

JEBS-25-07

From Resource Blessing to Ecological Burden: Mining and Environmental Costs in Northern Tanzania

Faraja Sanga *

Department of Humanities, Ruaha Catholic University, Iringa, Tanzania

*Corresponding author: Faraja Sanga, Department of Humanities, Ruaha Catholic University, Iringa, Tanzania, E-mail: sangafaraja@gmail.com

Received date: October 16, 2025; Accepted date: November 05, 2025; Published date: November 16, 2025

Citation: Sanga F (2025) From Resource Blessing to Ecological Burden: Mining and Environmental Costs in Northern Tanzania. J Environ Biol Sci. Vol.1 No.2: 07.

Abstract

The mineral sector in Africa and in the world at large plays a central role in the global green transition. This is achieved through providing basic raw materials for both industrial and economic development. Since time immemorial, minerals have been considered a blessing wherever they are. However, the extraction of this valuable resource creates ecological burdens to the environment. This review paper examines the ecological burdens created by mineral extraction in Northern Tanzania, where the promise of economic advancement is undermined by deforestation, water contamination, biodiversity loss and community displacement. A systematic review of peer-reviewed academic literature guided by PRISMA protocols was applied. The paper assesses how weak governance, limited regulatory enforcement and technological intensification trigger environmental degradation. The findings reveal severe ecological impacts, including mercury and heavy-metal contamination, landscape transformation and declining ecosystem health. By unpacking the tensions between global sustainability narratives and local realities, the study argues for inclusive governance, stronger environmental safeguards and policy innovations that align mineral wealth with sustainable development goals. Addressing these contradictions is essential to prevent Tanzania's mineral abundance from becoming an enduring ecological burden.

Keywords: Mineral extraction; Ecological burdens; Sustainable development; Governance and regulation; Northern Tanzania

Introduction

Tanzania has been blessed with the availability of vast quantities and types of natural resources that play a central role in economic growth. The extractions of natural resources, such as minerals, contribute to the increase in national income generation. However, the challenge is the distribution of the generated income among different zones of the country [1,2]. The projects associated with the extraction of natural resources, such as minerals, contribute to the increase of national income, normally accompanied by different social-ecological and environmental challenges. For instance, mineral extraction contributes to water pollution and deforestation [3,4]. The mineral sector plays a key role in the emerging economies of various countries in the Global South. For instance, Tanzania is ranked 4th in Africa in terms of endowment of mineral deposits [5]. However, this blessing has come with environmental challenges in Tanzania. Due to mineral extraction, the environment tends to be

compromised. For instance, in northern Tanzania, specifically in Mara, mercury and other toxic chemicals are released into the water, causing water pollution [6,7]. The polluted water becomes useless because people cannot use such water anyhow. In Tanzania, the intensified environmental damage has been extensively reported to cause adverse impacts to human health and animals [8,9].

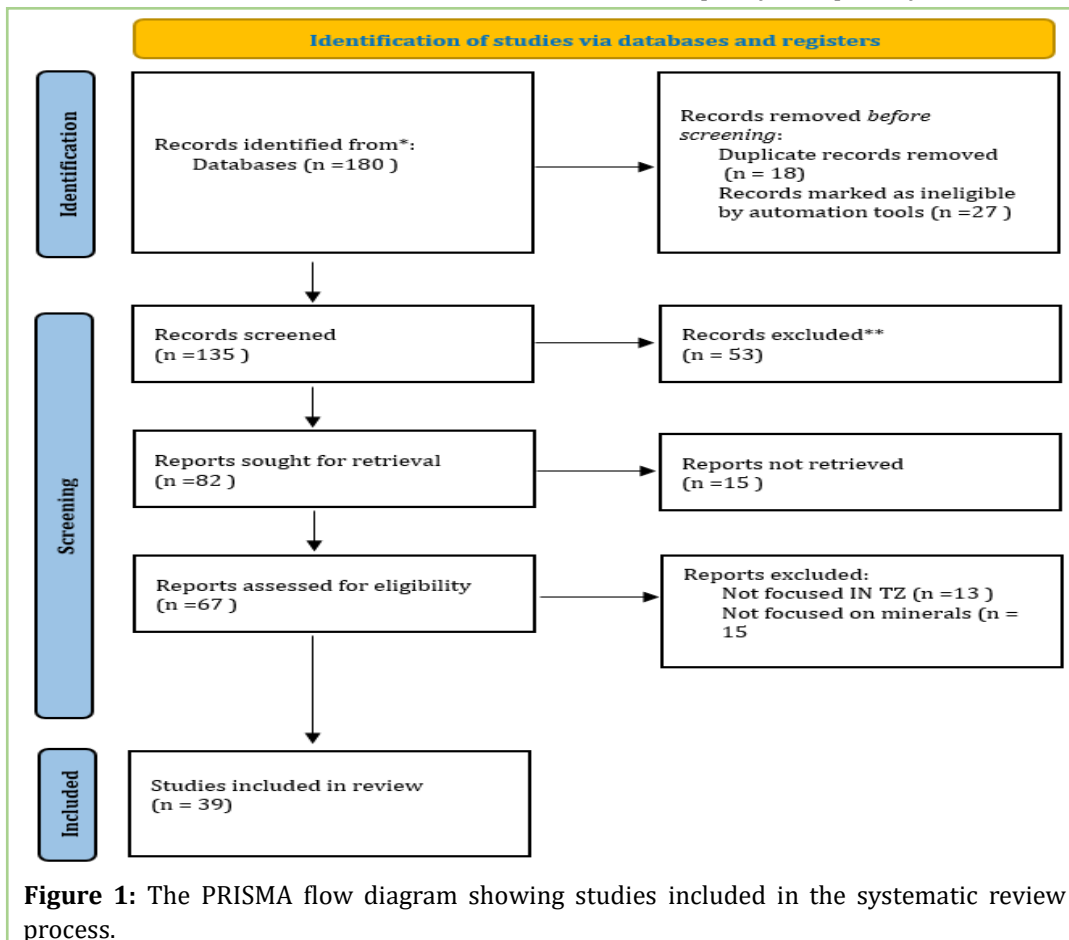
In Tanzania, projects dealing with the extraction of minerals contribute to the occurrence of a series of complex environmental changes [10]. The changes triggered by the exploitation of minerals are population growth, movement and installation of heavy machinery, land use changes, increased business, economic opportunities and household resettlement [11-13]. The mentioned changes have positive and negative impacts on the health of communities residing near the mineral extraction projects. This concern calls for a comprehensive health impact assessment in all mining

projects. It should be noted that during mining activities, the influence of human beings on topographical change is an integral part of mineral extraction. Nevertheless, in developing countries, the impact of mining on the changes in landscape structure is more significant. This is due to less adherence to mandated practices and rules governing mining activities [14,15]. This implies that government authorities need to enforce adherence to the policies and established rules for the bright future of the country. The degree to which the landscape is changed depends on the intensity of mining activities in the respective geographical region. More importantly, the technological procedures applied in mining also determine the nature and the magnitude of environmental changes during mining [16,17]. This implies that the technological advancement has both negative and positive effects in the mining sector. The paper intends to address the following research questions: How do governance structures and regulatory enforcement influence the environmental costs of mineral extraction in Northern Tanzania? What are the most severe ecological impacts in mining zones? And how do mining activities influence changes in landscape structure and ecosystem health over time?

Materials and Methods

Methodology

The study has confined itself to Northern Tanzania. This zone of Tanzania has been chosen because it is highly endowed with minerals. Generally, Northern Tanzania is a leading zone in terms of minerals in Tanzania. The study area has also been chosen because it faces many environmental challenges associated with the extraction of minerals. A systematic review methodology has been adopted for providing evidence relating to the environmental costs of mining activities in northern Tanzania. Through this method, a wider range of the literature was reviewed for the accomplishment of the study objectives. This method was chosen because I was able to survey different literature needed to collect the required evidence for the study. Moreover, the PRISMA method (**Figure 1**) was adopted to select a few published academic analysis papers. Keywords, like “minerals”, “mining”, “mines”, “mining sector” and “north Tanzania” were applied in searching the required literature from various databases like Web of Science, Scopus and Google Scholar. Through this search, the researcher obtained substantial quality and quantity results needed for the study.



After the screening process, 30 studies were selected for the systematic review, as they were the only ones that met the inclusion criteria set at the initial stage. The selected studies served as the foundation for assessing the environmental cost of mineral extraction in northern Tanzania. The findings facilitated the analysis of threats generated through mining activities in the cited study region.

The geographical keywords” (northern Tanzania OR) and “impact keywords.” To accomplish the data collection through a review of the literature, a keyword search was performed. The search string was developed from the identified keywords such as “(minerals AND mining AND mine AND mining sector and northern Tanzania and Tanzania) and pubyear > 2000 and pubyear <2025 and (limit-to (doctype, "ar") or limit-to (doctype, "ch").” These search terms were developed to capture studies related to mining activities, mines, minerals and their influence on environmental costs. The initial search identified a total of 180 records. Before screening, duplicate records (n = 18) and studies automatically marked as ineligible by database automation tools (n = 27) were removed, leaving 135 records for further assessment.

During the screening process, the title and abstract were presented first, followed by full-text screening. To determine their applicability to the review's goals, the 180 records were first assessed based on their titles and abstracts. This led to the exclusion of 53 records that did not meet the inclusion criteria, primarily due to a lack of focus on mineral extraction in Northern Tanzania. A total of 39 reports were identified for retrieval at this stage. The inclusion criteria were: (i) empirical not review studies explicitly addressing mineral extraction; (ii) a geographical focus on northern Tanzania and (iii) relevance to the theme of environmental costs of

mining activities. Articles were excluded if they were not regionally focused on northern Tanzania and lacked a focus on mineral extraction. This procedure made sure that only studies that were both contextually relevant and methodologically sound were kept.

Inclusion and exclusion criteria

The inclusion and exclusion criteria were developed to ensure that appropriate peer-reviewed literature related to mineral extraction and environmental costs is included in the systematic review. The study was guided by PRISMA principles to select suitable literature for review. The main focus of this approach is on in-depth scrutiny of the reviewed document. This gives room to have a deep understanding of the research problem being interrogated because only a few documents are reviewed thoroughly. The study established qualifying criteria that aligned with the expectations outlined in the relevant literature. Eligible studies included those that were related to mineral extraction and environmental costs, focusing on Northern Tanzania.

The publication dates, content, language, document formats and study quality score were among the inclusion criteria used to select appropriate studies for a review. Studies that did not meet eligibility requirements were excluded and only those that did were included. For instance, this paper concentrated on empirical publications published in peer-reviewed journals from 2000 to 2025. Additionally, only studies published using the English language were considered, while those without full-text access or irrelevant to the research theme were excluded. The inclusion and exclusion criteria table (**Table 1**) illustrates how the PRISMA concept was applied to develop the criteria following the completion of the inclusion and exclusion criteria analysis.

Table 1: Inclusion and exclusion table.

Criterion	Inclusion criteria and rationale	Exclusion criteria
Type of literature	Peer-reviewed articles. These usually provide the most empirical evidence on the subject under study.	Editorials, opinion pieces, conference papers, posters, dissertations, book chapters, and workshop papers
Language	English. This is simply because many published in English, and authors are fluent in English.	Articles published in languages other than English were excluded.
Geographical location	Northern Tanzania. The region was selected since it is endowed with minerals. Its environment has been affected due to mining activities.	Articles from other geographical locations were excluded.
Publication period	2000-2025. This is simply because this range of years could supply the required information	Articles published before 2000 were excluded.

Accessibility	Full-text articles are available for access. The rigorous review requires reading the full text to obtain rich and detailed information on the subject under study.	Articles without full-text access were excluded.
Content relevance	Articles addressing issues related to mineral extraction and environmental costs were considered to be relevant for inclusion. This enabled the authors to focus on the central research question.	Articles not addressing issues related to mineral extraction and environmental costs were excluded.

Extraction of data

The extraction of data to make it reliable and extensive, an organised and structured method was employed. Essential information on every study was systematically collected through a standardised template, which included details such as the author(s), publication title, year of publication, source or journal and the thematic focus, methods used in the research and the key findings.

Synthesis of data

A thorough evaluation of the selected peer-reviewed articles was conducted to extract the most valuable information relevant to the study's objectives. To achieve meaningful results, the data was thematically analysed, organised, summarised, interpreted and presented in texts.

Result and Discussion

This section presents findings based on the identified key themes. Such themes include: the influence of governance structures and regulatory enforcement on the environmental costs of mineral extraction in Northern Tanzania, severe ecological impacts in mining zones and the influence of mining activities on changes in landscape structure and ecosystem health over time. Through these themes, the research questions of the study are addressed accordingly.

Environmental impact of mineral extraction and governance

In Tanzania, the environmental costs resulting from mineral extraction are evident in many spheres of the earth, such as the lithosphere, biosphere, hydrosphere and atmosphere. The sphere of the earth experiences deforestation, loss of biodiversity, water contamination, air pollution and soil degradation [18,19]. This signifies that mining activities have side effects on the environment. For instance, the literature indicates that studies conducted in Singida and Mara regions showed that the expansion of gold mining has triggered severe land-use change and vegetation loss [20]. This threatened local ecosystems and the

livelihoods of people in the vicinity of the mines. Moreover, large-scale gold mining like Bulyanhulu and North Mara is associated with mercury and cyanide discharges, causing water pollution and livestock deaths. The discharge of mercury to water sources caused water insecurity in the region, hence threatening the health of people [21,22]. This situation calls for urgent mitigation to solve the existing problems in mining zones. The presented findings indicate that minerals play a critical role economically, impose heavy ecological and social costs when governance and compliance mechanisms remain weak.

The impacts of mining activities on the environment are amplified by weak environmental governance [23]. For instance, in Tanzania, mining regulations provide for environmental impact assessment and environmental management plans. However, limited technical capacity and political interference hinder the enforcement of the established rules and regulations [20,22]. These situations signify that rules are there, but they are not enforced by the respective authorities. Likewise, the observed governance challenges face even other countries with different resources [24]. Therefore, this suggests that regulatory frameworks exist on paper with no implementations by the respective authorities. Hence, effective governance of the environment from mineral extraction impacts requires the proper implementation of regulations. According to Bridge, et al. and Sonter et al., mineral extraction causes significant pressure on water resources, soil resources and atmospheric systems [25,26]. Normally, large-scale mining activities are associated with extensive land clearing, hence causing loss of biodiversity and soil erosion [27]. These are environmental costs triggered by mineral extraction in different mining zones.

The disturbance of soils and the removal of topsoil trigger sediment run-off into river courses and lakes. This circumstance threatens aquatic ecosystems because of the impacts of silting [28]. Processing heavy metals such as arsenic, mercury and lead causes water contamination. This becomes the case when such chemicals infiltrate streams and groundwater. This threatens the life of both human beings

and wildlife. Moreover, the extraction of minerals produces particulates, sulfur dioxide and greenhouse gases, which contribute to air pollution and climate change. This implies that mineral extraction has impacts on both the lithosphere and atmosphere. To reduce the impacts caused by mineral extraction, it is important to have effective governance, strong regulations, well-established enforcement mechanisms and community involvement in decision-making. It is suggested so because weak government institutional capacity and poor enforcement of laws and regulations tend to trigger environmental degradation. In many countries, governance frameworks that regulate effectively the natural resource extraction and post-closure restoration have proven essential in mitigating ecological harm. Moreover, Inclusive decision-making and recognition of Indigenous rights increase transparency and accountability, reducing the likelihood of “sacrifice zones” where local communities bear disproportionate environmental burdens.

Observed severe ecological impacts of mining in northern Tanzania

In Tanzania, mineral extraction has caused significant ecological degradation, especially in zones with intensive gold extraction. For instance, in Singida region, satellite imagery covering from 1995 to 2023 has shown a 72.6% reduction in forested areas and a 43.5% decline in shrub and grassland cover due to mining activities. This means that mining activities trigger land use change in the vicinity of the mines. Moreover, a survey has indicated that 88% of respondents observed deforestation, 90% noted biodiversity loss and 63% reported water pollution associated with mining activities. Likewise, artisanal mining in the Mara River Basin has resulted in soil erosion, siltation of rivers and contamination of water bodies with mercury and other toxic chemicals, threatening biodiversity and reducing agricultural productivity. Moreover, studies near the North Mara Gold Mine have detected elevated levels of heavy metals such as arsenic, mercury, lead, chromium, nickel and selenium in river sediment, fish and local aquifers, leading to adverse health effects like skin ailments and increased cancer risk among local communities. Therefore, the findings suggest the urgent need for stringent environmental regulations and sustainable mining practices to mitigate the adverse ecological impacts in Tanzania's mining zones.

Harmful chemicals from mining cause contamination of the environment and foodstuffs. This has become a serious concern due to the associated health risks to human beings and wildlife. The study conducted at Shenda gold mine in Geita, Tanzania, indicated that soil and food crops from farms

were contaminated by mercury (Hg). This means that the soil and food crops were polluted by chemicals released from mines. The presence of potentially harmful elements in soil, air and water causes side effects on the food quality, hence affecting human health. Potentially harmful elements are normally considered hazardous in the environment because they are non-biodegradable and have a toxic nature. Apart from the mentioned impacts, mining activities lead to the digging of pits, noise and dust, flooding and the production of rock waste. These compromise the quality of the environment, hence affecting human health. The government of Tanzania needs to revisit its mining policies and laws to mitigate the environmental challenges posed by mining activities. The development of science and technology has intensified the environmental impact of mining. The use of heavy machines like bulldozers, cranes, dynamite and chemicals degrades the natural environment by producing waste materials, noise and dust [27].

Conclusions and Recommendations

This paper examines the burdens created by mineral extraction on the environment in Northern Tanzania. The minerals in northern Tanzania are considered a blessing from God; however, their extraction creates burdens to the environment, such as water pollution, soil degradation, deforestation, landscape transformation and biodiversity loss. The mineral sector plays a significant role in economic development. Technological intensification, Weak governance structures and inadequate regulatory enforcement exacerbate the impacts of mineral exploitation on the environment. The burdens created by mineral extraction have an impact on both environmental sustainability and community well-being. Therefore, mining activities in Northern Tanzania resulted in the concentration of heavy metals, leading to declining ecosystem health. It also triggers health risks for human populations in the vicinity of the mines. Mineral abundance in Northern Tanzania is becoming a permanent ecological liability rather than a blessing and a pathway to sustainable development. The existing rules and regulations governing the mineral extractions are not implemented effectively. The transformation of mineral resources from a lasting ecological burden requires policy and governance efforts. Strengthening environmental governance is one of the governance mechanisms for reducing the ecological burdens of mineral extraction. This mechanism calls for the enforcement of existing mining regulations and rules; also, the environmental impact assessment needs independent oversight and regular audits. It is important to enhance the technical and institutional capacity of all regulatory agencies that are responsible for monitoring and penalizing

environmental violations. It is imperative to review and update all mining policies, which goes hand in hand with incorporating binding sustainability standards that align with the UN Sustainable Development Goals (SDGs).

Declaration on Data Availability

The data are available because this is a review paper

References

- Poncian J, George C (2015) Mineral extraction for socio-economic transformation of Tanzania : The need to move from papers to implementation of mining policy and law. *J Soc Sci Stud* 2: 160-175. [Crossref], [Google Scholar]
- Haulle E, Poncian J (2025) The place of the Indigenous knowledge system in mapping and extraction of minerals in the Lake zone of Tanzania. *Afr Identities* 1-19. [Crossref], [Google Scholar]
- Lyatuu I, Loss G, Farnham A, Lyatuu GW, Fink G, et al. (2021) Associations between natural resource extraction and incidence of acute and chronic health conditions: Evidence from Tanzania. *Int J Environ Res Public Health* 18: 6052. [Crossref], [Google Scholar] [Indexed]
- Macháček J (2019) Typology of environmental impacts of artisanal and small-scale mining in african great lakes region. *Sustain* 11: 3027. [Crossref], [Google Scholar]
- Rwiza MJ, Focus E, Bayuo J, Modest J, Kleinke M, et al. (2023) Artisanal and small-scale mining in Tanzania and health implications: A policy perspective. *Heliyon* 9: e14616. [Crossref], [Google Scholar] [Indexed]
- Mbowe WEN, Yabu N, Lugobi M (2016) Tanzanite processing in Tanzania: Challenges and opportunities. *App Econ Fian* 3: 236-257. [Crossref], [Google Scholar]
- Gibb KG, Leary O (2014) Mercury exposure and health impacts among individuals in the artisanal and small-scale gold mining community: A comprehensive review. *Environ Health Perspect* 122: 667-672. [Crossref], [Google Scholar] [Indexed]
- Kihampa C, Wenaty A (2013) Impact of mining and farming activities on water and sediment quality of the mara river basin, Tanzania. *Res J Chem Sci* 3: 15-24. [Google Scholar]
- Ikingura JR, Akagi H, Mujumba J, Messo C (2006) Environmental assessment of mercury dispersion, transformation and bioavailability in the lake victoria goldfields, Tanzania. *J Environ Manage* 81: 167-173. [Crossref], [Google Scholar] [Indexed]
- Sanga TR, Maseka KK, Ponraj M, Tungaraza C, Mng ME, et al. (2023) Accumulation and distribution of mercury in agricultural soils, food crops and associated health risks : A case study of Shenda gold mine, Geita, Tanzania. *Environ Chall* 11: 100697. [Crossref], [Google Scholar]
- Mariki SB, Azihou AF, Sengelela M (2023) Assessment of the effects of uranium exploration on wildlife, vegetation and tourism in Tanzania. *Tanz J For Nat Conserv* 92: 170-184. [Google Scholar]
- Dietler D, Farnham A, De Hoogh K, Winkler MS (2020) Quantification of annual settlement growth in rural mining areas using machine learning. *Remote Sens* 12: 235. [Crossref], [Google Scholar]
- Cust J, Poelhekke S (2015) The local economic impacts of natural resource extraction. *Annu Rev Resour Econ* 7: 251-268. [Crossref], [Google Scholar]
- Maganga SP, Mdee OJ, Kombe GG, Justin W (2023) Situational analysis of gold processing practices at artisanal and small-scale gold mining in Tanzania. *Tanz J Eng Tech* 42: 27-43. [Google Scholar]
- Kitula AGN (2006) The environmental and socio-economic impacts of mining on local livelihoods in Tanzania: A case study of Geita District. *J Clean Prod* 14: 405-414. [Crossref], [Google Scholar]
- Clashon O, Mshana ZM, Mathias P (2018) Environmental and socio-economic effects of tanzanite mining activities in mererani, simanjiro district, Tanzania. *J Logist Manage Eng Sci* 2: 29-39. [Google Scholar]
- Gomezulu ES (2025) Review of the environmental impacts mitigation measures on water resource management of mining projects in Tanzania , the case of buzwagi gold mine. *East Afr J Environ Nat Resour* 8: 429-441. [Crossref]
- Bakta S, Ombella J, Kilonzo C (2025) Legal gaps and contradictions in environmental preservation in small-scale sand mining in Tanzania : Brewing climate change?. *J Contemp Afr Legal Stud* 2: 32-44. [Crossref], [Google Scholar]
- Stephano A, Brian L, Abdalrahman R, Kipkulei H, Raymond S, et al. (2025) Land use/land cover changes due to gold mining in the Singida region, central Tanzania: Environmental and socio-economic implications. *Environ Monit Assess* 197: 13921. [Crossref], [Google Scholar] [Indexed]
- Walwa WJ (2017) Large-scale mining and the right to a clean, healthy and safe environment in Tanzania. *Afr Rev* 44: 84-105. [Google Scholar]
- Ahearne R, Childs J (2018) 'National resources? The fragmented citizenship of gas extraction in Tanzania. *J East Afr Stud* 696-715. [Crossref], [Google Scholar]
- Mwigamba E, Tungaraza C, Nguvava M (2024) Methodological inconsistencies and variations in environmental pollution reports : A case study of the mining-affected Geita region, Tanzania. *Heliyon* 10: e40678. [Crossref], [Google Scholar]
- Tegnan H, Rachman A, Azhari D (2022) Mining corruption and environmental degradation in Indonesia: Critical legal issues. *Bestuur* 10: 54-73. [Crossref], [Google Scholar]
- Bridge G, Bradshaw M (2017) Making a global mining economy. *Environ Plann* 49: 617-636.
- Sonter LJ, Ali SH, Watson JE (2017) Mining and biodiversity: Key issues and research needs in conservation science. *Proc Biol Sci* 284: 20171726. [Crossref], [Google Scholar] [Indexed]
- Kitole FA, Kalumanga VE, Hyera DW, Evason EM, Andrew F, et al. (2025) Risks, challenges and socioeconomic impacts of

- quarrying on rural livelihoods in Tanzania. *Cogent Soc Sci* 11. [Crossref], [Google Scholar]
27. Hilson G (2002) Small-scale mining and its socio-economic impact in developing countries. *Wiley Online Library* 26: 3-13. [Crossref], [Google Scholar]
28. Mudd GM (2010) The environmental sustainability of mining in Australia: Key mega-trends and looming constraints. *Resour Policy* 35: 98-115. [Crossref], [Google Scholar]