of these two important players in the gold production cycle and also affects the SMRC's ability to collect fees, as it is harder to collect from artisanal miners using thiourea in their farms and the backyards of their homes.

In other words, environmental conservation and protecting public health across all sectors and means of production have become secondary to fee collection and benefitting powerful groups in the current production cycle on the SMRC's agenda.

Cyanide control

Responsibility for oversight of cyanide rests with many bodies, the most important of which are the SMRC, Customs Police, General Intelligence Service (GIS), and Minerals Police. Upon completion of customs procedures, the transportation and delivery of shipments to the concerned company and mining site are monitored by the GIS with a view to ensuring that the mining site is the last point at which cyanide is used. After that, responsibility for monitoring storage, use and disposal operations rests with the SMRC.

The SMRC assigns an observer to each gold production company. The observer controls the use of cyanide, environmental impact and production. If a violation is committed, SMRC steps in and imposes penalties, from warnings, to financial penalties, to work suspensions until the act of infringement is resolved, to withdrawal of work licenses. However, these control processes lack transparency and penalties are not related to remedies. The "polluter pays" principle is an internationally recognized principle that whoever is responsible for environmental damage should pay to fix it. In the case of

²⁰ MRC- Ministry of Minerals, "Guide of occupational safety and health requirements," on file with author.

²¹ General Department of Environment and Safety (GDES) of SMRC "Activity report of the Directorate for Environment and Safety," (in Arabic) p. 1, available [here](#).

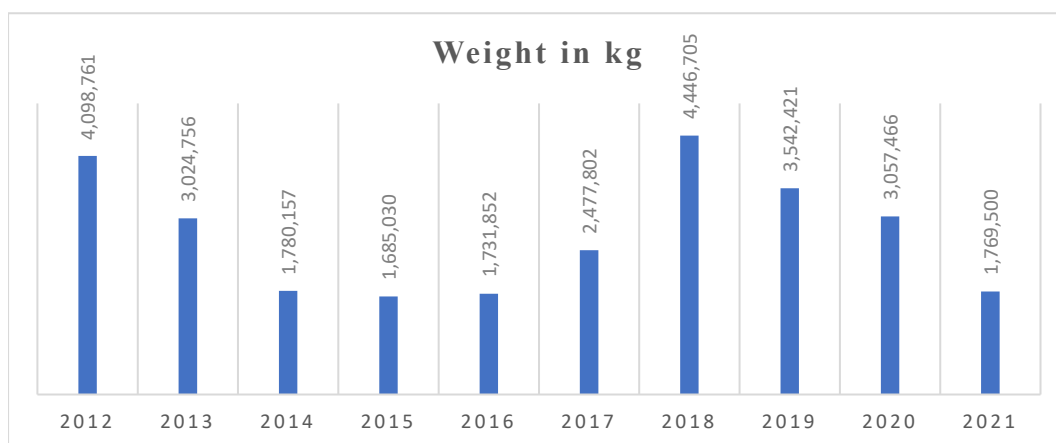
Sudan, however, the company is only required to pay money to the SMRC, which does not carry out any action to address the environmental impact. Consequently, penalties become only a tool to increase SMRC's income. As we mentioned earlier, the company's oversight role conflicts with its revenue collection targets, which makes it prioritize collection of fees.

The Higher Council for Environment and Natural Resources (HCENR) is the authority responsible for Sudan's natural resources. It reviews and approves environmental impact studies for mining companies. However, HCENR does not play any oversight role; the process of approving studies is completely separate from operations. In addition, HCENR is not entitled to enter companies' worksites or review their operations, according to testimonies from observers and workers in the field.

Companies that enjoy connections with the government and those owned by security authorities refuse to be subjected to oversight operations in principle.²² A fundamental contradiction comes forth where law enforcement authorities are also investors engaged in environmental abuses.

How does cyanide enter Sudan?

Sudan imports cyanide from several producing countries. The figure shows the total cyanide exports to Sudan for a ten-year period extending from 2012 to 2021 according to the database of the International Bank for World Trade (UN COMTRADE).²³ These exports amounted to 27.6 thousand tons, which means Sudan imported an average annual 2,761 tons of cyanide over the course of ten years.



Total of Cyanide Exports to Sudan (in tons) between 2012- 2021 (UN Comtrade)

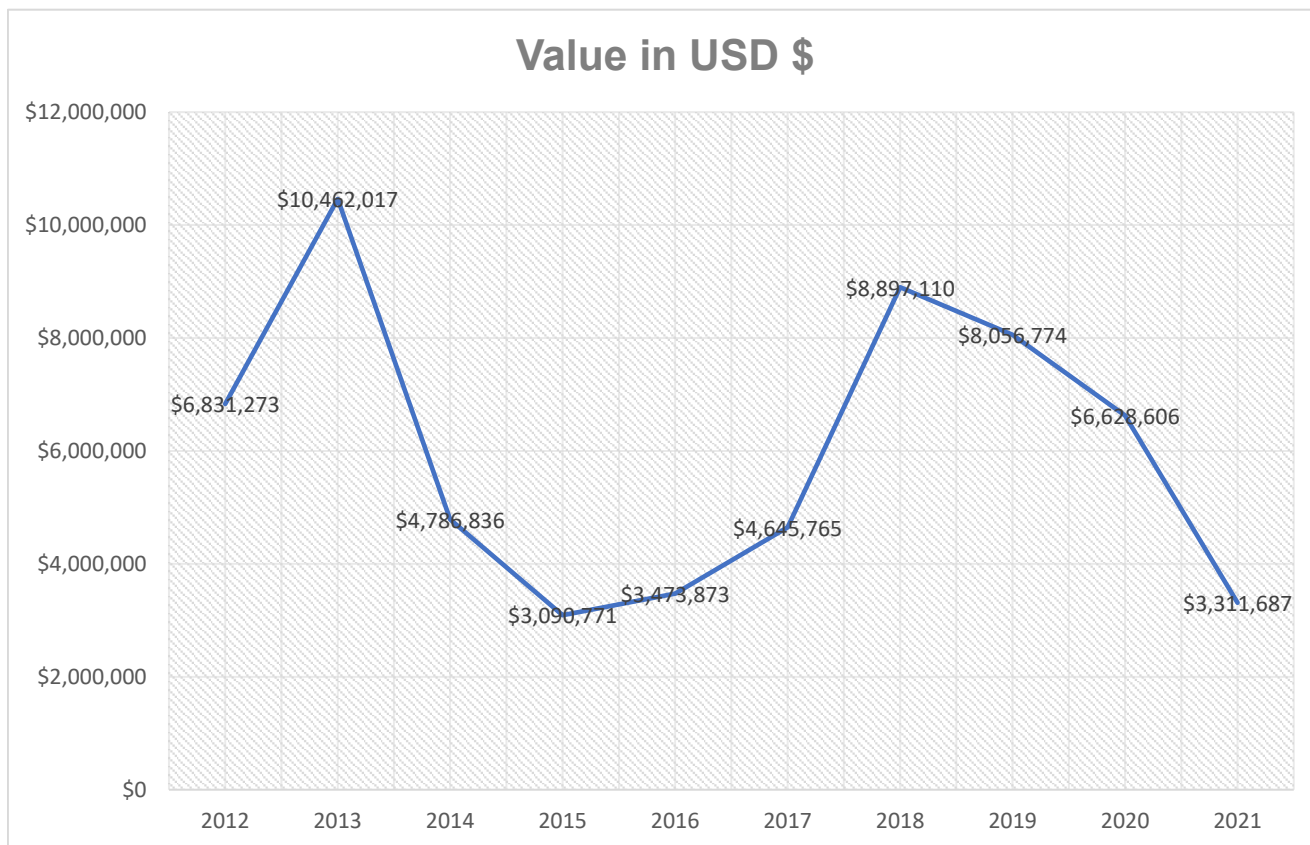
Many interviews and contacts were conducted with entities working in mining and processing of tailings for the purpose of this paper. We concluded that the reported quantities are relatively close to reality because companies use cyanide annually at the rate of 25-80 tons per company, with an average of 50 tons per company. This average can serve as a basis to calculate the average cyanide consumption in a specific site according to the number of companies and in Sudan in general, taking into account the volume and pace of work.

²² Many companies maintain ties with military authorities. In the link below is one case, but not an exception. See An-nilain, "Mining: Hemedti Takes Control Over a Copper Mine," September 2019 (in Arabic), available [here](#).

²³ Comtrade database, available [here](#).

The total value of cyanide imports to Sudan between 2012-2021 amounted to US 60.2 million dollars as shown in the figure below.

The largest cyanide exporters to Sudan are the Czech Republic, which is a member of the European Union, China, Georgia, India, and South Korea. It is noted that the cyanide factory in Georgia stopped working on the eve of the Russian war on Ukraine.



Sudan imports of cyanide in ten years (2012-2021). Source: UN Comtrade.

Cyanide imports are governed globally by the ICMR. Manufacturing countries ensure the arrival of materials and their use for the declared purpose, while importing countries are responsible for the control of transportation, storage, use, and disposal. From experience, controls are better enforced on the export side than on transfer, storage, use, and disposal.

In the past, cyanide import operations were open to all companies based on contracts with mining companies (or their subcontractors). SMRC issues certifications allowing mining companies to import cyanide in its name from the source country. This arrangement allowed SMRC to forecast the approximate production of each company using an equation based on the quantity of imported cyanide and ore available.

Despite this clear framework and its relative effectiveness, which allowed SMRC a pivotal role in supervising the import of cyanide, implementation was not free of serious abuses, mostly associated with corruption, overlapping of powers, and weak or absent accountability. To make it worse, SMRC devised an internal lending arrangement amongst mining companies. The latter can borrow cyanide from each other, provided that the loan is recovered later to ensure that production does not come to a halt. This arrangement allows transfers in violation of international controls, increases levels of risk during transportation, and compromises monitoring and follow-up. For instance, an official document reviewed for the purposes of this paper shows that Ariab Mining Company (owned and managed by

the state) sold quantities of cyanide to another company. This dealing violates international regulations and undermines the capacity of the regulatory bodies to monitor and control.



Countries from which Sudan has imported cyanide and the volume of imports from each one in the last decade (2012-2021).

Since the end of 2021, it seems that import licenses and sales of cyanide and other chemicals necessary to produce gold have been monopolized by Sudamin Ltd., which subcontracts other companies to import cyanide. STPT has reviewed several unpublished Sudamin documents showing this subcontracting. Apart from SMRC general safety requirements, there were no requirements specified for transportation, storage, use, and disposal of the highly dangerous wastes of cyanide, which increases both general risks and those of serious disasters.

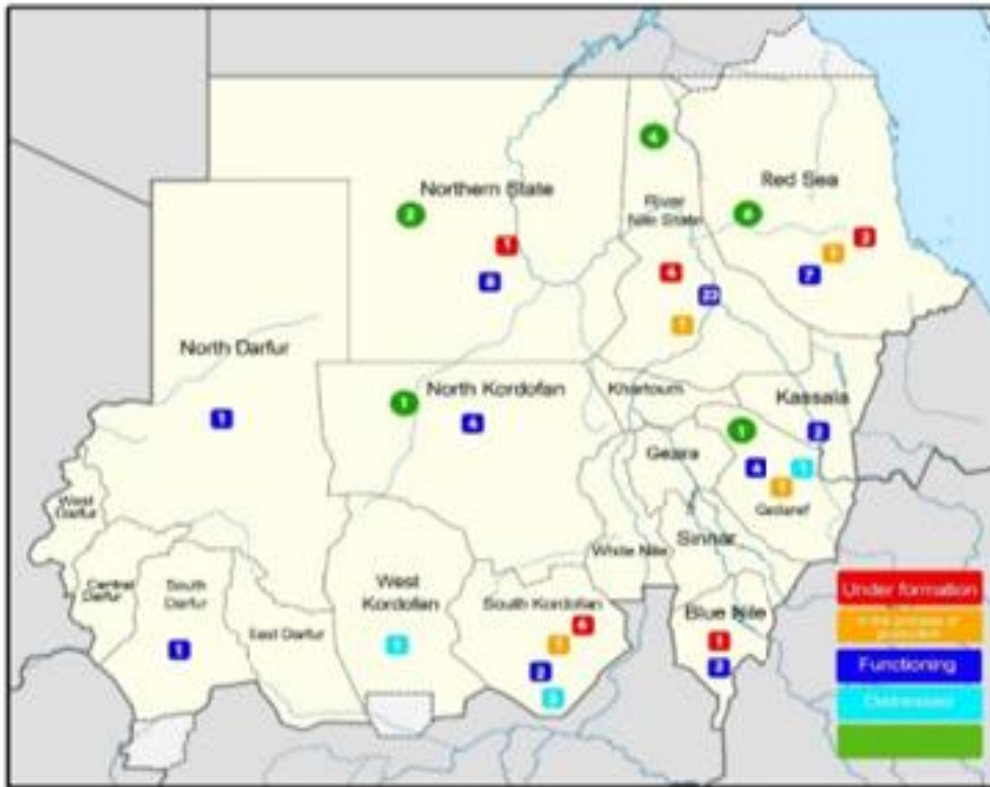
Since Sudamin monopolized cyanide imports, private companies have been entrusted with the management of cyanide in return for a percentage of profits paid to Sudamin, allowing it, and the companies it contracts, to avoid SMRC oversight. Sudamin's monopoly overrides the role of various state agencies involved in monitoring at all stages. Since Sudamin is not a supervisory body according to its founding documents and its administrative and technical structures, this monopoly means the state, represented by Sudamin, is sanctioning uncontrolled use of cyanide which involves a huge environmental cost. Also, this leads to a negative economic impact, as the public treasury loses large revenues from the gold sector and benefits a parallel economy.

Areas in Sudan where cyanide is used

Mining operations that legally use cyanide operate across 15 states in Sudan. It is used by concession companies, small-scale miners, and karta (tailings) treatment companies.

Sudan has witnessed an increase in the rates of illegal cyanide use, which previously took place in some remote locations where state agencies were effectively absent. However, by the end of 2021, cyanide was being used close to residential areas. Testimonies and reports received by STPT attest

that cyanide use takes place inside military facilities and under their protection.²⁴ This conduct is enabled by the accessibility of large quantities of cyanide in Sudan, even through social media as mentioned above, and the absence of oversight.



Locations of mining companies in Sudan.

Source: Map from NordNordWest under creative common license and data from Sudan Geological Research Authority.

Transport and storage operations

Transport operations from Sudanese ports to gold mining sites take place without necessary controls on the roads, including the provision of safety equipment and intervention tools to overcome emergencies such as traffic accidents. The absence of safety measures applies not only to the transport of cyanide, but also to other chemicals, including explosives used in mining operations. States with

²⁴ Akhbar Assudan, "Portsudan- Kassala Highway remains Closed at Dordeib for the Second Week," February 2023, available [here](#).

See also, Alrakouba, "Sudan Army starts to process gold ore inside a military zone", January 2023, available [here](#).

For another report about suspicious activities in River Nile State, see The Alliance of Demand-based Bodies (TAM), "The cyanide disaster protected by the long guns of Atbara Artillery," 2022 (in Arabic), available [here](#).

mining projects have witnessed several unfortunate accidents involving vehicles carrying explosives used in mining, leading to significant damage.

Once cyanide shipments are delivered to mining factories, they must be kept in an isolated facility designed according to specific controls regarding storage space, building material, size, and ventilation system. Despite the clarity of these requirements, storage operations are not carefully monitored by the SMRC. In a number of factories, cyanide is kept in containers out in the open, in some isolated areas, or at storage sites that lack proper design (see photos).



Empty containers of cyanide abandoned in the open air. Northern State, 2022.

Using cyanide to extract gold

There are different methods used in the treatment of gold using cyanide, namely Carbon-in-Leach (CIL), Carbon-in-column (CIC), and vat leaching. CIC and vat leaching methods depend on immersing the ore in a cyanide solution, either gradually by dripping or through prolonged immersion in open basins, after which cyanide is separated from the gold using carbon. The cyanide-saturated residue is waste.



Open cyanide basin, Northern State, 2020.

Using cyanide in open basins is probably the most concerning of these methods. It causes evaporation of highly toxic hydrogen cyanide gas. Living organisms (birds, livestock, wild animals, etc.) become directly or fatally exposed. In addition, treatment basins and cyanide are arbitrarily placed without considering natural waterways. This means the basins can be disturbed by floods, rain, and torrential waters leading to the chemical's spread to large areas outside company sites or leaks into groundwater sources causing even bigger exposures.

In the CIL method, the ore is treated, unlike the previous two systems, with cyanide inside tanks (closed system), extracting up to 95% of the gold. In theory, CIL provides better protection by reducing risks arising from open systems, though there is still a need to treat the ore and reduce the percentage of cyanide in it before disposal. But in practice, while companies in Sudan benefit from the increased extraction rate provided by this system, they release the waste without conducting the necessary treatment, which makes the CIL method as dangerous as open systems. Furthermore, the ore is placed in open tilling dams saturated with a high percentage of cyanide (up to 50-100 grams per ton, as mentioned earlier) and perhaps for long periods of time, which endangers the natural environment.

Waste disposal

Waste disposal qualifies as one of the most dangerous stages in the gold production cycle. Mining companies dig large pits or open basins in which cyanide-saturated waste is dumped without treatment, which causes the spread of cyanide pollution. In this stage, cyanide gradually disintegrates and evaporates in the form of toxic hydrogen cyanide gas, or seeps into and mixes with groundwater.

In addition, there are no binding controls on how to get rid of contaminated tools used in handling cyanide. Sometimes empty containers and contaminated tools are dumped in the open, and cyanide is disposed of by surface burial, in some cases to hide its existence. Local activists and state-level authorities in South Kordofan documented such a case.

Cyanide becomes an uncontrolled commodity threatening the environment and the mining sector itself



Chemicals buried in Tadamon Locality, South Kordofan state, 2020.

The uncontrolled use of cyanide spread across Sudan and the absence of oversight led to many violations of regulations. This reached its peak when Sudamin began to issue permits for the purchase and shipment by any means of any quantity of cyanide by any citizen without any requirements. This has created a new reality in which Sudan

even re-exports cyanide to other countries, foremost among them Ghana, possibly circumventing stricter controls on the import and use of cyanide there.²⁵

In conjunction with these administrative abuses, illegal gold extraction has begun to spread in remote areas where the state has less presence, including farms and residential areas. Recently, gold ore processing has extended to basins that are not officially authorized, but are protected by military authorities, as is the case in the northeastern regions of Atbara. Treatment operations in these sites use the immersion vat system without any form of control or protection for workers or the environment.



Reports indicate that military units provide protection in areas to carry out unpermitted processing operations without oversight. This

A copy of a permission issued by Sudamin to transfer and use cyanide for artisanal mining purposes.

²⁵ See Volaz database of global trade statistics on Sudan's cyanide's imports and exports, available [here](#).

has created an integrated system in service of illegal gold production under the protection of regular forces. It is noted that the production inputs for this emerging parallel mining are provided by Sudamin. It practically means building an integrated parallel system to official mining, despite its many disadvantages.



A copy of a letter by a local military commander suspending mining companies working in his garrison (left); and removal of mining equipment from the area (right).

The growing chaos and its consequences have given rise to a popular protest movement and, on occasion, friction between citizens and military units involved in mining activities. For instance, in early February 2023, citizens locked down the highway linking Kassala and Port Sudan in the Dordeib area to protest newly built gold extraction units using cyanide within the military zone of Dordeib Infantry Base. Protesters demanded the closing of the factory fearing severe damage to humans, animals, and the environment. They rejected a suggestion from the garrison commander to temporarily halt operations until a deal was reached.²⁶

The interviews conducted with workers in the mining sector confirmed that many companies have discontinued work in recent months. Quantities of gold ore entering mining markets have reportedly dropped significantly, up to 60% in some estimations. This has happened as traditional miners become more reluctant to sell their mining waste, which contains high percentages of gold as the increasing availability of mercury, cyanide, and thiourea, makes it more feasible to process it themselves or to sell it to other miners for a more money.

In remote areas where there is less state oversight, the use of cyanide is linked to the proliferation of small weapons used by formal and informal militias. This association between cyanide and weapons has turned cyanide into a factor of instability and violent competition over resources, a recipe for state disintegration as these groups concentrate their power and hold to their steady desire to dominate.

Prevalence of the uncontrolled use of thiourea

The promotion of thiourea as a safe alternative to cyanide was ushered in by the SMRC in 2017 when local communities in South Kordofan protested the use of cyanide. It didn't take long before the use of thiourea, which was imported from China, came to a halt after preliminary studies indicated that it

²⁶ Radio Dabanga, "Protests against gold mining continue in Sudan Red Sea state," February 15, 2023, available [here](#).



Closing the Thiourea factory by authorities, Khartoum State, 2020.

causes cancer and contains varying levels of cyanide as the main active substance in extraction. Thiourea mainly consists of carbon, sodium, ammonia, oxygen, and other substances and it represents a risk to human health as it affects the eyes, respiratory system, and skin. Thiourea causes many other diseases, and it has strict storage and disposal controls since it can also cause an explosion if it interacts with acidic substances. It is quite dangerous for living organisms to inhale it.

In early 2019, thiourea began to be promoted in the markets. A foreign group opened a thiourea factory in Khartoum without legal permission or setting the necessary controls for handling the substance. The factory sold large quantities in many markets, which made it abundantly available across the country. The demand for thiourea mixers skyrocketed as well, which helped to spread thiourea use within the neighborhoods of Khartoum and other major cities.

The suspension of the thiourea factory's work in mid-2020 by the Ministry of Mining didn't seem to have an effect. The low cost of smuggling thiourea and its high profitability led to the continued importation of large quantities. People use it in their homes, farms, and on the banks of the Nile, which multiplies its hazardous effects. That also expands the levels of pollution caused by thiourea and the wastes of traditional mining saturated with mercury and other heavy metals treated with thiourea.



Spread of mining Operations in Conflict Sites. A random use of expired cyanide, North Darfur State 2022.

Despite several decisions banning the use of thiourea, it continues to increase. The process has also increased the number of beneficiaries of traditional mining waste treatment. Instead of a single factory processing thousands of tons, revenues are divided among dozens of middle-income investors. This quality enhances the benefit to broader groups, making it more difficult to ban thiourea.

Recommendations

To the de facto government of Sudan

The continued uncontrolled use of toxic substances, primarily cyanide and thiourea, threatens human life and the natural environment, compromises the country's safety, and constitutes a major violation of international standards and a crime. The serious aggravation of the consequences of these appalling practices must be factored into the overall cost of war. Controlling toxic materials is an absolute necessity to ensure that they are not used in a lethal manner in war and to control widespread abuses in the mining sector.

To Sudanese civil society

Communities and groups combating environmental violations in mining have long stood at the forefront of addressing these risks, and still have a lot to do including raising awareness about the risks of uncontrolled use and protective measures that can be taken. Awareness-raising includes sharing experiences and methods of challenging violations, documentation, environmental conservation, and other important activities. It also requires combating illegal conduct that seeks to profit from gold mining in wartime, which is considered an ideal milieu for the spread of these toxins.

Other civil actors, including human rights groups, professional bodies, specialists and academics, journalists and media professionals, women's groups, and resistance committees share with local communities the task of addressing the repercussions of the ongoing war. Combating environmental damage resulting from mining operations must be part of the tasks of any civil front that genuinely seeks peace and attempts to address the consequences of the war.

To the international and regional community

The fluidity that characterizes the mining sector is one of the main environmental risks, not only to Sudan, but to the entire region, due to the difficulty of controlling the spread of hazardous materials considering the flexible borders in areas that suffer security fragility and increased cross-border mining.

The danger resulting from the use of cyanide and thiourea as weapons of war makes it necessary to declare a common international position to prevent the export of these toxins to Sudan and to raise the degree of control in the surrounding region, by activating international treaties and instruments for the prevention of pollutants perilous to human life and the natural environment, foremost of which is the International Cyanide Management Regulation.