



Review

# A Bibliometric Analysis of the Scientific Research on Artisanal and Small-Scale Mining

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**Abstract:** Mineral resource exploitation is one of the activities that contribute to economic growth and the development of society. Artisanal and small-scale mining (ASM) is one of these activities. Unfortunately, there is no clear consensus to define ASM. However, its importance is relevant in that it represents, in some cases, the only employment alternative for millions of people, although it also significantly impacts the environment. This work aims to investigate the scientific information related to ASM through a bibliometric analysis and, in addition, to define the new lines that are tending to this field. The study comprises three phases of work: (i) data collection, (ii) data processing and software selection, and (iii) data interpretation. The results reflect that the study on ASM developed intensively from 2010 to the present. In general terms, the research addressed focuses on four interrelated lines: (i) social conditioning factors of ASM, (ii) environmental impacts generated by ASM, (iii) mercury contamination and its implication on health and the environment, and (iv) ASM as a livelihood. The work also defines that geotourism in artisanal mining areas is a significant trend of the last decade, explicitly focusing on the conservation and use of the geological and mining heritage and, in addition, the promotion of sustainable development of ASM.

**Keywords:** mining; artisanal mining; small-scale mining; environment; bibliometric analysis



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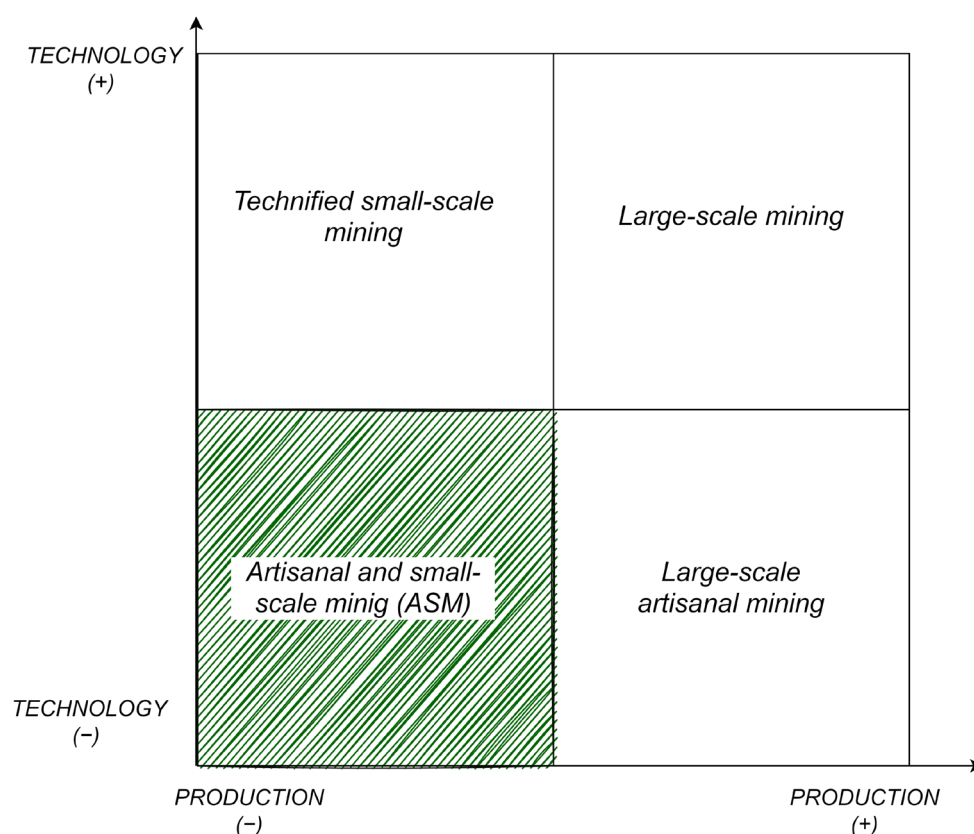
## 1. Introduction

Mining is a type of extractive activity considered to be one of the most important sources of metals and non-metals [1,2]. This activity is not always carried out by large-scale companies or industrial machinery; being called small-scale or artisanal mining. Small-scale mining (SSM) was first defined by the United Nations (UN) as: “Any single mining operation that has an annual raw material production of 50,000 metric tonnes or less, measured at the mine entrance” [3]. However, despite referring to the production magnitude or exploitation size, this concept differs at the level of countries and institutions. For example, in Brazil, the National Department of Mineral Research (DNPM) defines SSM as an operation that produces between 10,000 t/a (tonnes per year) and 100,000 t/a of ore [4]. On the other hand, in Ecuador, according to the mining law, the SSM exploits and processes up to 300 tons of ore per day (tpd) [5].

The SSM can be developed technically (conventional) or in a rudimentary way. When the operation of the SSM is conventional, it is characterised by being developed under a legal situation and the technical application of mechanised exploitation, as well as being

processed with engineering criteria and feasibility studies that guarantee the results of mineral production [6]. On the other hand, when the operation is carried out through simple and rudimentary techniques to extract ore without conventional ecological and engineering principles, it is called artisanal mining (AM) [7]. Currently, no country has clear regulations defining activities classified as AM, and almost all policies only refer to the size of the operation [8]. Hilson [9] describes that artisanal mining exploitation involves “intense labour activity located in remote and isolated sites using rudimentary techniques, low technological knowledge, low degree of mechanization and low levels of environmental, health and safety awareness”. This term refers to the rudimentary type of exploitation, regardless of whether the mine is small or large [10].

Artisanal mining and small-scale mining are used synonymously to refer to mining activity carried out by individuals or small groups with low technology or machinery [11]. Considering their close relationship, the legislations of developing countries refer to the term “artisanal and small-scale mining (ASM)” as “individuals, groups, families or mining cooperatives with minimal or no mechanization, often in the informal (illegal) sector of the market” [12] (Figure 1).



**Figure 1.** Schematic representation of ASM as a term that unites SSM and AM.

However, the definition of ASM is not uniform across many jurisdictions. Although there is still no internationally agreed upon definition of ASM, country-specific definitions reflect relevant situations and developments at the local level [13]. According to Seccatore et al. [7], “the term ASM is widely used to refer to those small or large operations that use rudimentary techniques to extract gold that operate legally or illegally and that are not on the radar of many companies mining companies, governments and international environmental agencies”. Various authors have studied and characterised this type of activity [12,14–23].

In general, ASM is an activity that exploits small deposits, has poor capital, lacks standards to ensure health and safety, is labour intensive, and has a significant environmental impact [14]. According to [24], millions of people worldwide are dedicated to primitive

mineral extraction (ASM). Most ASM operators mine precious metals and stones [25]. Other mineable materials, such as minerals, include diamonds, columbite-tantalite, and bauxite [26–28].

Recent studies have focused on large and medium-scale mining effects, updating sustainable and environmentally responsible production techniques [29–31]. However, the effects produced by ASM are still a reality due to economic, legislative, and technological limitations [22,32,33]. Furthermore, ASM has witnessed a massive expansion worldwide, employing millions of people [14,34] and producing 15–20% of the world's mineral production [7]. In addition, the areas where activities related to small-scale mining are located are studied, among other topics, from a geological point of view. In particular, in works oriented to the definition of the type of existing deposit (e.g., [35–37]), the characterization of the existing minerals of interest (e.g., [38–40]), and to the proposal of efficient exploitation alternatives (e.g., [41–43]).

Artisanal mining is driven by poverty, growing as an economic activity and adopted as a promising, and in many cases unique, alternative income [44]. However, ASM continues to develop without regulatory control in most developing countries, generating social and environmental problems in which crime, child labour, soil erosion, mercury contamination, and mining conflicts stand out [45]. The leading solution proposed by academics and professionals consists of improving ASM's environmental, technical, and socioeconomic performance by implementing regulations that organize and formalize the sector, respecting miners' rights [12,19,34].

Several literature review studies related to ASM mainly focus on systematic reviews of specific topics. Some examples are review studies about its relationship with poverty [24,46], agriculture [47], operator health [48], ecological problems [49,50], health risks [51,52], mercury contamination [6], mercury management and treatment [53], and water contamination [54], among others.

To date, no holistic analysis of ASM is recorded. This is possible with a bibliometric study that allows for knowing the structure and evolution of this field of research. Bibliometric analysis is a method that assesses the structure and trends of research in a specific body of literature [55–60], commonly used to categorize aspects of science as journals, institutions, universities, authors, and most contributing countries [61]. According to [62], this type of study is important for (i) obtaining a comprehensive overview of the subject under investigation, (ii) identifying knowledge gaps, (iii) defining novel lines in research, and (iv) positioning their contributions in the researched field. Bibliometric analysis can use two procedures: (i) analysis of scientific production, which leads to an evaluation of the impact of the field being investigated in the study and its scientific actors (authors, institutions, countries) [63,64]; and (ii) bibliometric mapping combined with clustering techniques that allow for evaluating of the cognitive structure and behaviour of the scientific field through the analysis of research fields, disciplines, and themes [65,66].

Based on the above, and considering the conflict (similarity and variation of definitions between SSM and AM), the following research question arises: How should we organize information to carry out a comprehensive analysis of the evolution and trends of the scientific production of the SSM and AM?

In this study, the term ASM is considered as a holistic concept that integrates SSM and AM as synonyms of low-production mining activity, characterised by the low-quality technology used and intensive labour. For this reason, the objective of this study is to analyse the existing literature base related to ASM through bibliometric methods that allow for the definition of the main areas being investigated, patterns, trends, and the proposal of new lines of research.

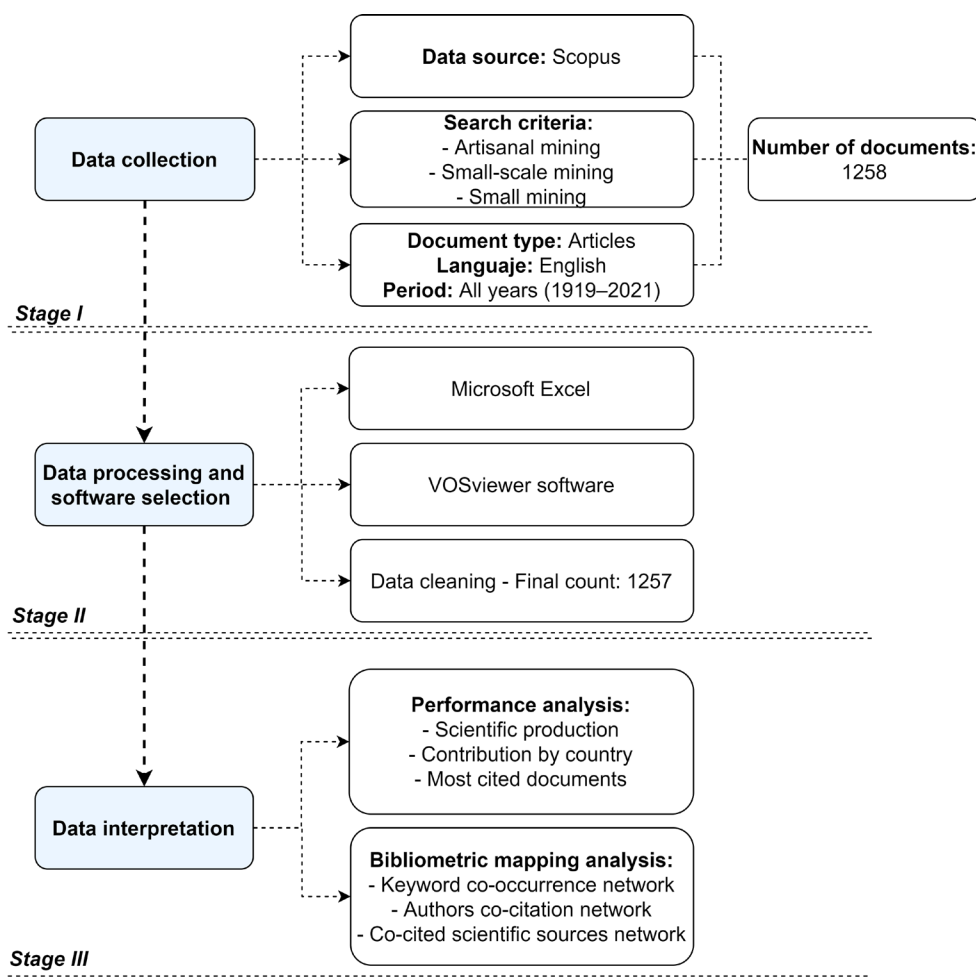
The article consists of six main sections: the introduction (Section 1), which includes a review of scientific literature related to ASM in the world; materials and methods (Section 2), which describes the procedure used in this study; results (Section 3), in which the results obtained from the analysis and processing of the database are presented; discussion (Section 4), which lies in exposing the importance of the study and the determination of future lines of

research; the conclusions (Section 5), which include the limitations of the study; and finally, the references used which support this research.

## 2. Materials and Methods

Bibliometric research, a meta-analytic literature research tool, was conducted in this study [57,67]. This type of study is about analyzing (mapping) the structure, evolution, and research trends of a specific database [55,56,58–60,68] through parameters such as authorship, citations, keywords, journal, and affiliations [61,69].

For the bibliometric analysis of a specific field of research, it is necessary to use bibliometric maps [70,71], which can be viewed in different software (e.g., Bibexcel, CitNetExplorer, CiteSpace, CoPalRed, HistCite, Network Workbench Tool, SciMAT, Sci2Tool, VantagePoint, and VOSviewer). This study used the VOSviewer software [65] to build bibliometric networks in order to facilitate the analysis of the intellectual structure using various parameters obtained from scientific publications [72]. The research contemplates a systematic process distributed in three phases (Figure 2): (i) data collection, (ii) data processing and software selection, and (iii) data interpretation.



**Figure 2.** General methodological scheme of the study.

### 2.1. Data Collection

Most of the research literature on small-scale mining is closely related to artisanal mining [34,73,74]. Furthermore, scientific contributions on artisanal and small-scale mining (ASM) generally expose case studies, mainly in developing countries, in which small-scale mining is a term frequently used to refer to artisanal mining activity [25,75]. Therefore, considering this relationship, the following search terms are considered in this study: (i) ar-

tisanal mining, (ii) small-scale mining, and (iii) small mining. The selected terms will allow for the obtaining of a complete literary body on the subject for its later bibliometric analysis.

Quality databases with accurate and consistent information are essential [76,77]. Therefore, the Scopus database was selected for the search, as it is considered one of the central databases with great coverage, facilitating the study and comparison of different scientific fields [78–83]. In addition to its comprehensive coverage and ease in the tools provided for bibliometric analysis, in this specific study (artisanal and small-scale mining), we considered the main reason for the extensive coverage of Scopus in terms of scientific production related to geosciences [84–86].

Scopus constitutes an indexed and well-organised database of scientific production, with tools that allow the export of metadata [63,80,87]. In addition, it provides a series of data on scientific publications such as authors, institutions, countries, number of citations, and research areas [78,80,88,89]. An important aspect to consider in selecting the database is that the growth in the coverage of journals from Latin America and the Caribbean indexed within the Scopus database [90,91] strengthens the analysis carried out in different areas.

The search was carried out on 8 November 2021, using the terms previously defined in the titles, abstracts, and keywords of the different existing publications in Scopus. The initial search equation used was: ((TITLE-ABS-KEY (“artisanal mining”) OR TITLE-ABS-KEY (“small scale mining”) OR TI-TLE-ABS-KEY (“small mining”))), with a result of 1665 documents. Subsequently, the database was delimited through inclusion and exclusion criteria according to the analysis to be carried out. As a first criterion, it was considered appropriate to exclude the year 2022 and carry out the study with documents published up to the present (search date). Subsequently, the number of documents was limited to articles, since the results obtained from the initial search equation yielded more than 75% of documents as articles. Finally, considering that the English language is the most frequent in scientific publications [92], the initial search of the investigated area indicated that more than 90% of documents are written in English; the study was limited to documents in that language. The final database represents 1258 documents, which will be the basis for processing phase two of the study.

## 2.2. Data Processing and Software Selection

The data processing and software selection phase begins with extracting data from the Scopus database through a Microsoft Excel spreadsheet. The software uses data analysis and error elimination [93–95] and evaluated the investigated area’s scientific production [96]. Specifically, the downloaded database contains authors, titles, keywords, years, number of citations, and abstracts. Then, a cleaning and error elimination process is carried out [97,98], eliminating repeated and incomplete data for this research, obtaining 1257 documents to analyse.

With the adjusted database, we construct two-dimensional bibliometric networks, which define the research structure of the field being studied using the VOSviewer software (Version 1.6.17) [65]. The software is freely available and is used as the primary tool for constructing detailed bibliometric maps through simple graphs [70,99,100]. This software is used in different scientific areas such as medicine [101–104], management [105–109], natural and cultural resources [110–112], and geosciences [68,113–116], among others.

## 2.3. Data Interpretation

The investigated field analysed the results through (i) performance analysis and (ii) scientific mapping [117]. The first analysis makes it possible to determine the evolution of scientific production and its impact by evaluating parameters such as authors, year, affiliations, journals, and countries [118–120]. The subsequent analysis (scientific mapping) allows for the definition of different relationships between the analysed variables, obtaining information at the micro-level (co-occurrence of author keywords), meso-level (co-citation of authors) and macro-level (journal co-citation) [94,121]. Specifically, the objective of the



analysed approaches was to identify the main areas of research on ASM for the definition of new lines based mainly on innovative, sustainable, and affordable research.

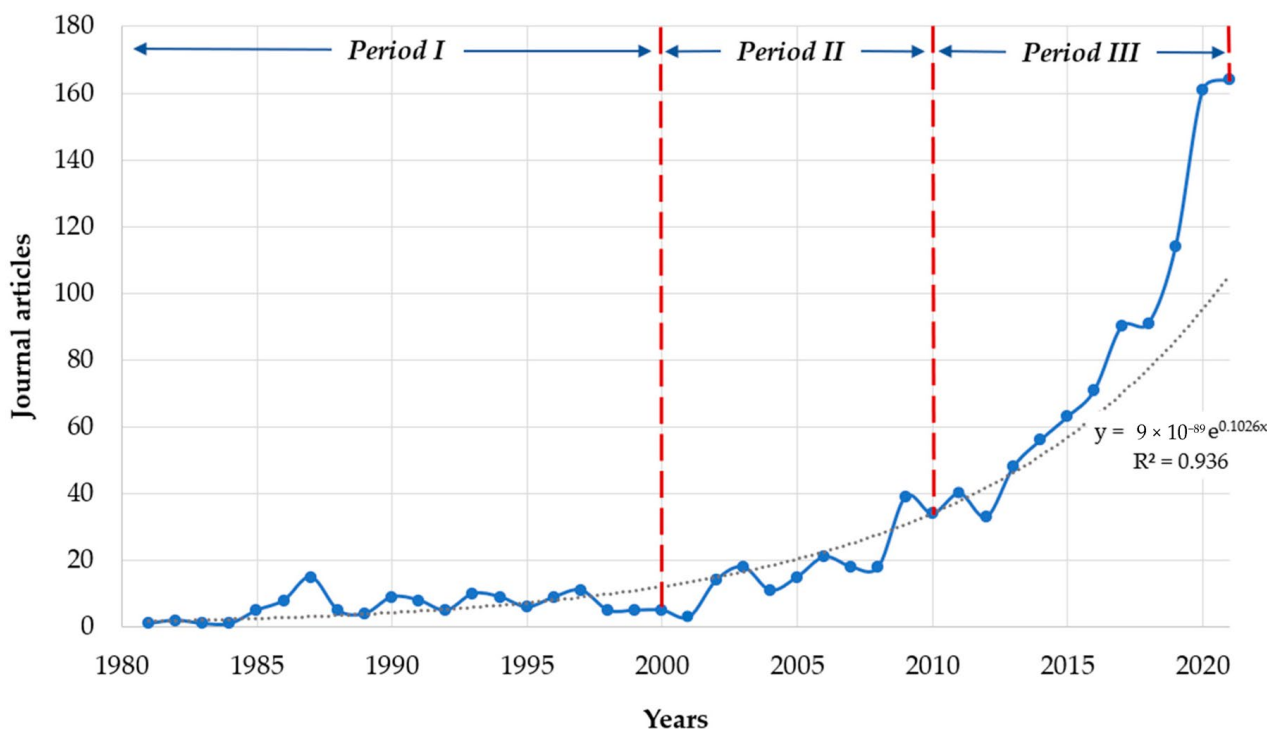
### 3. Results

#### 3.1. Performance Analysis

##### 3.1.1. Scientific Production Analysis

Research studies related to artisanal and small-scale mining (ASM) began in 1919, with the study of Wormleighton [122], which marked the interest in this type of research on sewage and drainage works in a mining district. However, the first five decades (until 1979) of research in this field are scarce, with eight articles representing 0.63% of the total scientific production of ASM. Due to these reasons, excluding these years from the production analysis is considered pertinent.

This analysis is divided into three periods distributed by decades: period I (from 1981 to 2000), period II (from 2001 to 2010), and period III (from 2011 to 2021) (Figure 3). For period I, two decades are grouped (1981–2000) due to the low number of published articles.



**Figure 3.** The behavior of ASM scientific research over time (1981–2021).

*Period I (1981–2000):* This research period of ASM in the world begins with 124 scientific articles, in which a similar production trend can be observed every five years (Figure 3). It is essential to highlight that in 1987 the highest production was obtained within the analysed period (Figure 3), with 15 published articles. In general, this first period marks the beginning of ASM research. The primary study topics focus on the contribution of small-scale mining to world mineral production [123], as well as its contribution to the socioeconomic development of developing countries [124]. Likewise, case studies of small-scale mining [125–129], the role of the government in promoting small-scale mining [130], and the need for government policies [131,132] are presented.

Within this research period, the authors also expose the importance and characteristics of small-scale mining [133], as well as the primary technical considerations that reduce the human and environmental risk [134], despite its limitations [135]. Likewise, it is possible to observe studies focused on the pollution problems of small-scale mining [136,137] (e.g.,

in water [138], soil [139], and environment [140,141]), seismicity inductions [142,143], and mining-associated diseases [144].

*Period II (2001–2010):* This decade is characterised by significant growth in research, with a total of 191 articles representing 15.15% of the ASM research field. In 2009 there was a peak in research with 39 publications (Figure 3). Ranging from 2001 to 2010, ASM research is related to mining environmental management [145–148] and the need for mining legislation [34,149–152] that will solve environmental pollution problems [42,153–158]. During this period, studies on illegal mining are also visible [159–162], which generate land-use conflicts due to small and large-scale mining [163,164]. On the other hand, it is essential to highlight the increase in the scientific production of gold ASM, in which the scarce legislation [147,152,154,165,166], problems of health in people [167–169], and the inclusion of women in this type of activity [170] are emphasised.

*Period III (2011–2021):* Finally, the third period analysed is characterised by an exponential growth in scientific production related to ASM, with a total of 911 articles representing 74.21% of the total documents analysed (Figure 3). The average annual production exceeds 80 articles, with a peak in 2020 (161 articles) and 2021 (164 articles) investigated, defining ASM as a booming research field. As mentioned in previous periods, this field of research is generally related to lines such as pollution [49,171–177], agriculture problems caused by ASM [178–181], the association of ASM with poverty [182–184], mining conflicts [185,186], informal/illegal ASM [187–189], and the influence of ASM on water quality [190,191], among others. However, this period is characterised by an intensive growth in the scientific contribution to solving mining conflict problems through ASM formalization strategies [45,192–198], in addition to contributing to research focused on strategies for reducing environmental pollution [199,200] and health risk mitigation [201].

### 3.1.2. Regional and Country Contribution

According to the authors' different affiliations, the contribution by country indicates that, worldwide, 46 countries contribute to research related to ASM (Figure 4). In general, four countries stand out due to their high scientific production: the United States (210 articles), United Kingdom (209 articles), Canada (133 articles), and Ghana (109 articles) (Figure 5). In addition, these countries are characterised by a high number of citations compared to the other contributing nations, with the United Kingdom standing out as the most cited country worldwide on topics related to ASM (94,929 citations) (Table 1).

**Table 1.** Top 10 countries by the number of documents.

Ranking	Country	Region	Documents	Citations
1	United States	América	210	3989
2	United Kingdom	Europa	209	6440
3	Canada	América	133	2891
4	Ghana	África	109	1792
5	Australia	Oceanía	83	1076
6	China	Asia	71	1508
7	Germany	Europa	67	1209
8	Brazil	América	63	931
9	South Africa	África	57	394
10	Belgium	Europa	56	1307

According to the affiliation obtained, it is essential to note that the top 10 countries that contributed the most in the field can be differentiated (Table 1), highlighting the participation of developed countries such as the United States, United Kingdom, and Canada, leaders in ASM research throughout the world.

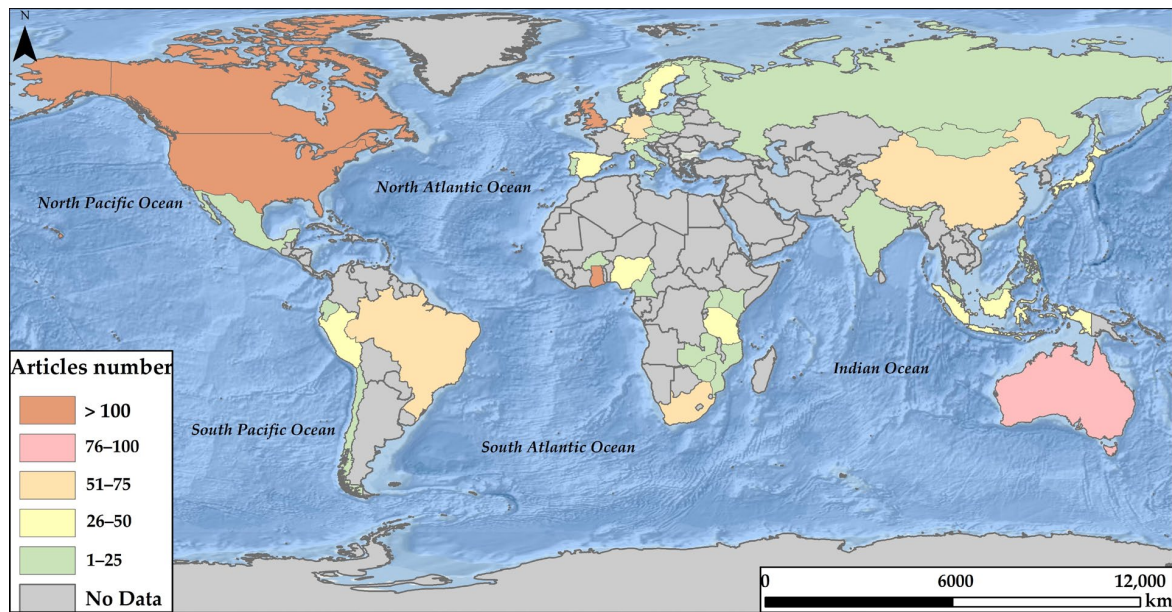


Figure 4. Contribution of studies related to ASM by country.

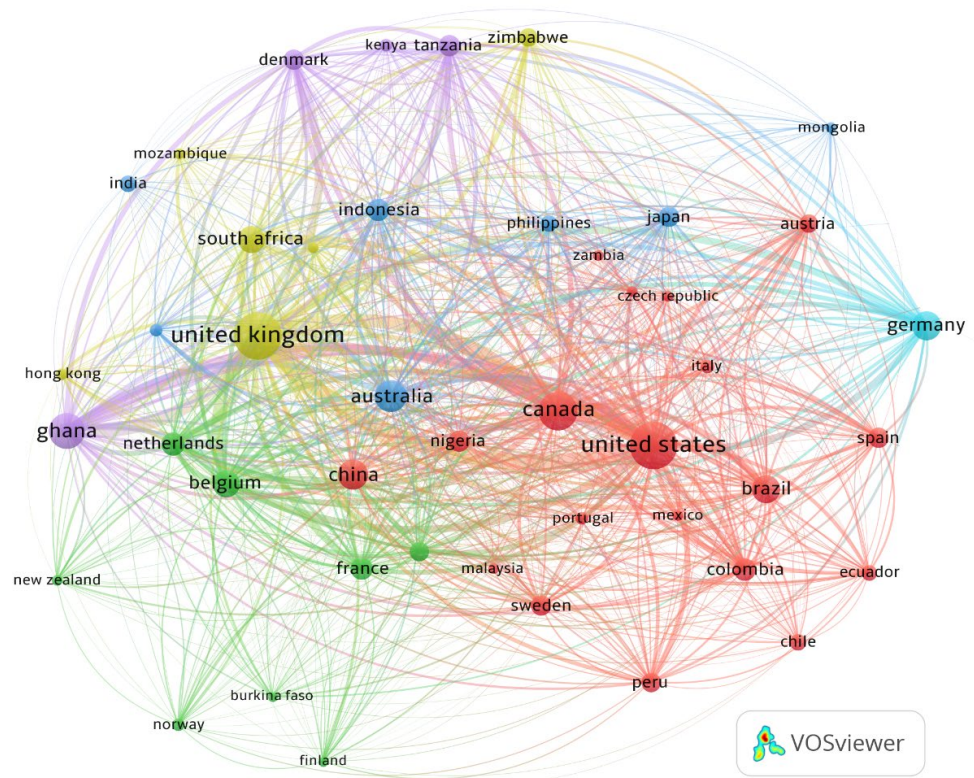


Figure 5. Country contribution bibliometric map in ASM. The nodes' size varies depending on the number of documents per country, related through links in which their collaboration is reflected.

The behaviour of collaboration between countries, based on affiliation data, indicates that the United States, Canada, Australia, Germany, Austria, and Spain are the countries with the most significant collaboration (each one collaborates with 45 different countries). The United States, the country with the highest production, contributes to 45 countries, of which Canada, Ghana, and Germany stand out. When analyzing the United States production, the studies focus on issues related to the impact that ASM generates on the



environment [49,156,157,202,203], health implications [168,171,173,204–206], the effects of ASM on socioeconomic factors [24,184,207], and the inclusion of women in jobs related to this type of activity [23,170,208]. Strengthening its studies of problems associated with ASM, the United States also generated contributions in the areas focused on the need for ASM regulations [195,209–211], as well as ASM risk and contamination mitigation alternatives [201,212–214].

Although the United States is the country with the highest scientific production, the United Kingdom, with only one less article, far exceeds the number of citations in its works. These studies include the socioeconomic impacts of ASM in developing countries and strategies focused on the sector’s sustainability [9], environmental problems of small-scale gold mining [42], poverty-driven informal artisanal gold mining [73], and ASM reforms [215]. This analysis also includes the study of the dependence on mercury as an agent of poverty in artisanal gold mining [216] and the pollution generated in these communities [217]. Studies on strategies to eradicate illegal artisanal mining are also included [162].

Canada, occupying third place in the contribution of ASM articles, makes contributions focused on African or South American countries. The investigations are related to the current use of mercury in ASM [7] and the proposal of actions focused on the reduction of these types of emissions [218], as well as the responsibility of miners, governments, and organizations in the search for solutions to pollution problems [41,219,220]. There are also studies related to the role of ASM formalization in Africa [34].

### 3.1.3. Journal Performance

The analysis included 468 journals in which 1257 scientific articles were published (database analysed) related to ASM. Table 2 shows the top 10 of the most outstanding journals, with 401 articles representing 31.9% of the total.

**Table 2.** Top 10 journals with the highest number of publications.

Ranking	Journal	Country	Documents Number	Representation	Citations	SJR *	Cite Score
1	<i>Resources Policy</i>	United Kingdom	116	9.2	2912	1.276	6.3
2	<i>Extractive Industries and Society</i>	The Netherlands	82	6.5	951	0.999	4.2
3	<i>Journal of Cleaner Production</i>	United Kingdom	40	3.2	1384	1.937	13.1
4	<i>Natural Resources Forum</i>	United Kingdom	37	2.9	843	0.646	2.9
5	<i>Science of the Total Environment</i>	The Netherlands	31	2.5	1492	1.795	10.5
6	<i>International Journal of Environmental Research and Public Health</i>	Switzerland	27	2.1	450	0.747	3.4
7	<i>Minerals and Energy—Raw Materials Report</i>	United Kingdom	18	1.4	70	0.143	-
8	<i>Geoforum</i>	United Kingdom	17	1.4	472	1.584	5.5
9	<i>World Development</i>	United Kingdom	17	1.4	820	2.386	8.4
10	<i>Environmental Research</i>	United States	16	1.3	677	1.460	7.9

\* SJR data was obtained from Scimago Journal & Country Rank.

*Resources Policy* is the leading journal in scientific publications in the analysed field with 116 articles representing 9.2% of the total. This journal is the most cited worldwide, with 2912 citations. The top five studies with the highest citations (Banchirigah [162], Hilson [221], Siegel & Veiga [34], (Mohammed Banchirigah [215], and y Geenen [193]) focus on formalization and poverty related to ASM in Africa. Based on its citations (163), the most relevant study was developed by Banchirigah [162] in Ghana. The study argues for the need to eradicate illegal mining through formalization, work alternatives, and government and military intervention. On the other hand, the journal *Science of the Total Environment*,

occupying fifth place in the production of ASM, represents the second most cited journal (1492 citations). The two most cited articles correspond to the one carried out by Hylander and Goodsite [157] (191 citations) and de Cordy et al. [41] (162 citations), which discuss mercury contamination from ASM and the costs involved in remediating the environment.

### 3.1.4. Frequently Cited Documents

Citation analysis exposes a given article's influence by the citation it receives in another articles [222]. The scientific production for ASM globally (1257 articles) presents 20,579 citations. Table 3 presents the top 10 of the most cited documents with 1776 citations, representing 8.63% of the total. The established ranking is characterised by documents published in 2005.

**Table 3.** Top 10 most cited documents.

Ranking	Authors	Year	Title	Citations	Journal
1	Bebbington et al. [223]	2008	Mining and Social Movements: Struggles Over Livelihood and Rural Territorial Development in the Andes	292	<i>World Development</i>
2	Xiao et al. [173]	2017	Soil heavy metal contamination and health risks associated with artisanal gold mining in Tongguan, Shaanxi, China	196	<i>Ecotoxicology and Environmental Safety</i>
3	Hilson & Potter [73]	2005	Structural adjustment and subsistence industry: Artisanal gold mining in Ghana	194	<i>Development and Change</i>
4	Hylander & Goodsite [157]	2006	Environmental costs of mercury pollution	191	<i>Science of the Total Environment</i>
5	Banchirigah [162]	2008	Challenges with eradicating illegal mining in Ghana: A perspective from the grassroots	163	<i>Resources Policy</i>
6	Cordy et al. [41]	2011	Mercury contamination from artisanal gold mining in Antioquia, Colombia: The world's highest per capita mercury pollution	162	<i>Science of the Total Environment</i>
7	Fisher [224]	2007	Occupying the margins: Labour integration and social exclusion in artisanal mining in Tanzania	149	<i>Development and Change</i>
8	Veiga et al. [218]	2006	Origin and consumption of mercury in small-scale gold mining	149	<i>Journal of Cleaner Production</i>
9	Hilson [221]	2009	Small-scale mining, poverty and economic development in sub-Saharan Africa: An overview	141	<i>Resources Policy</i>
10	Bose-O'Reilly [167]	2008	Mercury as a serious health hazard for children in gold mining areas	139	<i>Environmental Research</i>

The study by Bebbington et al. [223] is the most cited article (292 citations), with intervention of authors from the United Kingdom, the United States, Ecuador, and Peru. In his study, reference is made to the influence of social movements against mining investment in Latin America. Mainly two case studies are exposed (Ecuador and Peru), in which it is evident how social activities can significantly modify the form and effects of the extractive industry.

Second place is occupied by Xiao et al. [173], with the presence of authors from China and the United States. The research analyses soil contamination from artisanal gold mining in China and its implications for human health and environmental wellbeing by assessing heavy metal levels in soil and plants. Likewise, within its objectives, the identification of plants that promote the phytoremediation of the area is addressed.

Finally, the third most cited article related to ASM is the work developed by Hilson and Potter [73], authors from the United Kingdom. Their scientific contribution focuses on analysing Ghana's National Structural Adjustment Program (SAP) as a driver in the growth of informal artisanal gold mining driven by poverty.

### 3.2. Intellectual Structure Analysis

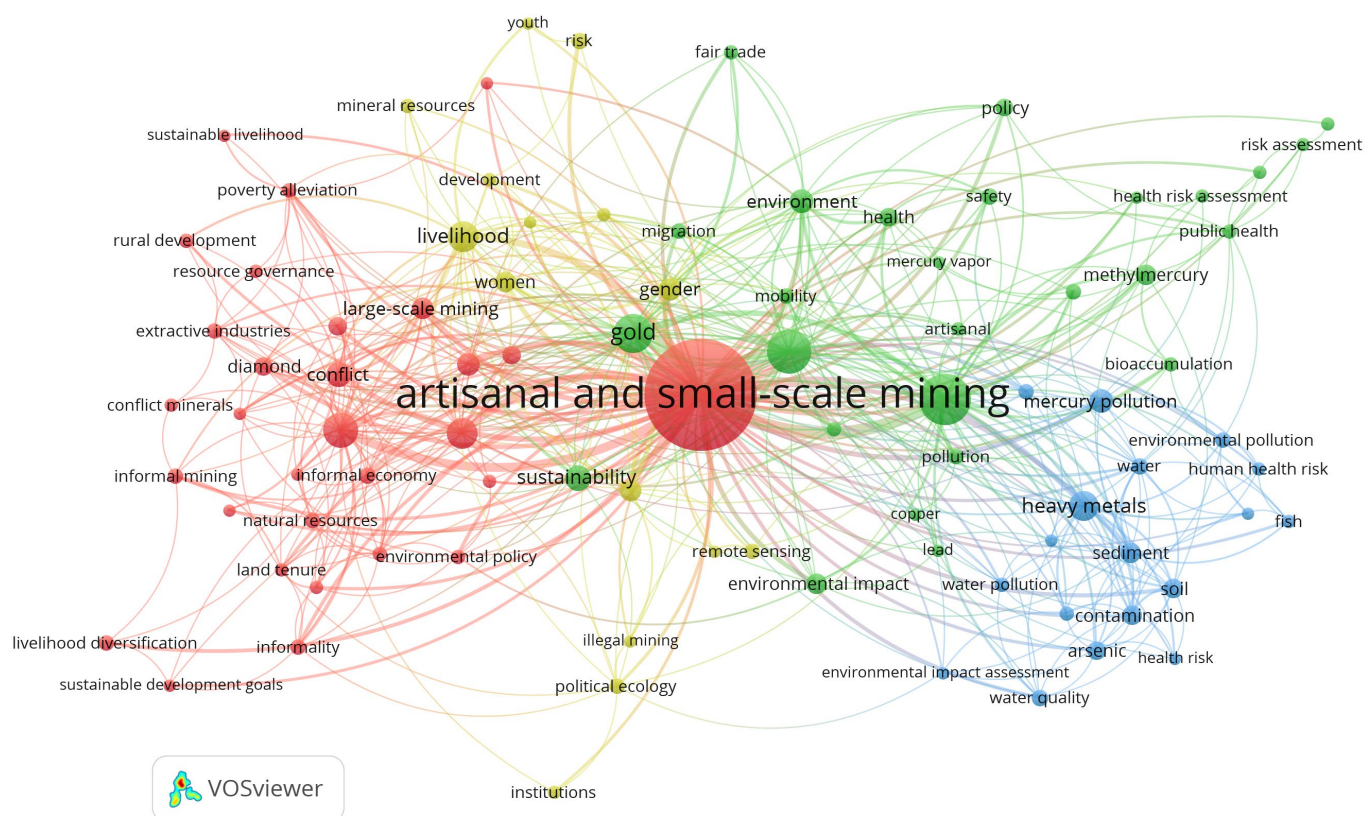
#### 3.2.1. Co-Occurrence Author Keyword Network

The co-occurrence analysis of author words allows for the formation of connections and the building of a domain structure based on keywords [225]. The analysis included a process of cleaning and filtering the information, obtaining 90 keywords. Table 4 shows the top 15 words with the highest occurrence in the area studied, highlighting "artisanal and small-scale mining", "mercury", and "mining" as the top three most frequent keywords in ASM studies.

**Table 4.** The 15 main words with the highest occurrence in ASM studies.

Ranking	Keywords	Occurrences	Links	Total Link Strength
1	artisanal and small-scale mining	597	88	764
2	mercury	109	41	198
3	mining	80	49	98
4	gold	60	39	129
5	formalization	48	35	101
6	livelihood	38	24	71
7	poverty	36	23	73
8	heavy metals	34	21	53
9	sustainability	25	14	32
10	conflict	23	20	51
11	environment	21	20	52
12	mercury pollution	21	14	30
13	gender	20	19	44
14	sustainable development	20	20	34
15	galamsey	18	19	34

The bibliometric map obtained grouped the 90 keywords into nodes of different colours grouped into four clusters that represent the main research areas of ASM (Figure 6). The nodes' size varies depending on the number of occurrences of each keyword, and they are related through links in which the thickness represents a better relationship.



**Figure 6.** Author keyword co-occurrence bibliometric map in ASM.

#### Cluster 1 (Red Colour): Social Conditioning Factors of the ASM

The social conditioning factors of ASM represent one of the research areas aimed at understanding how poverty drives the development of this type of activity as a subsistence alternative, which entails informality [189], conflict [185,186], child labour [226], and women's labour [227]. Likewise, the link between mining and agricultural activity in rural areas with low economic resources is exposed as the primary source of subsistence for people [27,180,228]. Considering this type of problem, it is evident how formalization represents a considerable challenge [186] and is regarded as a tool that allows for regulating, controlling, and effectively supporting ASM operators [34,45,197,209,229]. However, several case studies show that formalization in various countries aggravates mining conflicts, informality, poverty, illegality, and state control [193,230–232]; entrenching poverty without achieving sustainable development [233].

Given this situation, research developed to establish strategies in ASM that allow for achieving sustainable development [234] through an analysis of social, political, economic, environmental, and health aspects [235–237]. Some examples of this type of action are: (i) the implementation of design thinking and multi-criteria decision analysis of ASM [238], (ii) national minerals policies and stakeholder participation in planning decisions [239], (iii) collaboration between the LSM and ASM, for the benefit of the communities [240], and (iv) integration of scientific and local knowledge in the planning of the remediation of contamination by ASM [214,241].

#### Cluster 2 (Blue Colour): ASM Environmental Impacts

Artisanal and small-scale gold mining (ASSGM) is the most developed activity in ASM. In this area of research, significant production of environmental and health impacts caused by ASSGM is evident [156,218,219], and limited studies are addressing the effects on the health and environmental impacts of artisanal sandstone mining [242] and diamond mining [26,234,243].



The investigations are most frequently related to pollution generated in the soil [244–248], water [249–251], and crops or trees [158,252], which directly influence the health and well-being of humans. Faced with this problem, finding innovative research to eliminate, replace, or reduce environmental pollution in mineral processing is standard. Some examples are the cyanide phytoremediation by water hyacinths (*Eichhornia crassipes*) in the cyanide effluents treatment in small-scale gold mining [253], hyperaccumulation of zinc by *Corydalis davidii* in Zn-polluted soils [254], *Erato polymnioides* as a phytoremediation plant for soils contaminated with Pb, Zn, Cu, and Cd [255], and *Heliconia psittacorum* in remediating soils and water polluted with heavy metals [256].

#### Cluster 3 (Green Colour): Mercury Contamination and Its Implication on Health and the Environment

Mercury is a heavy, liquid metal frequently used in artisanal gold mining. This cluster reflects a marked trend of studies focused on the health and environmental effects of mercury or methylmercury contamination in soil, sediments, and water [257–259]. This type of contamination generated significant research on health problems associated with direct or indirect exposure of humans to mercury due to mining activities [167,260–263], as well as studies evaluating the risk posed to human health by ingestion of heavy metals that are present in the water and plants [176,264–266].

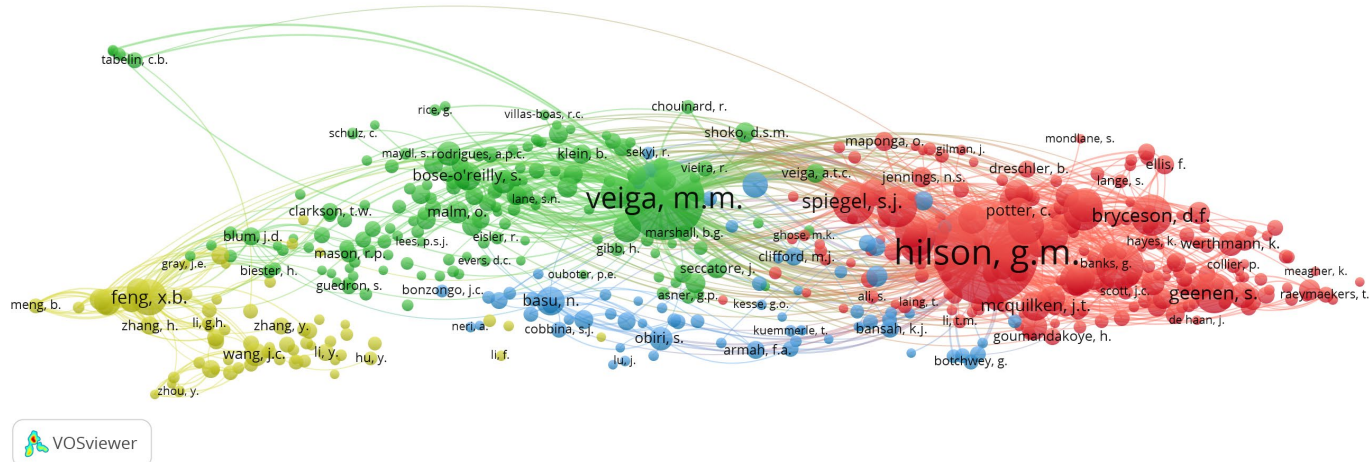
Given the implications of mercury on the environment and health, the reason for the emergence of research that highlights the importance of cooperation between government, regional, and local organisations to improve mineral extraction and processing processes through legalisation, financial support, technological innovation, and training [9,212,267,268], as well as studies focused on reducing pollution to ensure human and environmental health [202,269,270], is evident. These include analyses that seek to minimise the use of mercury through price increases [219], laws (agreements) that prohibit its use in mining [269,271–273], promotion of appropriate technology [154,274], and training on improved technologies for gold extraction [275] (e.g., use of cassava to leach gold [276]). Finally, it is essential to highlight how local participation in decision making [277] and indigenous participation due to their ecological knowledge [278] are alternatives to achieving sustainability in ASM mineral processing.

#### Cluster 4 (Yellow Colour): ASM as Livelihood

In this cluster, the most frequent studies are those related to ASM as a subsistence activity in rural communities with limited resources. Within her research, the women's role in ASM as a means of subsistence due to poverty is emphasised [227,279,280], as well as the need for policies that improve the economic wellbeing of people who depend on ASM regardless of gender [229,281]. On the other hand, considering that several countries chose to ban this type of mining, there is also research related to alternative livelihood strategies for miners who were displaced from their activity [282,283]. Some examples of these strategies are promoting agriculture as an alternative economic source [179,284] or complementary [178], and promoting government support in ASM through regulations that allow regulating activity [194].

#### 3.2.2. Co-Citation Network of Cited Authors

The analysis carried out allowed for the identification of co-cited authors and authors that make up the scientific base of the area studied [285]. This type of analysis proposes that two authors share the same area of research if their documents are cited jointly by one or more documents [286–288]. The author co-citation network (Figure 7), built in the VOSviewer software, groups 512 authors (nodes) into six clusters representing similarities in the topics investigated with more than twenty co-citations.



**Figure 7.** Co-citation network of authors in ASM.

Cluster 1 (red colour), “ASM and implications in society”, comprises 206 authors, including Hilson, G.M. (2212), Maconachie, R. (456); Spiegel, S.J. (363); Bryceson, D.F. (353); y Banchirigah, S.M. (337) due to its high number of co-citations. This group of researchers carried out studies within ASM that include: (i) positive and negative effects of artisanal mining formalization [194,197,198,215,289], (ii) ASM and agriculture as a means of subsistence [47,180,284,290,291], and (iii) analysis of alternatives that improve mineral extraction or processing systems [269,292–294].

Within cluster 2 (green colour), “consequences and challenges of Mercury in ASM”, the researchers Veiga, M.M.; Beinhoff, C.; Bose-O’reilly, S.; Telmer, K.H.; and y Drasch, G. represent the top five co-cited authors, in a cluster with a total of 166 authors. This research includes studies of mercury contamination in gold mining areas [41,295,296], evaluation of risks to human health due to exposure to mercury by operators, women, and children [167,295,297,298], and strategies to reduce this type of contamination based on the modernization of mineral processing in obtaining gold [148,199,219,299–302].

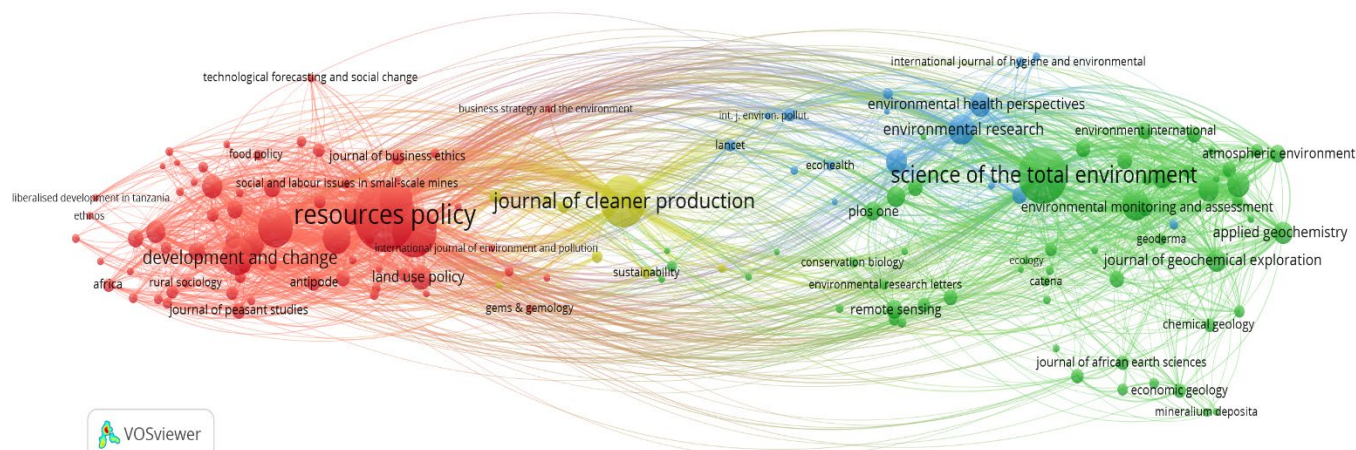
Cluster 3 (blue colour), “Implications of ASM in health”, composed of 73 authors, in which Basu, N.; Pardie, S.; Obiri, S.; Aryee, B.N.A.; and Amankwah, R.K. are the most coveted authors. This cluster mainly includes studies of risk to human health due to exposure to mercury [48,303], environmental impacts of ASM [49], consumption of contaminated food or water [304], or multiple heavy metals [305]. Likewise, the authors expose an interest in providing strategies to reduce pollution produced by ASM, mainly due to the use of mercury [155,216,217,234,242,306].

Finally, cluster 4 (yellow colour) with 67 authors, called “Effects of artisanal mercury extraction”, leads to the top five most co-cited authors, represented by Feng, X.B.; Qiu, G.L.; Li, P.; Wang, J.C.; and Wang, S.F. This group of authors dedicate their studies to topics related to Hg contamination in the air [307], water [308], sediments, soil, or crops [309–312] in mercury mining areas, mainly in China. They also analyse the risk posed to miners and people in mining areas when exposed to Hg or methylmercury [313–315].

### 3.2.3. Journal Co-Citation Network

The analysis considers the similarity between a group of journals based on the citations received when two or more journals are cited jointly by several related documents [316]. The objective of this analysis is based on understanding the structures of the academic areas.

Figure 8 shows the co-citation network of 152 journals (nodes) with more than 20 citations, grouped into four different clusters (differentiated by colours) and their other connections.



**Figure 8.** Journal co-citation network in ASM.

Cluster 1 (red colour), “Management, Policy and Development”, contains 70 journals representing 8757 citations. In this group, the journals *Resources Policy* (1799 citations, United Kingdom), *Extractive Industries and Society* (939 citations, The Netherlands), *World Development* (578 citations, United Kingdom), *Natural Resources Forum* (526 citations, United Kingdom), and *Development and Change* (502 citations, UK) are shown as the top five of the most talked-about magazines. The studies within this cluster comprise analyses of ASM’s political, economic, environmental, and social aspects in different parts of the world.

Cluster 2 (green colour), “Environmental Science and Pollution”, with 58 journals and 5675 citations, mainly exposes studies associated with the environmental contamination of ASM and its human implications. In this group are journals such as *Science of the Total Environment* (1170 citations, The Netherlands), *Environmental Science & Technology* (365 citations, United States), *Environmental Pollution* (245 citations, United Kingdom), *Chemosphere* (205 citations, United Kingdom), and *Water, Air and Soil Pollution* (205 citations, The Netherlands), among others.

Cluster 3 (blue), “Environmental Science and Health”, has 16 journals and 1327 citations. The journals with the highest citations include *Environmental Research* (322 citations, United States), *Environmental Health Perspectives* (230 citations, United States), *International Journal of Environmental Research and Public Health* (230 citations, Switzerland), *Minerals Engineering* (101 citations, United Kingdom), and *International Journal of Occupational and Environmental Health* (68 citations, UK). Within this cluster, the primary studies focus on evaluating the impact of ASM on human health due to direct or indirect exposure to heavy metals.

Cluster 4 (yellow colour), “Renewable Energy, Sustainability and the Environment”, consists of 8 journals with 1305 citations. These journals include research papers focused on mineral extraction and processing sustainability in ASM. The top five most-cited journals are *Journal of Cleaner Production* (1000 citations, UK), *Environmental Science & Policy* (65 citations, The Netherlands), *Ecological Economics* (57 citations, The Netherlands), *Sustainability* (57 citations, Switzerland), and *Journal of Sustainable Mining* (54 citations, Poland).

#### 4. Discussion

The systematic process applied in this study made it possible to identify the intellectual structure of artisanal and small-scale mining (ASM) in the world. Considering the performance analysis carried out, it is apparent that the scientific production of ASM began in 1919, being until 1980 a scarce production (eight articles). Furthermore, the range of years analysed (distributed in three periods) indicates that the research remained relatively constant since 1980 (periods I and II). However, as of 2010 (period III), ASM research increased exponentially worldwide, representing 74.21% of the articles produced (Figure 3). This marked difference in scientific production could refer to the artisanal mining boom



that the world experienced in the last decade, mainly due to the increase in poverty within rural areas. The rise of ASM, characterised by extraction and processing techniques without technical and environmental considerations, clearly represents a risk to humanity and the environment. This is why the increase mentioned above in scientific production focuses its studies on ASM contamination [173,174], mining conflicts [185,186], illegal ASM [187–189], as well as strategies to solve these types of problems [196,197,200,201].

On the other hand, when analyzing scientific production by country, the United States, the United Kingdom, and Canada represent the most significant contributions to research related to ASM (Table 1). Of these countries, the United Kingdom is characterised by its high number of citations (Table 1) and its extensive collaboration (greater than 70%) in studies carried out in African countries (e.g., Ghana and Tanzania). Likewise, this country occupies the number one position with the *Resource Policy* magazine, contributing the highest number of ASM publications (116 articles) (Table 2). On the other hand, the United States and Canada collaborate in studies mainly in South American countries such as Brazil, Peru, and Colombia, and Africa, mainly in Ghana.

Considering the analysis of the intellectual structure through three scientific maps, the study of the co-occurrence of author keywords (Figure 6) made it possible to define, through clusters, four research areas of ASM. Within these areas, “Social conditioning factors of the ASM” and “Mercury contamination and its implication in health and environment” are the most studied topics (e.g., [34,192,209,218,240,252]). On the other hand, it is essential to highlight that cluster 2 (“ASM environmental impacts”) and cluster 3 (“Mercury contamination and its implication in health and environment”) are strongly related (Figure 6), with studies focused on the impacts of ASM on the environment (e.g., [249,251,258,309]) and health (e.g., [261,263,265]). However, considering a specific orientation and significant scientific production related to mercury, the results reflect the study of mercury as a particular area in this analysis.

Cluster 4 (ASM as livelihood) is an ASM area with relatively less scientific production, strongly related to cluster 1. The objective of ASM as a livelihood area includes research in which ASM is analysed as a means of subsistence and the search for strategies to propose alternative or complementary activities that benefit the living conditions of people who depend economically on this type of activity (e.g., [179,194,280]).

To complement the analysis of the co-occurrence of keywords, the co-citation analysis of authors was carried out, which allowed for the identifying of the relationships between different authors in the references of the research works carried out on ASM. The results obtained reflect the existence of 512 authors grouped into four clusters, representing the author’s areas or lines of research (Figure 7). These areas are very well defined in specific topics; however, they are all within a large area called “Effects of ASM and mitigation measures”. Of the clusters obtained, clusters 2 and 3 are firmly related, presenting studies that address similar issues regarding the use and effects of mercury in ASM [216,219,297,303]. On the other hand, it is important to highlight an area aimed at research related to the artisanal extraction of mercury (Cluster 4), in which authors such as Feng, X.B.; Qiu, G.L.; Li, P.; Wang, J.C.; and Wang, S.F. carried out works that include the contamination generated by mercury mines in the soil, water, and air [307–309], as well as the risk it represents for human health [310,313].

Finally, the co-citation analysis of journals was carried out to understand the different academic areas in which ASM studies are published. The results show us four main academic areas (clusters) (Figure 8), defined based on the research topics. For example, in the cluster with the highest number of co-cited journals (cluster 1), the journals *Resources Policy* and *Extractive Industries* stand out with the highest number of co-citations in works oriented to ASM’s political, economic, social, and environmental aspects. Likewise, it is essential to highlight that clusters 2 and 3 show related academic areas in which the journals publish research topics on environmental pollution of ASM and its health risks. In these clusters, the journals with the highest number of co-citations correspond to *Science*



of the Total Environment (cluster 2) and Environmental Research (cluster 3), which add up to 1170 and 322 citations, respectively.

On the other hand, the connection offered by cluster 4 (Renewable Energy, Sustainability, and the Environment) with the other clusters is visible. Being in the centre of the clusters obtained (Figure 8), despite its limited number of journals (eight), its high number of co-citations (1305) highlights the importance of its research topics focused on the socio-environmental aspects of ASM, with the *Journal of Cleaner Production* as the most prominent journal.

Specifically, ASM research exposes excellent studies that identify the causes and effects of the leading social, economic, and environmental problems that compromise environmental and human wellbeing in the short, medium, and long term (e.g., [9,34,73,157,173,218,223,317]). These studies lay the groundwork for issues that must be mitigated and eliminated. The analysed database reflects that, over time, studies developed that focus on solutions to problems generated by ASM (e.g., [238,239,241,253,256,268,278,294,318,319]). However, despite the worldwide importance and impact of research aimed at ASM solutions, it is still scarce (less than 20% of the analysed database). For this reason, the possibility arises that the different authors in ASM strengthen this type of study to the point that in the best of cases, it is considered one of the top research areas in ASM.

The analysis made it possible to evaluate the evolution and trends of research in ASM and propose strengthening innovative studies regarding ASM's environmental, social, legal, and economical solutions. Therefore, this type of research can be included by the representative authors and journals of ASM as a new booming field that represents sustainable solutions for the effects produced by this type of mining activity.

## 5. Conclusions

The bibliometric analysis allowed us to evaluate the structure of ASM research field within the last four decades. Within the performance analysis, the results obtained show a scientific production with exponential growth in ASM research, with the collaboration of 46 countries, highlighting the United States, United Kingdom, and Canada as the countries with the highest scientific production that address ASM research in mainly Latin American and African countries, respectively. Furthermore, the works are the products of 512 authors published in 468 journals, qualifying ASM as a booming research field.

By analysing the co-occurrence of keywords, four areas of research in ASM were defined: (i) social conditioning factors of ASM, (ii) environmental impacts generated by ASM, (iii) mercury contamination and its implication on health and the environment, and (iv) ASM as a livelihood. Within these areas, a clear trend of studies related to the implications of ASM from the political, social, economic, and environmental points of view is apparent. On the other hand, it is essential to highlight the effects of mercury on the environment and health as topics on the rise, mainly in health risk assessment and strategies that minimise the impact of mercury on ASM. However, studies aimed at finding solutions in ASM to date are scarce and need to be strengthened.

Despite limiting the study to only one database (Scopus) and considering only one type of document (articles) in the English language, the proposed research establishes a global analysis of the ASM study. This analysis can serve as a reference for future researchers in the field for the most researched topics, authors, and outstanding journals; and raise the possibility of forming collaborative networks inside and outside your country.

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## References

1. Li, Z.; Ma, Z.; van der Kuijp, T.J.; Yuan, Z.; Huang, L. A review of soil heavy metal pollution from mines in China: Pollution and health risk assessment. *Sci. Total Environ.* **2014**, *468–469*, 843–853. [[CrossRef](#)] [[PubMed](#)]
2. Zhuang, P.; McBride, M.B.; Xia, H.; Li, N.; Li, Z. Health risk from heavy metals via consumption of food crops in the vicinity of Dabaoshan mine, South China. *Sci. Total Environ.* **2009**, *407*, 1551–1561. [[CrossRef](#)] [[PubMed](#)]
3. UN. *Small-Scale Mining in the Developing Countries*; United Nations: New York, NY, USA, 1972.
4. Vale, E. *Análise Econômica das Pequenas e Médias Empresas de Mineração: Relatório Final*; CPRM: Rio de Janeiro, Brazil, 2002.
5. Vergara, F. Ecuador Registro Oficial, año III, N.517. Available online: [http://www.mineriaecuador.com/download/ley\\_mineriaec.pdf](http://www.mineriaecuador.com/download/ley_mineriaec.pdf) (accessed on 28 June 2022).
6. Veiga, M.M.; Angeloci-Santos, G.; Meech, J.A. Review of barriers to reduce mercury use in artisanal gold mining. *Extr. Ind. Soc.* **2014**, *1*, 351–361. [[CrossRef](#)]
7. Seccatore, J.; Veiga, M.; Origliasso, C.; Marin, T.; De Tomi, G. An estimation of the artisanal small-scale production of gold in the world. *Sci. Total Environ.* **2014**, *496*, 662–667. [[CrossRef](#)]
8. Marshall, B.G.; Veiga, M.M. Formalization of artisanal miners: Stop the train, we need to get off! *Extr. Ind. Soc.* **2017**, *4*, 300–303. [[CrossRef](#)]
9. Hilson, G. Small-scale mining and its socio-economic impact in developing countries. *Nat. Resour. Forum* **2002**, *26*, 3–13. [[CrossRef](#)]
10. Veiga, M.M. *Introducing New Technologies for Abatement of Global Mercury Pollution in Latin America*; UNIDO; UBC; CETEM: Rio de Janeiro, Brazil, 1997.
11. Mossa, J.; James, L.A. 13.6 Impacts of Mining on Geomorphic Systems. In *Treatise on Geomorphology*; Elsevier: Amsterdam, The Netherlands, 2013; pp. 74–95.
12. Hentschel, T.; Hruschka, F.; Priester, M. *Global Report on Artisanal & Small-Scale Mining*; IIED: London, UK; WBCSD: Geneva, Switzerland, 2002.
13. D’Souza, K.P.C.J. Artisanal and small-scale mining in Africa: The poor relation. *Geol. Soc. London Spec. Publ.* **2005**, *250*, 95–120. [[CrossRef](#)]
14. Buxton, A. *Sustainable Markets, Responding to the Challenges of Artisanal and Small-Scale Mining. How Can Knowledge Networks Help?* IIED: London, UK, 2013.
15. World Bank. *Mining Together Large-Scale Mining Meets Artisanal Mining: A Guide for Action*; Communities and Small-Scale Mining (CASM), The World Bank: Washington, DC, USA, 2013.
16. Maldar, S. *Fairtrade and Fairmined Gold, Empowering Responsible Artisanal and Small-Scale Miners*; Adam Matthew Digital: London, UK, 2011.
17. ICMM. *Working Together: How Large-Scale Mining Can Engage with Artisanal and Small-Scale Miners*; International Council on Mining Metals (ICMM): London, UK, 2010.
18. UNECA. *Minerals and Africa’s Development: The International Study Group Report on Africa’s Mineral Regimes*; United Nations Economic Commission for Africa (UNECA); Conference Management Section (PCMS): Addis Ababa, Ethiopia, 2011.
19. Hinton, J.J. *Communities and Small-Scale Mining: An Integrated Review for Development Planning*; Communities and Small-Scale Mining (CASM) Initiative Report: Washington, DC, USA, 2005.
20. ILO. *Facts on Small-Scale Mining*; ILO: Geneva, Switzerland, 2003.
21. SDC Swiss Agency for Development Cooperation (SDC). *SDC Experiences with Formalization and Responsible Environmental Practices in Artisanal and Small-Scale Gold Mining in Latin America and Asia (Mongolia)*; Swiss Federal Department of Foreign Affairs (FDFA): Bern, Switzerland, 2011.
22. Hentschel, T.; Hruschka, F.; Priester, M. *Artisanal and Small-Scale Mining: Challenges and Opportunities*; IIED: London, UK, 2003.
23. Labonne, B. Artisanal mining: An economic stepping stone for women. *Nat. Resour. Forum* **1996**, *20*, 117–122. [[CrossRef](#)]

24. Schwartz, F.W.; Lee, S.; Darrah, T.H. A Review of the Scope of Artisanal and Small-Scale Mining Worldwide, Poverty, and the Associated Health Impacts. *GeoHealth* **2021**, *5*, e2020GH000325. [[CrossRef](#)]
25. Hilson, G.; McQuilken, J. Four decades of support for artisanal and small-scale mining in sub-Saharan Africa: A critical review. *Extr. Ind. Soc.* **2014**, *1*, 104–118. [[CrossRef](#)]
26. Maconachie, R. Diamonds, governance and 'local' development in post-conflict Sierra Leone: Lessons for artisanal and small-scale mining in sub-Saharan Africa? *Resour. Policy* **2009**, *34*, 71–79. [[CrossRef](#)]
27. Kamlongera, P.J. Making the poor 'poorer' or alleviating poverty? artisanal mining livelihoods in rural malawi. *J. Int. Dev.* **2011**, *23*, 1128–1139. [[CrossRef](#)]
28. Bleischwitz, R.; Dittrich, M.; Pierdicca, C. Coltan from Central Africa, international trade and implications for any certification. *Resour. Policy* **2012**, *37*, 19–29. [[CrossRef](#)]
29. Hilson, G. Barriers to implementing cleaner technologies and cleaner production (CP) practices in the mining industry: A case study of the Americas. *Miner. Eng.* **2000**, *13*, 699–717. [[CrossRef](#)]
30. Carrión-Mero, P.; Aguilar-Aguilar, M.; Morante-Carballo, F.; Domínguez-Cuesta, M.J.; Sánchez-Padilla, C.; Sánchez-Zambrano, A.; Briones-Bitar, J.; Blanco-Torrens, R.; Córdova-Rizo, J.; Berrezueta, E. Surface and Underground Geomechanical Characterization of an Area Affected by Instability Phenomena in Zaruma Mining Zone (Ecuador). *Sustainability* **2021**, *13*, 3272. [[CrossRef](#)]
31. Carrión Mero, P.; Blanco Torrens, R.; Borja Bernal, C.; Aguilar Aguilar, M.; Morante Carballo, F.; Briones Bitar, J. Geomechanical characterization and analysis of the effects of rock massif in Zaruma City, Ecuador. In Proceedings of the 17th LACCEI International Multi-Conference for Engineering, Education, and Technology: "Industry, Innovation, and Infrastructure for Sustainable Cities and Communities", Montego Bay, Jamaica, 24–26 July 2019.
32. Carrión-Mero, P.; Loo-Oporto, O.; Andrade-Ríos, H.; Herrera-Franco, G.; Morante-Carballo, F.; Jaya-Montalvo, M.; Aguilar-Aguilar, M.; Torres-Peña, K.; Berrezueta, E. Quantitative and Qualitative Assessment of the "El Sexmo" Tourist Gold Mine (Zaruma, Ecuador) as A Geosite and Mining Site. *Resources* **2020**, *9*, 28. [[CrossRef](#)]
33. Mata-Perelló, J.; Carrión, P.; Molina, J.; Villas-Boas, R. Geomining Heritage as a Tool to Promote the Social Development of Rural Communities. In *Geoheritage*; Elsevier: Amsterdam, The Netherlands, 2018; pp. 167–177, ISBN 9780128095423.
34. Siegel, S.; Veiga, M.M. Artisanal and small-scale mining as an extralegal economy: De Soto and the redefinition of "formalization". *Resour. Policy* **2009**, *34*, 51–56. [[CrossRef](#)]
35. Berrezueta, E. Caracterización mineralógica y petrográfica de las vetas Vizcaya, Octubrina y Gabi del yacimiento aurífero epitermal Zaruma-Portovelo, Ecuador. *Boletín Geológico Min.* **2021**, *132*, 421–437. [[CrossRef](#)]
36. Tonggiroh, A.; Nur, I. Geochemical correlation of gold placer and indication of Au-Cu-Pb-Zn-Ag mineralization at Parigi Moutong, Central Sulawesi, Indonesia. *J. Phys. Conf. Ser.* **2019**, *1341*, 052003. [[CrossRef](#)]
37. Ibrahim, E.; Lema, L.; Barnabé, P.; Lacroix, P.; Pirard, E. Small-scale surface mining of gold placers: Detection, mapping, and temporal analysis through the use of free satellite imagery. *Int. J. Appl. Earth Obs. Geoinf.* **2020**, *93*, 102194. [[CrossRef](#)]
38. Berrezueta, E.; Castroviejo, R.; Pantoja, F.; Álvarez, R. Mineralogical study and digital image analysis quantification of gold ores from Nariño (Colombia). Application to the improvement of the processing. *Boletín Geol. Min.* **2002**, *113*, 369–379.
39. Iglesias-Martínez, M.; Ordóñez-Casado, B.; Berrezueta, E. Optical image and microchemical analysis of gold grains from a weathered profile of the Minvoul greenstone belt, northern Gabon. *Geol. Mag.* **2020**, *157*, 307–320. [[CrossRef](#)]
40. Castroviejo, R.; Berrezueta, E.; Lastra, R. Microscopic digital image analysis of gold ores: A critical test of methodology, comparing reflected light and electron microscopy. *Min. Metall. Explor.* **2002**, *19*, 102–109. [[CrossRef](#)]
41. Cordy, P.; Veiga, M.M.; Salih, I.; Al-Saadi, S.; Console, S.; García, O.; Mesa, L.A.; Velásquez-López, P.C.; Roeser, M. Mercury contamination from artisanal gold mining in Antioquia, Colombia: The world's highest per capita mercury pollution. *Sci. Total Environ.* **2011**, *410–411*, 154–160. [[CrossRef](#)]
42. Hilson, G. The environmental impact of small-scale gold mining in Ghana: Identifying problems and possible solutions. *Geogr. J.* **2002**, *168*, 57–72. [[CrossRef](#)]
43. Salomons, W. Environmental impact of metals derived from mining activities: Processes, predictions, prevention. *J. Geochem. Explor.* **1995**, *52*, 5–23. [[CrossRef](#)]
44. Labonne, B. Seminar on Artisanal and Small-Scale Mining in Africa: Identifying Best Practices and Building the Sustainable Livelihoods of Communities. In *The Socioeconomic Impacts of Artisanal and Small-Scale Mining in Developing Countries*; Hilson, G., Ed.; A.A. Balkema: Amsterdam, The Netherlands, 2003; pp. 131–150.
45. Verbrugge, B.; Besmanos, B. Formalizing artisanal and small-scale mining: Whither the workforce? *Resour. Policy* **2016**, *47*, 134–141. [[CrossRef](#)]
46. Gamu, J.; Le Billon, P.; Spiegel, S. Extractive industries and poverty: A review of recent findings and linkage mechanisms. *Extr. Ind. Soc.* **2015**, *2*, 162–176. [[CrossRef](#)]
47. Hilson, G. Farming, small-scale mining and rural livelihoods in Sub-Saharan Africa: A critical overview. *Extr. Ind. Soc.* **2016**, *3*, 547–563. [[CrossRef](#)]
48. Basu, N.; Clarke, E.; Green, A.; Calys-Tagoe, B.; Chan, L.; Dzodzomenyo, M.; Fobil, J.; Long, R.; Neitzel, R.; Obiri, S.; et al. Integrated Assessment of Artisanal and Small-Scale Gold Mining in Ghana—Part 1: Human Health Review. *Int. J. Environ. Res. Public Health* **2015**, *12*, 5143–5176. [[CrossRef](#)]

49. Rajae, M.; Obiri, S.; Green, A.; Long, R.; Cobbina, S.; Nartey, V.; Buck, D.; Antwi, E.; Basu, N. Integrated Assessment of Artisanal and Small-Scale Gold Mining in Ghana—Part 2: Natural Sciences Review. *Int. J. Environ. Res. Public Health* **2015**, *12*, 8971–9011. [[CrossRef](#)] [[PubMed](#)]
50. HIRONS, M. Managing artisanal and small-scale mining in forest areas: Perspectives from a poststructural political ecology. *Geogr. J.* **2011**, *177*, 347–356. [[CrossRef](#)]
51. Cossa, H.; Scheidegger, R.; Leuenberger, A.; Ammann, P.; Munguambe, K.; Utzinger, J.; Macete, E.; Winkler, M.S. Health Studies in the Context of Artisanal and Small-Scale Mining: A Scoping Review. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1555. [[CrossRef](#)] [[PubMed](#)]
52. Gibb, H.; O’Leary, K.G. Mercury Exposure and Health Impacts among Individuals in the Artisanal and Small-Scale Gold Mining Community: A Comprehensive Review. *Environ. Health Perspect.* **2014**, *122*, 667–672. [[CrossRef](#)] [[PubMed](#)]
53. Zolnikov, T.R.; Ramirez Ortiz, D. A systematic review on the management and treatment of mercury in artisanal gold mining. *Sci. Total Environ.* **2018**, *633*, 816–824. [[CrossRef](#)]
54. Bustamante, N.; Danoucaras, N.; McIntyre, N.; Díaz-Martínez, J.C.; Restrepo-Baena, O.J. Review of improving the water management for the informal gold mining in Colombia. *Rev. Fac. Ing. Univ. Antioq.* **2016**, *79*, 163–172. [[CrossRef](#)]
55. Echchakoui, S. Why and how to merge Scopus and Web of Science during bibliometric analysis: The case of sales force literature from 1912 to 2019. *J. Mark. Anal.* **2020**, *8*, 165–184. [[CrossRef](#)]
56. Muhuri, P.K.; Shukla, A.K.; Abraham, A. Industry 4.0: A bibliometric analysis and detailed overview. *Eng. Appl. Artif. Intell.* **2019**, *78*, 218–235. [[CrossRef](#)]
57. Donthu, N.; Kumar, S.; Pandey, N.; Lim, W.M. Research Constituents, Intellectual Structure, and Collaboration Patterns in Journal of International Marketing: An Analytical Retrospective. *J. Int. Mark.* **2021**, *29*, 1–25. [[CrossRef](#)]
58. Donthu, N.; Kumar, S.; Pandey, N. A retrospective evaluation of Marketing Intelligence and Planning: 1983–2019. *Mark. Intell. Plan.* **2020**, *39*, 48–73. [[CrossRef](#)]
59. Verma, S.; Gustafsson, A. Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. *J. Bus. Res.* **2020**, *118*, 253–261. [[CrossRef](#)] [[PubMed](#)]
60. Gimenez, E.; Salinas, M.; Manzano-Agugliaro, F. Worldwide Research on Plant Defense against Biotic Stresses as Improvement for Sustainable Agriculture. *Sustainability* **2018**, *10*, 391. [[CrossRef](#)]
61. Ellegaard, O.; Wallin, J.A. The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics* **2015**, *105*, 1809–1831. [[CrossRef](#)] [[PubMed](#)]
62. Donthu, N.; Kumar, S.; Mukherjee, D.; Pandey, N.; Lim, W.M. How to conduct a bibliometric analysis: An overview and guidelines. *J. Bus. Res.* **2021**, *133*, 285–296. [[CrossRef](#)]
63. Cobo, M.J.; López-Herrera, A.G.; Herrera-Viedma, E.; Herrera, F. An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the Fuzzy Sets Theory field. *J. Informetr.* **2011**, *5*, 146–166. [[CrossRef](#)]
64. Cobo, M.J.; Martínez, M.A.; Gutiérrez-Salcedo, M.; Fujita, H.; Herrera-Viedma, E. 25years at Knowledge-Based Systems: A bibliometric analysis. *Knowl.-Based Syst.* **2015**, *80*, 3–13. [[CrossRef](#)]
65. Van Eck, N.J.; Waltman, L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* **2010**, *84*, 523–538. [[CrossRef](#)]
66. Waltman, L.; van Eck, N.J.; Noyons, E.C.M. A unified approach to mapping and clustering of bibliometric networks. *J. Informetr.* **2010**, *4*, 629–635. [[CrossRef](#)]
67. Kim, J.; McMillan, S.J. Evaluation of Internet Advertising Research: A Bibliometric Analysis of Citations from Key Sources. *J. Advert.* **2008**, *37*, 99–112. [[CrossRef](#)]
68. Carrión-Mero, P.; Montalván-Burbano, N.; Paz-Salas, N.; Morante-Carballo, F. Volcanic Geomorphology: A Review of Worldwide Research. *Geosciences* **2020**, *10*, 347. [[CrossRef](#)]
69. Bellis, N. *Bibliometrics and Citation Analysis*; The Scarecrow Press: Toronto, ON, Canada, 2009.
70. van Eck, N.J.; Waltman, L. Visualizing Bibliometric Networks. In *Measuring Scholarly Impact*; Springer International Publishing: Cham, Switzerland, 2014; pp. 285–320.
71. Morante-Carballo, F.; Montalván-Burbano, N.; Carrión-Mero, P.; Espinoza-Santos, N. Cation Exchange of Natural Zeolites: Worldwide Research. *Sustainability* **2021**, *13*, 7751. [[CrossRef](#)]
72. Parish, A.J.; Boyack, K.W.; Ioannidis, J.P.A. Dynamics of co-authorship and productivity across different fields of scientific research. *PLoS ONE* **2018**, *13*, e0189742. [[CrossRef](#)] [[PubMed](#)]
73. Hilson, G.; Potter, C. Structural Adjustment and Subsistence Industry: Artisanal Gold Mining in Ghana. *Dev. Change* **2005**, *36*, 103–131. [[CrossRef](#)]
74. Sidorenko, O.; Sairinen, R.; Moore, K. Rethinking the concept of small-scale mining for technologically advanced raw materials production. *Resour. Policy* **2020**, *68*, 101712. [[CrossRef](#)]
75. Lahiri-Dutt, K. *Between the Plough and the Pick: Informal, Artisanal and Small-Scale Mining in the Contemporary World*; ANU Press: Canberra, Australia, 2018.
76. Andrés, A. *Measuring Academic Research*; Chandos Publishing: Oxford, UK, 2009.
77. Sánchez, A.D.; de la Cruz Del Río Rama, M.; García, J.Á. Bibliometric analysis of publications on wine tourism in the databases Scopus and WoS. *Eur. Res. Manag. Bus. Econ.* **2017**, *23*, 8–15. [[CrossRef](#)]



78. Mongeon, P.; Paul-Hus, A. The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics* **2016**, *106*, 213–228. [[CrossRef](#)]
79. Wang, Q.; Waltman, L. Large-scale analysis of the accuracy of the journal classification systems of Web of Science and Scopus. *J. Informetr.* **2016**, *10*, 347–364. [[CrossRef](#)]
80. Baas, J.; Schotten, M.; Plume, A.; Côté, G.; Karimi, R. Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quant. Sci. Stud.* **2020**, *1*, 377–386. [[CrossRef](#)]
81. Álvarez-García, J.; Durán-Sánchez, A.; del Río-Rama, M.; García-Vélez, D. Active Ageing: Mapping of Scientific Coverage. *Int. J. Environ. Res. Public Health* **2018**, *15*, 2727. [[CrossRef](#)]
82. Martín-Martín, A.; Orduna-Malea, E.; Delgado López-Cózar, E. Coverage of highly-cited documents in Google Scholar, Web of Science, and Scopus: A multidisciplinary comparison. *Scientometrics* **2018**, *116*, 2175–2188. [[CrossRef](#)]
83. Montalván-Burbano, N.; Velastegui-Montoya, A.; Gurumendi-Noriega, M.; Morante-Carballo, F.; Adami, M. Worldwide Research on Land Use and Land Cover in the Amazon Region. *Sustainability* **2021**, *13*, 6039. [[CrossRef](#)]
84. Ruban, D.A. Geotourism—A geographical review of the literature. *Tour. Manag. Perspect.* **2015**, *15*, 1–15. [[CrossRef](#)]
85. Doussoulin, J.P.; Mougnot, B. Mapping mining and ecological distribution conflicts in Latin America, a bibliometric analysis. *Resour. Policy* **2022**, *77*, 102650. [[CrossRef](#)]
86. Ojeda-Pereira, I.; Campos-Medina, F. International trends in mining tailings publications: A descriptive bibliometric study. *Resour. Policy* **2021**, *74*, 102272. [[CrossRef](#)]
87. Martín-Martín, A.; Thelwall, M.; Orduna-Malea, E.; Delgado López-Cózar, E. Google Scholar, Microsoft Academic, Scopus, Dimensions, Web of Science, and OpenCitations' COCI: A multidisciplinary comparison of coverage via citations. *Scientometrics* **2021**, *126*, 871–906. [[CrossRef](#)] [[PubMed](#)]
88. Montoya, F.G.; Alcayde, A.; Baños, R.; Manzano-Agugliaro, F. A fast method for identifying worldwide scientific collaborations using the Scopus database. *Telemat. Inform.* **2018**, *35*, 168–185. [[CrossRef](#)]
89. Parlina, A.; Ramli, K.; Murfi, H. Theme Mapping and Bibliometrics Analysis of One Decade of Big Data Research in the Scopus Database. *Information* **2020**, *11*, 69. [[CrossRef](#)]
90. Collazo-Reyes, F. Growth of the number of indexed journals of Latin America and the Caribbean: The effect on the impact of each country. *Scientometrics* **2014**, *98*, 197–209. [[CrossRef](#)]
91. Vera-Baceta, M.-A.; Thelwall, M.; Kousha, K. Web of Science and Scopus language coverage. *Scientometrics* **2019**, *121*, 1803–1813. [[CrossRef](#)]
92. Martín-Martín, A.; Orduna-Malea, E.; Thelwall, M.; Delgado López-Cózar, E. Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories. *J. Informetr.* **2018**, *12*, 1160–1177. [[CrossRef](#)]
93. Najmi, A.; Rashidi, T.H.; Abbasi, A.; Travis Waller, S. Reviewing the transport domain: An evolutionary bibliometrics and network analysis. *Scientometrics* **2017**, *110*, 843–865. [[CrossRef](#)]
94. Chandra, Y. Mapping the evolution of entrepreneurship as a field of research (1990–2013): A scientometric analysis. *PLoS ONE* **2018**, *13*, e0190228.
95. Briones-Bitar, J.; Carrión-Mero, P.; Montalván-Burbano, N.; Morante-Carballo, F. Rockfall Research: A Bibliometric Analysis and Future Trends. *Geosciences* **2020**, *10*, 403. [[CrossRef](#)]
96. Aznar-Sánchez, J.A.; Velasco-Muñoz, J.F.; Belmonte-Ureña, L.J.; Manzano-Agugliaro, F. The worldwide research trends on water ecosystem services. *Ecol. Indic.* **2019**, *99*, 310–323. [[CrossRef](#)]
97. Pico-Saltos, R.; Carrión-Mero, P.; Montalván-Burbano, N.; Garzás, J.; Redchuk, A. Research Trends in Career Success: A Bibliometric Review. *Sustainability* **2021**, *13*, 4625. [[CrossRef](#)]
98. Taşkın, Z.; Aydinoglu, A.U. Collaborative interdisciplinary astrobiology research: A bibliometric study of the NASA Astrobiology Institute. *Scientometrics* **2015**, *103*, 1003–1022. [[CrossRef](#)]
99. van Eck, N.J.; Waltman, L.; Noyons, E.C.M.; Buter, R.K. Automatic term identification for bibliometric mapping. *Scientometrics* **2010**, *82*, 581–596. [[CrossRef](#)]
100. Morante-Carballo, F.; Montalván-Burbano, N.; Carrión-Mero, P.; Jácome-Francis, K. Worldwide Research Analysis on Natural Zeolites as Environmental Remediation Materials. *Sustainability* **2021**, *13*, 6378. [[CrossRef](#)]
101. Ye, C. Bibliometrical Analysis of International Big Data Research: Based on Citespace and VOSviewer. In Proceedings of the 2018 14th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD), Huangshan, China, 28–30 July 2018; pp. 927–932.
102. Li, W.-S.; Yan, Q.; Chen, W.-T.; Li, G.-Y.; Cong, L. Global Research Trends in Robotic Applications in Spinal Medicine: A Systematic Bibliometric Analysis. *World Neurosurg.* **2021**, *155*, e778–e785. [[CrossRef](#)]
103. Yu, Y.; Li, Y.; Zhang, Z.; Gu, Z.; Zhong, H.; Zha, Q.; Yang, L.; Zhu, C.; Chen, E. A bibliometric analysis using VOSviewer of publications on COVID-19. *Ann. Transl. Med.* **2020**, *8*, 816. [[CrossRef](#)]
104. Wong, C.-S. Science Mapping: A Scientometric Review on Resource Curses, Dutch Diseases, and Conflict Resources during 1993–2020. *Energies* **2021**, *14*, 4573. [[CrossRef](#)]
105. Belmonte-Ureña, L.J.; Plaza-Úbeda, J.A.; Vazquez-Brust, D.; Yakovleva, N. Circular economy, degrowth and green growth as pathways for research on sustainable development goals: A global analysis and future agenda. *Ecol. Econ.* **2021**, *185*, 107050. [[CrossRef](#)]

106. Cavalieri, A.; Reis, J.; Amorim, M. Circular Economy and Internet of Things: Mapping Science of Case Studies in Manufacturing Industry. *Sustainability* **2021**, *13*, 3299. [[CrossRef](#)]
107. Payán-Sánchez, B.; Belmonte-Ureña, L.J.; Plaza-Úbeda, J.A.; Vazquez-Brust, D.; Yakovleva, N.; Pérez-Valls, M. Open Innovation for Sustainability or Not: Literature Reviews of Global Research Trends. *Sustainability* **2021**, *13*, 1136. [[CrossRef](#)]
108. Abad-Segura, E.; Batlles-delaFuente, A.; González-Zamar, M.-D.; Belmonte-Ureña, L.J. Implications for Sustainability of the Joint Application of Bioeconomy and Circular Economy: A Worldwide Trend Study. *Sustainability* **2021**, *13*, 7182. [[CrossRef](#)]
109. Nobanee, H.; Al Hamadi, F.Y.; Abdulaziz, F.A.; Abukarsh, L.S.; Alqahtani, A.F.; AlSubaey, S.K.; Alqahtani, S.M.; Almansoori, H.A. A Bibliometric Analysis of Sustainability and Risk Management. *Sustainability* **2021**, *13*, 3277. [[CrossRef](#)]
110. Flores-Romero, M.B.; Pérez-Romero, M.E.; Álvarez-García, J.; del Río-Rama, M.D.L.C.D. Bibliometric Mapping of Research on Magic Towns of Mexico. *Land* **2021**, *10*, 852. [[CrossRef](#)]
111. Cavalcante, W.Q.F.; Coelho, A.; Bairrada, C.M. Sustainability and Tourism Marketing: A Bibliometric Analysis of Publications between 1997 and 2020 Using VOSviewer Software. *Sustainability* **2021**, *13*, 4987. [[CrossRef](#)]
112. Mishra, H.G.; Pandita, S.; Bhat, A.A.; Mishra, R.K.; Sharma, S. Tourism and carbon emissions: A bibliometric review of the last three decades: 1990–2021. *Tour. Rev.* **2021**, *77*, 636–658. [[CrossRef](#)]
113. Gao, Y.; Xu, Y.; Zhu, Y.; Zhang, J. An analysis of the hotspot and frontier of mine eco-environment restoration based on big data visualization of VOSviewer and CiteSpace. *Geol. Bull. China* **2018**, *37*, 2144–2153.
114. Gizzi, F.T.; Potenza, M.R. The Scientific Landscape of November 23rd, 1980 Irpinia-Basilicata Earthquake: Taking Stock of (Almost) 40 Years of Studies. *Geosciences* **2020**, *10*, 482. [[CrossRef](#)]
115. Asli, B.; Eghbali, M.; Ghamami, N.; Abbasabad, H.D.; Rasuli, B.; Rezaie, F. The necessity of developing knowledge map of the world in Earth Sciences and mines field studies based on research activities: A case study of Iran. *Terrae Didat.* **2019**, *15*, e019007. [[CrossRef](#)]
116. Herrera-Franco, G.; Montalván-Burbano, N.; Carrión-Mero, P.; Jaya-Montalvo, M.; Gurumendi-Noriega, M. Worldwide Research on Geoparks through Bibliometric Analysis. *Sustainability* **2021**, *13*, 1175. [[CrossRef](#)]
117. Noyons, E.C.M.; Moed, H.F.; Van Raan, A.F.J. Integrating research performance analysis and science mapping. *Scientometrics* **1999**, *46*, 591–604. [[CrossRef](#)]
118. Alshehhi, A.; Nobanee, H.; Khare, N. The Impact of Sustainability Practices on Corporate Financial Performance: Literature Trends and Future Research Potential. *Sustainability* **2018**, *10*, 494. [[CrossRef](#)]
119. Carrión-Mero, P.; Montalván-Burbano, N.; Herrera-Narváez, G.; Morante-Carballo, F. Geodiversity and Mining Towards the Development of Geotourism: A Global Perspective. *Int. J. Des. Nat. Ecodynamics* **2021**, *16*, 191–201. [[CrossRef](#)]
120. León-Castro, M.; Rodríguez-Insuasti, H.; Montalván-Burbano, N.; Victor, J.A. Bibliometrics and Science Mapping of Digital Marketing. In *Marketing and Smart Technologies*; Rocha, Á., Reis, J.L., Peter, M.K., Cayolla, R., Loureiro, S., Bogdanović, Z., Eds.; Springer: Singapore, 2021; pp. 95–107.
121. Herrera-Franco, G.; Montalván-Burbano, N.; Carrión-Mero, P.; Bravo-Montero, L. Worldwide Research on Socio-Hydrology: A Bibliometric Analysis. *Water* **2021**, *13*, 1283. [[CrossRef](#)]
122. Wormleighton, B.J. Sewerage and Drainage Works in a Small Mining District. *J. R. Sanit. Inst.* **1919**, *40*, 260–263. [[CrossRef](#)]
123. Carman, J.S. The Contribution of Small-Scale Mining to World Mineral Production. *Nat. Resour. Forum* **1985**, *9*, 119–124. [[CrossRef](#)]
124. Davidson, J. The transformation and successful development of small-scale mining enterprises in developing countries. *Nat. Resour. Forum* **1993**, *17*, 315–326. [[CrossRef](#)]
125. Fairbairn, R.A. An Account of a Small Nineteenth-Century Lead Mining Company on Alston Moor. *Ind. Archaeol. Rev.* **1980**, *4*, 245–256. [[CrossRef](#)]
126. Godoy, R.A. Small-scale mining and agriculture among the Jukumani Indians, Northern Potosí, Bolivia. *J. Dev. Stud.* **1988**, *24*, 177–196. [[CrossRef](#)]
127. Van Vuuren, W.; Hamilton, J. The payoff of developing a small-scale phosphate mine and beneficiating operation in the Mbeya region of Tanzania. *World Dev.* **1992**, *20*, 907–918. [[CrossRef](#)]
128. Chachage, C.S.L. New forms of accumulation in Tanzania: The case of gold mining. *Miner. Energy-Raw Mater. Rep.* **1993**, *9*, 2–13. [[CrossRef](#)]
129. Wu, Y. Scale, factor intensity and efficiency: An empirical study of the Chinese coal industry. *Appl. Econ.* **1993**, *25*, 325–334. [[CrossRef](#)]
130. Alpan, S. The Role of Government in Promoting Small-scale Mining. *Nat. Resour. Forum* **1986**, *10*, 95–97. [[CrossRef](#)]
131. Kumar, R.; Amaratunga, D. Government policies towards small-scale mining. *Resour. Policy* **1994**, *20*, 15–22. [[CrossRef](#)]
132. Tsikata, F.S. The vicissitudes of mineral policy in Ghana. *Resour. Policy* **1997**, *23*, 9–14. [[CrossRef](#)]
133. Carma, J.S. Why Small Mining? *Episodes* **1987**, *10*, 159–164. [[CrossRef](#)]
134. Amegbey, N.A.; Dankwa, J.B.K.; Al-Hassan, S. Small scale mining in Ghana—Techniques and environmental considerations. *Int. J. Surf. Min. Reclam. Environ.* **1997**, *11*, 135–138. [[CrossRef](#)]
135. Traore, P.A. Constraints on small-scale mining in Africa. *Nat. Resour. Forum* **1994**, *18*, 207–212. [[CrossRef](#)]
136. Bezerra, O.; Veríssimo, A.; Uhl, C. The regional impacts of small-scale gold mining in Amazonia. *Nat. Resour. Forum* **1996**, *20*, 305–317. [[CrossRef](#)]
137. Appleton, J.D.; Williams, T.; Breward, N.; Apostol, A.; Miguel, J.; Miranda, C. Mercury contamination associated with artisanal gold mining on the island of Mindanao, the Philippines. *Sci. Total Environ.* **1999**, *228*, 95–109. [[CrossRef](#)]

138. Aldous, P.J.; Smart, P.L.; Black, J.A. Groundwater management problems in abandoned coal-mined aquifers: A case study of the Forest of Dean, England. *Q. J. Eng. Geol. Hydrogeol.* **1986**, *19*, 375–388. [[CrossRef](#)]
139. Tingle, T.N.; Borch, R.S.; Hochella, M.F.; Becker, C.H.; Walker, W.J. Characterization of lead on mineral surfaces in soils contaminated by mining and smelting. *Appl. Surf. Sci.* **1993**, *72*, 301–306. [[CrossRef](#)]
140. Mighall, T.; Chambers, F.M. The environmental impact of prehistoric mining at Copa Hill, Cwmystwyth, Wales. *Holocene* **1993**, *3*, 260–264. [[CrossRef](#)]
141. Tarras-Wahlberg, N.H.; Flachier, A.; Fredriksson, G.; Lane, S.; Lundberg, B.; Sangfors, O. Environmental Impact of Small-scale and Artisanal Gold Mining in Southern Ecuador. *AMBIO J. Hum. Environ.* **2000**, *29*, 484–491. [[CrossRef](#)]
142. Wong, I.G.; Humphrey, J.R.; Adams, J.A.; Silva, W.J. Observations of mine seismicity in the eastern Wasatch Plateau, Utah, U.S.A.: A possible case of implosional failure. *Pure Appl. Geophys. PAGEOPH* **1989**, *129*, 369–405. [[CrossRef](#)]
143. Šílený, J. The mechanism of small mining tremors from amplitude inversion. *Pure Appl. Geophys. PAGEOPH* **1989**, *129*, 309–324. [[CrossRef](#)]
144. Tsuda, T.; Nagira, T.; Yamamoto, M.; Kume, Y. An epidemiological study on cancer in certified arsenic poisoning patients in Toroku. *Ind. Health* **1990**, *28*, 53–62. [[CrossRef](#)]
145. Tarras-Wahlberg, N. Environmental management of small-scale and artisanal mining: The Portovelo-Zaruma goldmining area, southern Ecuador. *J. Environ. Manag.* **2002**, *65*, 165–179. [[CrossRef](#)] [[PubMed](#)]
146. Burke, G. Opportunities for Environmental Management in the Mining Sector in Asia. *J. Environ. Dev.* **2006**, *15*, 224–235. [[CrossRef](#)]
147. Roopnarine, L. Small-Scale Gold Mining and Environmental Policy Challenges in Guyana: Protection or Pollution. *Can. J. Lat. Am. Caribb. Stud.* **2006**, *31*, 115–143. [[CrossRef](#)]
148. Babut, M.; Sekyi, R.; Rambaud, A.; Potin-Gautier, M.; Tellier, S.; Bannerman, W.; Beinhoff, C. Improving the environmental management of small-scale gold mining in Ghana: A case study of Dumasi. *J. Clean. Prod.* **2003**, *11*, 215–221. [[CrossRef](#)]
149. Andrews-Speed, P.; Zamora, A.; Rogers, C.D.; Shen, L.; Cao, S.; Yang, M. A framework for policy formulation for small-scale mines: The case of coal in China. *Nat. Resour. Forum* **2002**, *26*, 45–54. [[CrossRef](#)]
150. Hilson, G.; Maponga, O. How has a shortage of census and geological information impeded the regularization of artisanal and small-scale mining? *Nat. Resour. Forum* **2004**, *28*, 22–33. [[CrossRef](#)]
151. Hilson, G. Strengthening artisanal mining research and policy through baseline census activities. *Nat. Resour. Forum* **2005**, *29*, 144–153. [[CrossRef](#)]
152. Spiegel, S.J. Resource policies and small-scale gold mining in Zimbabwe. *Resour. Policy* **2009**, *34*, 39–44. [[CrossRef](#)]
153. Limbong, D.; Kumampung, J.; Rimper, J.; Arai, T.; Miyazaki, N. Emissions and environmental implications of mercury from artisanal gold mining in north Sulawesi, Indonesia. *Sci. Total Environ.* **2003**, *302*, 227–236. [[CrossRef](#)]
154. Maponga, O.; Ngorima, C.F. Overcoming environmental problems in the gold panning sector through legislation and education: The Zimbabwean experience. *J. Clean. Prod.* **2003**, *11*, 147–157. [[CrossRef](#)]
155. Aryee, B.N.; Ntibery, B.K.; Atorkui, E. Trends in the small-scale mining of precious minerals in Ghana: A perspective on its environmental impact. *J. Clean. Prod.* **2003**, *11*, 131–140. [[CrossRef](#)]
156. Tschakert, P.; Singha, K. Contaminated identities: Mercury and marginalization in Ghana’s artisanal mining sector. *Geoforum* **2007**, *38*, 1304–1321. [[CrossRef](#)]
157. Hylander, L.D.; Goodsite, M.E. Environmental costs of mercury pollution. *Sci. Total Environ.* **2006**, *368*, 352–370. [[CrossRef](#)] [[PubMed](#)]
158. Feng, X.; Li, G.; Qiu, G. A preliminary study on mercury contamination to the environment from artisanal zinc smelting using indigenous methods in Hezhang County, Guizhou, China: Part 2. Mercury contaminations to soil and crop. *Sci. Total Environ.* **2006**, *368*, 47–55. [[CrossRef](#)]
159. Hilson, G.; Potter, C. Why Is Illegal Gold Mining Activity so Ubiquitous in Rural Ghana? *African Dev. Rev.* **2003**, *15*, 237–270. [[CrossRef](#)]
160. Lahiri-Dutt, K. Informality in mineral resource management in Asia: Raising questions relating to community economies and sustainable development. *Nat. Resour. Forum* **2004**, *28*, 123–132. [[CrossRef](#)]
161. Lahiri-Dutt, K. Informal coal mining in Eastern India: Evidence from the Raniganj Coalbelt. *Nat. Resour. Forum* **2003**, *27*, 68–77. [[CrossRef](#)]
162. Banchirigah, S.M. Challenges with eradicating illegal mining in Ghana: A perspective from the grassroots. *Resour. Policy* **2008**, *33*, 29–38. [[CrossRef](#)]
163. Hilson, G. Land use competition between small- and large-scale miners: A case study of Ghana. *Land Use Policy* **2002**, *19*, 149–156. [[CrossRef](#)]
164. Andrew, J. Potential application of mediation to land use conflicts in small-scale mining. *J. Clean. Prod.* **2003**, *11*, 117–130. [[CrossRef](#)]
165. Childs, J. Reforming small-scale mining in sub-Saharan Africa: Political and ideological challenges to a Fair Trade gold initiative. *Resour. Policy* **2008**, *33*, 203–209. [[CrossRef](#)]
166. Jønsson, J.B.; Fold, N. Handling uncertainty: Policy and organizational practices in Tanzania’s small-scale gold mining sector. *Nat. Resour. Forum* **2009**, *33*, 211–220. [[CrossRef](#)]

167. Bose-O'Reilly, S.; Lettmeier, B.; Matteucci Gothe, R.; Beinhoff, C.; Siebert, U.; Drasch, G. Mercury as a serious health hazard for children in gold mining areas. *Environ. Res.* **2008**, *107*, 89–97. [[CrossRef](#)] [[PubMed](#)]
168. Wickre, J.B.; Folt, C.L.; Sturup, S.; Karagas, M.R. Environmental Exposure and Fingernail Analysis of Arsenic and Mercury in Children and Adults in a Nicaraguan Gold Mining Community. *Arch. Environ. Health Int. J.* **2004**, *59*, 400–409. [[CrossRef](#)] [[PubMed](#)]
169. Cortes-Maramba, N.; Reyes, J.P.; Francisco-Rivera, A.T.; Akagi, H.; Sunio, R.; Panganiban, L.C. Health and environmental assessment of mercury exposure in a gold mining community in Western Mindanao, Philippines. *J. Environ. Manag.* **2006**, *81*, 126–134. [[CrossRef](#)]
170. Heemskerk, M. Self-Employment and Poverty Alleviation: Women's Work in Artisanal Gold Mines. *Hum. Organ.* **2003**, *62*, 62–73. [[CrossRef](#)]
171. Ashe, K. Elevated Mercury Concentrations in Humans of Madre de Dios, Peru. *PLoS ONE* **2012**, *7*, e33305. [[CrossRef](#)]
172. Castilhos, Z.; Rodrigues-Filho, S.; Cesar, R.; Rodrigues, A.P.; Villas-Bôas, R.; de Jesus, I.; Lima, M.; Faial, K.; Miranda, A.; Brabo, E.; et al. Human exposure and risk assessment associated with mercury contamination in artisanal gold mining areas in the Brazilian Amazon. *Environ. Sci. Pollut. Res.* **2015**, *22*, 11255–11264. [[CrossRef](#)]
173. Xiao, R.; Wang, S.; Li, R.; Wang, J.J.; Zhang, Z. Soil heavy metal contamination and health risks associated with artisanal gold mining in Tongguan, Shaanxi, China. *Ecotoxicol. Environ. Saf.* **2017**, *141*, 17–24. [[CrossRef](#)]
174. Banza Lubaba Nkulu, C.; Casas, L.; Haufroid, V.; De Putter, T.; Saenen, N.D.; Kayembe-Kitenge, T.; Musa Obadia, P.; Kyanika Wa Mukoma, D.; Lunda Ilunga, J.-M.; Nawrot, T.S.; et al. Sustainability of artisanal mining of cobalt in DR Congo. *Nat. Sustain.* **2018**, *1*, 495–504. [[CrossRef](#)]
175. Yard, E.E.; Horton, J.; Schier, J.G.; Caldwell, K.; Sanchez, C.; Lewis, L.; Gastañaga, C. Mercury Exposure Among Artisanal Gold Miners in Madre de Dios, Peru: A Cross-sectional Study. *J. Med. Toxicol.* **2012**, *8*, 441–448. [[CrossRef](#)] [[PubMed](#)]
176. Plumlee, G.S.; Durant, J.T.; Morman, S.A.; Neri, A.; Wolf, R.E.; Dooyema, C.A.; Hageman, P.L.; Lowers, H.A.; Fernette, G.L.; Meeker, G.P.; et al. Linking Geological and Health Sciences to Assess Childhood Lead Poisoning from Artisanal Gold Mining in Nigeria. *Environ. Health Perspect.* **2013**, *121*, 744–750. [[CrossRef](#)] [[PubMed](#)]
177. Nakazawa, K.; Nagafuchi, O.; Kawakami, T.; Inoue, T.; Yokota, K.; Serikawa, Y.; Cyio, B.; Elvince, R. Human health risk assessment of mercury vapor around artisanal small-scale gold mining area, Palu city, Central Sulawesi, Indonesia. *Ecotoxicol. Environ. Saf.* **2016**, *124*, 155–162. [[CrossRef](#)] [[PubMed](#)]
178. Cartier, L.E.; Bürge, M. Agriculture and artisanal gold mining in sierra leone: Alternatives or complements? *J. Int. Dev.* **2011**, *23*, 1080–1099. [[CrossRef](#)]
179. Maconachie, R. Re-agrarianising livelihoods in post-conflict sierra leone? Mineral wealth and rural change in artisanal and small-scale mining communities. *J. Int. Dev.* **2011**, *23*, 1054–1067. [[CrossRef](#)]
180. Hilson, G.; Garforth, C. 'Agricultural Poverty' and the Expansion of Artisanal Mining in Sub-Saharan Africa: Experiences from Southwest Mali and Southeast Ghana. *Popul. Res. Policy Rev.* **2012**, *31*, 435–464. [[CrossRef](#)]
181. Zhao, L.; Anderson, C.W.N.; Qiu, G.; Meng, B.; Wang, D.; Feng, X. Mercury methylation in paddy soil: Source and distribution of mercury species at a Hg mining area, Guizhou Province, China. *Biogeosciences* **2016**, *13*, 2429–2440. [[CrossRef](#)]
182. Hilson, G. Poverty traps in small-scale mining communities: The case of sub-Saharan Africa. *Can. J. Dev. Stud. Can. D'études Du Développement* **2012**, *33*, 180–197. [[CrossRef](#)]
183. Tonts, M.; Plummer, P.; Lawrie, M. Socio-economic wellbeing in Australian mining towns: A comparative analysis. *J. Rural Stud.* **2012**, *28*, 288–301. [[CrossRef](#)]
184. Loayza, N.; Rigolini, J. The Local Impact of Mining on Poverty and Inequality: Evidence from the Commodity Boom in Peru. *World Dev.* **2016**, *84*, 219–234. [[CrossRef](#)]
185. Kolk, A.; Lenfant, F. Multinationals, CSR and Partnerships in Central African Conflict Countries. *Corp. Soc. Responsib. Environ. Manag.* **2013**, *20*, 43–54. [[CrossRef](#)]
186. Geenen, S. Dispossession, displacement and resistance: Artisanal miners in a gold concession in South-Kivu, Democratic Republic of Congo. *Resour. Policy* **2014**, *40*, 90–99. [[CrossRef](#)]
187. Hilson, G.; Hilson, A.; Adu-Darko, E. Chinese participation in Ghana's informal gold mining economy: Drivers, implications and clarifications. *J. Rural Stud.* **2014**, *34*, 292–303. [[CrossRef](#)]
188. Van Bockstael, S. The persistence of informality: Perspectives on the future of artisanal mining in Liberia. *Futures* **2014**, *62*, 10–20. [[CrossRef](#)]
189. Verbrugge, B. The Economic Logic of Persistent Informality: Artisanal and Small-Scale Mining in the Southern Philippines. *Dev. Change* **2015**, *46*, 1023–1046. [[CrossRef](#)]
190. Rakotondrabe, F.; Ndam Ngoupayou, J.R.; Mfonka, Z.; Rasolomanana, E.H.; Nyangono Abolo, A.J.; Ako Ako, A. Water quality assessment in the Bétaré-Oya gold mining area (East-Cameroon): Multivariate Statistical Analysis approach. *Sci. Total Environ.* **2018**, *610–611*, 831–844. [[CrossRef](#)]
191. Cobbina, S.; Duwiejuah, A.; Quansah, R.; Obiri, S.; Bakobie, N. Comparative Assessment of Heavy Metals in Drinking Water Sources in Two Small-Scale Mining Communities in Northern Ghana. *Int. J. Environ. Res. Public Health* **2015**, *12*, 10620–10634. [[CrossRef](#)]
192. Maconachie, R.; Hilson, G. Safeguarding livelihoods or exacerbating poverty? Artisanal mining and formalization in West Africa. *Nat. Resour. Forum* **2011**, *35*, 293–303. [[CrossRef](#)]



193. Geenen, S. A dangerous bet: The challenges of formalizing artisanal mining in the Democratic Republic of Congo. *Resour. Policy* **2012**, *37*, 322–330. [[CrossRef](#)]
194. Spiegel, S.J. Governance Institutions, Resource Rights Regimes, and the Informal Mining Sector: Regulatory Complexities in Indonesia. *World Dev.* **2012**, *40*, 189–205. [[CrossRef](#)]
195. Teschner, B.A. Small-scale mining in Ghana: The government and the galamsey. *Resour. Policy* **2012**, *37*, 308–314. [[CrossRef](#)]
196. Spiegel, S.J. Shifting Formalization Policies and Recentralizing Power: The Case of Zimbabwe’s Artisanal Gold Mining Sector. *Soc. Nat. Resour.* **2015**, *28*, 543–558. [[CrossRef](#)]
197. Hilson, G.; Hilson, A.; Maconachie, R.; McQuilken, J.; Goumandakoye, H. Artisanal and small-scale mining (ASM) in sub-Saharan Africa: Re-conceptualizing formalization and ‘illegal’ activity. *Geoforum* **2017**, *83*, 80–90. [[CrossRef](#)]
198. Hilson, G.; Maconachie, R. Formalising artisanal and small-scale mining: Insights, contestations and clarifications. *Area* **2017**, *49*, 443–451. [[CrossRef](#)]
199. García, O.; Veiga, M.M.; Cordy, P.; Suescún, O.E.; Molina, J.M.; Roeser, M. Artisanal gold mining in Antioquia, Colombia: A successful case of mercury reduction. *J. Clean. Prod.* **2015**, *90*, 244–252. [[CrossRef](#)]
200. Marrugo-Negrete, J.; Marrugo-Madrid, S.; Pinedo-Hernández, J.; Durango-Hernández, J.; Díez, S. Screening of native plant species for phytoremediation potential at a Hg-contaminated mining site. *Sci. Total Environ.* **2016**, *542*, 809–816. [[CrossRef](#)]
201. Smith, N.M.; Ali, S.; Bofinger, C.; Collins, N. Human health and safety in artisanal and small-scale mining: An integrated approach to risk mitigation. *J. Clean. Prod.* **2016**, *129*, 43–52. [[CrossRef](#)]
202. Adler Miserendino, R.; Bergquist, B.A.; Adler, S.E.; Guimarães, J.R.D.; Lees, P.S.J.; Niquen, W.; Velasquez-López, P.C.; Veiga, M.M. Challenges to measuring, monitoring, and addressing the cumulative impacts of artisanal and small-scale gold mining in Ecuador. *Resour. Policy* **2013**, *38*, 713–722. [[CrossRef](#)]
203. Gardner, R.M.; Nyland, J.F.; Silva, I.A.; Maria Ventura, A.; Maria de Souza, J.; Silbergeld, E.K. Mercury exposure, serum antinuclear/antinucleolar antibodies, and serum cytokine levels in mining populations in Amazonian Brazil: A cross-sectional study. *Environ. Res.* **2010**, *110*, 345–354. [[CrossRef](#)]
204. Sherman, L.S.; Blum, J.D.; Basu, N.; Rajae, M.; Evers, D.C.; Buck, D.G.; Petrlik, J.; DiGangi, J. Assessment of mercury exposure among small-scale gold miners using mercury stable isotopes. *Environ. Res.* **2015**, *137*, 226–234. [[CrossRef](#)]
205. Rajae, M.; Long, R.; Renne, E.; Basu, N. Mercury Exposure Assessment and Spatial Distribution in A Ghanaian Small-Scale Gold Mining Community. *Int. J. Environ. Res. Public Health* **2015**, *12*, 10755–10782. [[CrossRef](#)] [[PubMed](#)]
206. Steckling, N.; Boese-O’Reilly, S.; Gradel, C.; Gutschmidt, K.; Shinee, E.; Altangerel, E.; Badrakh, B.; Bonduush, I.; Surenjav, U.; Ferstl, P. Mercury exposure in female artisanal small-scale gold miners (ASGM) in Mongolia: An analysis of human biomonitoring (HBM) data from 2008. *Sci. Total Environ.* **2011**, *409*, 994–1000. [[CrossRef](#)] [[PubMed](#)]
207. Tschakert, P. Recognizing and nurturing artisanal mining as a viable livelihood. *Resour. Policy* **2009**, *34*, 24–31. [[CrossRef](#)]
208. Malpeli, K.C.; Chirico, P.G. The influence of geomorphology on the role of women at artisanal and small-scale mine sites. *Nat. Resour. Forum* **2013**, *37*, 43–54. [[CrossRef](#)]
209. Hilson, G.; Zolnikov, T.R.; Ortiz, D.R.; Kumah, C. Formalizing artisanal gold mining under the Minamata convention: Previewing the challenge in Sub-Saharan Africa. *Environ. Sci. Policy* **2018**, *85*, 123–131. [[CrossRef](#)]
210. Putzel, L.; Kelly, A.B.; Cerutti, P.O.; Artati, Y. Formalization as Development in Land and Natural Resource Policy. *Soc. Nat. Resour.* **2015**, *28*, 453–472. [[CrossRef](#)]
211. Huntington, H.; Marple-Cantrell, K. Customary governance of artisanal and small-scale mining in Guinea: Social and environmental practices and outcomes\*. *Land Use Policy* **2021**, *102*, 105229. [[CrossRef](#)]
212. Drace, K.; Kiefer, A.M.; Veiga, M.M.; Williams, M.K.; Ascari, B.; Knapper, K.A.; Logan, K.M.; Breslin, V.M.; Skidmore, A.; Bolt, D.A.; et al. Mercury-free, small-scale artisanal gold mining in Mozambique: Utilization of magnets to isolate gold at clean tech mine. *J. Clean. Prod.* **2012**, *32*, 88–95. [[CrossRef](#)]
213. Morgan, V.L.; McLamore, E.S.; Correll, M.; Kiker, G.A. Emerging mercury mitigation solutions for artisanal small-scale gold mining communities evaluated through a multicriteria decision analysis approach. *Environ. Syst. Decis.* **2021**, *41*, 413–424. [[CrossRef](#)]
214. O’Brien, R.M.; Smits, K.M.; Smith, N.M.; Schwartz, M.R.; Crouse, D.R.; Phelan, T.J. Integrating scientific and local knowledge into pollution remediation planning: An iterative conceptual site model framework. *Environ. Dev.* **2021**, *40*, 100675. [[CrossRef](#)]
215. Mohammed Banchirigah, S. How have reforms fuelled the expansion of artisanal mining? Evidence from sub-Saharan Africa. *Resour. Policy* **2006**, *31*, 165–171. [[CrossRef](#)]
216. Hilson, G.; Pardie, S. Mercury: An agent of poverty in Ghana’s small-scale gold-mining sector? *Resour. Policy* **2006**, *31*, 106–116. [[CrossRef](#)]
217. Hilson, G.; Hilson, C.J.; Pardie, S. Improving awareness of mercury pollution in small-scale gold mining communities: Challenges and ways forward in rural Ghana. *Environ. Res.* **2007**, *103*, 275–287. [[CrossRef](#)] [[PubMed](#)]
218. Veiga, M.M.; Maxson, P.A.; Hylander, L.D. Origin and consumption of mercury in small-scale gold mining. *J. Clean. Prod.* **2006**, *14*, 436–447. [[CrossRef](#)]
219. Veiga, M.M.; Hinton, J.J. Abandoned artisanal gold mines in the Brazilian Amazon: A legacy of mercury pollution. *Nat. Resour. Forum* **2002**, *26*, 15–26. [[CrossRef](#)]
220. Pestana, M.; Formoso, M. Mercury contamination in Lavras do Sul, south Brazil: A legacy from past and recent gold mining. *Sci. Total Environ.* **2003**, *307*, 125–140. [[CrossRef](#)]

221. Hilson, G. Small-scale mining, poverty and economic development in sub-Saharan Africa: An overview. *Resour. Policy* **2009**, *34*, 1–5. [[CrossRef](#)]
222. Culnan, M.J.; O'Reilly III, C.A.; Chatman, J.A. Intellectual structure of research in organizational behavior, 1972–1984: A cocitation analysis. *J. Am. Soc. Inf. Sci.* **1990**, *41*, 453–458. [[CrossRef](#)]
223. Bebbington, A.; Humphreys Bebbington, D.; Bury, J.; Langan, J.; Muñoz, J.P.; Scurrah, M. Mining and Social Movements: Struggles Over Livelihood and Rural Territorial Development in the Andes. *World Dev.* **2008**, *36*, 2888–2905. [[CrossRef](#)]
224. Fisher, E. Occupying the Margins: Labour Integration and Social Exclusion in Artisanal Mining in Tanzania. *Dev. Change* **2007**, *38*, 735–760. [[CrossRef](#)]
225. Zupic, I.; Čater, T. Bibliometric Methods in Management and Organization. *Organ. Res. Methods* **2015**, *18*, 429–472. [[CrossRef](#)]
226. Hilson, G. Family Hardship and Cultural Values: Child Labor in Malian Small-Scale Gold Mining Communities. *World Dev.* **2012**, *40*, 1663–1674. [[CrossRef](#)]
227. Brottem, L.V.; Ba, L. Gendered livelihoods and land tenure: The case of artisanal gold miners in Mali, West Africa. *Geoforum* **2019**, *105*, 54–62. [[CrossRef](#)]
228. Okoh, G.; Hilson, G. Poverty and livelihood diversification: Exploring the linkages between smallholder farming and artisanal mining in rural Ghana. *J. Int. Dev.* **2011**, *23*, 1100–1114. [[CrossRef](#)]
229. Stewart, J.; Kibombo, R.; Rankin, L.P. Gendered livelihoods in the artisanal mining sector in the Great Lakes Region. *Can. J. African Stud./Rev. Can. Des Études Afr.* **2020**, *54*, 37–56. [[CrossRef](#)]
230. Hilson, G. Shootings and burning excavators: Some rapid reflections on the Government of Ghana's handling of the informal Galamsey mining 'menace. *Resour. Policy* **2017**, *54*, 109–116. [[CrossRef](#)]
231. Byemba, G.K. Formalization of artisanal and small-scale mining in eastern Democratic Republic of the Congo: An opportunity for women in the new tin, tantalum, tungsten and gold (3TG) supply chain? *Extr. Ind. Soc.* **2020**, *7*, 420–427. [[CrossRef](#)]
232. Siwale, A.; Siwale, T. Has the promise of formalizing artisanal and small-scale mining (ASM) failed? The case of Zambia. *Extr. Ind. Soc.* **2017**, *4*, 191–201. [[CrossRef](#)]
233. Dery Tuokuu, F.X.; Idemudia, U.; Bawelle, E.B.G.; Baguri Sumani, J.B. Criminalization of "galamsey" and livelihoods in Ghana: Limits and consequences. *Nat. Resour. Forum* **2020**, *44*, 52–65. [[CrossRef](#)]
234. Amankwah, R.K.; Anim-Sackey, C. Strategies for sustainable development of the small-scale gold and diamond mining industry of Ghana. *Resour. Policy* **2003**, *29*, 131–138. [[CrossRef](#)]
235. Zvarivadza, T.; Nhleko, A.S. Resolving artisanal and small-scale mining challenges: Moving from conflict to cooperation for sustainability in mine planning. *Resour. Policy* **2018**, *56*, 78–86. [[CrossRef](#)]
236. Zvarivadza, T. Artisanal and Small-Scale Mining as a challenge and possible contributor to Sustainable Development. *Resour. Policy* **2018**, *56*, 49–58. [[CrossRef](#)]
237. Muduli, K.; Barve, A. Establishment of a sustainable development framework in small scale mining supply chains in India. *Int. J. Intell. Enterp.* **2013**, *2*, 84. [[CrossRef](#)]
238. Sinan Erzurumlu, S.; Erzurumlu, Y.O. Sustainable mining development with community using design thinking and multi-criteria decision analysis. *Resour. Policy* **2015**, *46*, 6–14. [[CrossRef](#)]
239. Mtegha, H.D.; Cawood, F.T.; Minnitt, R.C.A. National minerals policies and stakeholder participation for broad-based development in the southern African development community (SADC). *Resour. Policy* **2006**, *31*, 231–238. [[CrossRef](#)]
240. Maconachie, R.; Conteh, F. Artisanal mining policy reforms, informality and challenges to the Sustainable Development Goals in Sierra Leone. *Environ. Sci. Policy* **2021**, *116*, 38–46. [[CrossRef](#)]
241. Masuku, S. An indigenous knowledge-based approach to environmental conservation in Zimbabwe. *Afr. Renaiss.* **2019**, *16*, 165–183. [[CrossRef](#)]
242. Armah, F.A.; Boamah, S.A.; Quansah, R.; Obiri, S.; Luginaah, I. Working conditions of male and female artisanal and small-scale goldminers in Ghana: Examining existing disparities. *Extr. Ind. Soc.* **2016**, *3*, 464–474. [[CrossRef](#)]
243. Yelapaala, K.; Ali, S.H. Multiple scales of diamond mining in Akwatia, Ghana: Addressing environmental and human development impact. *Resour. Policy* **2005**, *30*, 145–155. [[CrossRef](#)]
244. Odumo, B.O.; Carbonell, G.; Angeyo, H.K.; Patel, J.P.; Torrijos, M.; Rodríguez Martín, J.A. Impact of gold mining associated with mercury contamination in soil, biota sediments and tailings in Kenya. *Environ. Sci. Pollut. Res.* **2014**, *21*, 12426–12435. [[CrossRef](#)]
245. Podolský, F.; Ettler, V.; Šebek, O.; Ježek, J.; Mihaljevič, M.; Křibek, B.; Sracek, O.; Vaněk, A.; Penížek, V.; Majer, V.; et al. Mercury in soil profiles from metal mining and smelting areas in Namibia and Zambia: Distribution and potential sources. *J. Soils Sediments* **2015**, *15*, 648–658. [[CrossRef](#)]
246. Sun, Z.; Xie, X.; Wang, P.; Hu, Y.; Cheng, H. Heavy metal pollution caused by small-scale metal ore mining activities: A case study from a polymetallic mine in South China. *Sci. Total Environ.* **2018**, *639*, 217–227. [[CrossRef](#)] [[PubMed](#)]
247. Mandeng, E.P.B.; Bidjeck, L.M.B.; Bessa, A.Z.E.; Ntomb, Y.D.; Wadjou, J.W.; Doumo, E.P.E.; Dieudonné, L.B. Contamination and risk assessment of heavy metals, and uranium of sediments in two watersheds in Abiete-Toko gold district, Southern Cameroon. *Heliyon* **2019**, *5*, e02591. [[CrossRef](#)]
248. Yevugah, L.L.; Darko, G.; Bak, J. Does mercury emission from small-scale gold mining cause widespread soil pollution in Ghana? *Environ. Pollut.* **2021**, *284*, 116945. [[CrossRef](#)] [[PubMed](#)]
249. Tomiyasu, T.; Hamada, Y.K.; Kodamatani, H.; Hidayati, N.; Rahajoe, J.S. Transport of mercury species by river from artisanal and small-scale gold mining in West Java, Indonesia. *Environ. Sci. Pollut. Res.* **2019**, *26*, 25262–25274. [[CrossRef](#)]

250. Niane, B.; Moritz, R.; Guédron, S.; Ngom, P.M.; Pfeifer, H.R.; Mall, I.; Poté, J. Effect of recent artisanal small-scale gold mining on the contamination of surface river sediment: Case of Gambia River, Kedougou region, southeastern Senegal. *J. Geochemical Explor.* **2014**, *144*, 517–527. [[CrossRef](#)]
251. Goix, S.; Maurice, L.; Laffont, L.; Rinaldo, R.; Lagane, C.; Chmeleff, J.; Menges, J.; Heimbürger, L.-E.; Maury-Brachet, R.; Sonke, J.E. Quantifying the impacts of artisanal gold mining on a tropical river system using mercury isotopes. *Chemosphere* **2019**, *219*, 684–694. [[CrossRef](#)]
252. Wang, X.; Yuan, W.; Lin, C.-J.; Wu, F.; Feng, X. Stable mercury isotopes stored in Masson Pinus tree rings as atmospheric mercury archives. *J. Hazard. Mater.* **2021**, *415*, 125678. [[CrossRef](#)]
253. Ebel, M.; Evangelou, M.W.H.; Schaeffer, A. Cyanide phytoremediation by water hyacinths (*Eichhornia crassipes*). *Chemosphere* **2007**, *66*, 816–823. [[CrossRef](#)]
254. Lin, W.; Xiao, T.; Wu, Y.; Ao, Z.; Ning, Z. Hyperaccumulation of zinc by *Corydalis davidii* in Zn-polluted soils. *Chemosphere* **2012**, *86*, 837–842. [[CrossRef](#)]
255. Chamba, I.; Gazquez, M.J.; Selvaraj, T.; Calva, J.; Toledo, J.J.; Armijos, C. Selection of a suitable plant for phytoremediation in mining artisanal zones. *Int. J. Phytoremediation* **2016**, *18*, 853–860. [[CrossRef](#)] [[PubMed](#)]
256. Samuel, W.; Richard, B.; Nyantakyi, J.A. Phytoremediation of heavy metals contaminated water and soils from artisanal mining enclave using *Heliconia psittacorum*. *Model. Earth Syst. Environ.* **2021**, *8*, 591–600. [[CrossRef](#)]
257. Gerson, J.R.; Driscoll, C.T.; Hsu-Kim, H.; Bernhardt, E.S. Senegalese artisanal gold mining leads to elevated total mercury and methylmercury concentrations in soils, sediments, and rivers. *Elem. Sci. Anthr.* **2018**, *6*, 11. [[CrossRef](#)]
258. Niane, B.; Guédron, S.; Feder, F.; Legros, S.; Ngom, P.M.; Moritz, R. Impact of recent artisanal small-scale gold mining in Senegal: Mercury and methylmercury contamination of terrestrial and aquatic ecosystems. *Sci. Total Environ.* **2019**, *669*, 185–193. [[CrossRef](#)] [[PubMed](#)]
259. Pinedo-Hernández, J.; Marrugo-Negrete, J.; Díez, S. Speciation and bioavailability of mercury in sediments impacted by gold mining in Colombia. *Chemosphere* **2015**, *119*, 1289–1295. [[CrossRef](#)]
260. Bose-O'Reilly, S.; Schierl, R.; Nowak, D.; Siebert, U.; William, J.F.; Owi, F.T.; Ir, Y.I. A preliminary study on health effects in villagers exposed to mercury in a small-scale artisanal gold mining area in Indonesia. *Environ. Res.* **2016**, *149*, 274–281. [[CrossRef](#)]
261. Gyamfi, O.; Sorenson, P.B.; Darko, G.; Ansah, E.; Bak, J.L. Human health risk assessment of exposure to indoor mercury vapour in a Ghanaian artisanal small-scale gold mining community. *Chemosphere* **2020**, *241*, 125014. [[CrossRef](#)]
262. Calao-Ramos, C.; Bravo, A.G.; Paternina-Uribe, R.; Marrugo-Negrete, J.; Díez, S. Occupational human exposure to mercury in artisanal small-scale gold mining communities of Colombia. *Environ. Int.* **2021**, *146*, 106216. [[CrossRef](#)]
263. Camacho-delaCruz, A.A.; Espinosa-Reyes, G.; Reboloso-Hernández, C.A.; Carrizales-Yáñez, L.; Ilizaliturri-Hernández, C.A.; Reyes-Arreguín, L.E.; Díaz-Barriga, F. Holistic health risk assessment in an artisanal mercury mining region in Mexico. *Environ. Monit. Assess.* **2021**, *193*, 541. [[CrossRef](#)]
264. de Souza, E.S.; Texeira, R.A.; da Costa, H.S.C.; Oliveira, F.J.; Melo, L.C.A.; do Carmo Freitas Faial, K.; Fernandes, A.R. Assessment of risk to human health from simultaneous exposure to multiple contaminants in an artisanal gold mine in Serra Pelada, Pará, Brazil. *Sci. Total Environ.* **2017**, *576*, 683–695. [[CrossRef](#)]
265. Tirima, S.; Bartrem, C.; von Lindern, I.; von Braun, M.; Lind, D.; Anka, S.M.; Abdullahi, A. Food contamination as a pathway for lead exposure in children during the 2010–2013 lead poisoning epidemic in Zamfara, Nigeria. *J. Environ. Sci.* **2018**, *67*, 260–272. [[CrossRef](#)] [[PubMed](#)]
266. Veiga, M.M.; Fadina, O. A review of the failed attempts to curb mercury use at artisanal gold mines and a proposed solution. *Extr. Ind. Soc.* **2020**, *7*, 1135–1146. [[CrossRef](#)]
267. Silvestre, B.S.; Silva Neto, R.E. Are cleaner production innovations the solution for small mining operations in poor regions? The case of Padua in Brazil. *J. Clean. Prod.* **2014**, *84*, 809–817. [[CrossRef](#)]
268. Shandro, J.A.; Veiga, M.M.; Chouinard, R. Reducing mercury pollution from artisanal gold mining in Munhena, Mozambique. *J. Clean. Prod.* **2009**, *17*, 525–532. [[CrossRef](#)]
269. Hilson, G. Abatement of mercury pollution in the small-scale gold mining industry: Restructuring the policy and research agendas. *Sci. Total Environ.* **2006**, *362*, 1–14. [[CrossRef](#)]
270. Rodriguez, L.A.; Pfaff, A.; Velez, M.A. Graduated stringency within collective incentives for group environmental compliance: Building coordination in field-lab experiments with artisanal gold miners in Colombia. *J. Environ. Econ. Manag.* **2019**, *98*, 102276. [[CrossRef](#)]
271. Spiegel, S.; Keane, S.; Metcalf, S.; Veiga, M. Implications of the Minamata Convention on Mercury for informal gold mining in Sub-Saharan Africa: From global policy debates to grassroots implementation? *Environ. Dev. Sustain.* **2015**, *17*, 765–785. [[CrossRef](#)]
272. Clifford, M.J. Future strategies for tackling mercury pollution in the artisanal gold mining sector: Making the Minamata Convention work. *Futures* **2014**, *62*, 106–112. [[CrossRef](#)]
273. Spiegel, S.J. Labour challenges and mercury management at gold mills in Zimbabwe: Examining production processes and proposals for change. *Nat. Resour. Forum* **2009**, *33*, 221–232. [[CrossRef](#)]
274. Vieira, R. Mercury-free gold mining technologies: Possibilities for adoption in the Guianas. *J. Clean. Prod.* **2006**, *14*, 448–454. [[CrossRef](#)]



275. Spiegel, S.J. Socioeconomic dimensions of mercury pollution abatement: Engaging artisanal mining communities in Sub-Saharan Africa. *Ecol. Econ.* **2009**, *68*, 3072–3083. [[CrossRef](#)]
276. Torkaman, P.; Veiga, M.M.; de Andrade Lima, L.R.P.; Oliveira, L.A.; Motta, J.S.; Jesus, J.L.; Lavkulich, L.M. Leaching gold with cassava: An option to eliminate mercury use in artisanal gold mining. *J. Clean. Prod.* **2021**, *311*, 127531. [[CrossRef](#)]
277. Owusu, O.; Bansah, K.J.; Mensah, A.K. “Small in size, but big in impact”: Socio-environmental reforms for sustainable artisanal and small-scale mining. *J. Sustain. Min.* **2019**, *18*, 38–44. [[CrossRef](#)]
278. Hennessy, L. Where There Is No Company: Indigenous Peoples, Sustainability, and the Challenges of Mid-Stream Mining Reforms in Guyana’s Small-Scale Gold Sector. *New Polit. Econ.* **2015**, *20*, 126–153. [[CrossRef](#)]
279. Kumah, C.; Hilson, G.; Quaicoe, I. Poverty, adaptation and vulnerability: An assessment of women’s work in Ghana’s artisanal gold mining sector. *Area* **2020**, *52*, 617–625. [[CrossRef](#)]
280. Velásquez-López, P.C.; Páez-Varas, C.; Benavides-Zúñiga, X.; Gallegos, F.; Fallon, G. Women mine-rock waste collectors in artisanal and small-scale mining in Ecuador: Challenges and opportunities. *Extr. Ind. Soc.* **2020**, *7*, 1579–1586. [[CrossRef](#)]
281. Bashwira, M.-R.; Cuvelier, J.; Hilhorst, D.; van der Haar, G. Not only a man’s world: Women’s involvement in artisanal mining in eastern DRC. *Resour. Policy* **2014**, *40*, 109–116. [[CrossRef](#)]
282. Adonteng-Kissi, O.; Adonteng-Kissi, B. Precarious work or sustainable livelihoods? Aligning Prestea’s Programme with the development dialogue on artisanal and small-scale mining. *Nat. Resour. Forum* **2018**, *42*, 123–137. [[CrossRef](#)]
283. Mabe, F.N.; Owusu-Sekyere, E.; Adeosun, O.T. Livelihood coping strategies among displaced small scale miners in Ghana. *Resour. Policy* **2021**, *74*, 102291. [[CrossRef](#)]
284. Banchirigah, S.M.; Hilson, G. De-agrarianization, re-agrarianization and local economic development: Re-orientating livelihoods in African artisanal mining communities. *Policy Sci.* **2010**, *43*, 157–180. [[CrossRef](#)]
285. Carrión-Mero, P.; Montalván-Burbano, N.; Morante-Carballo, F.; Quesada-Román, A.; Apolo-Masache, B. Worldwide Research Trends in Landslide Science. *Int. J. Environ. Res. Public Health* **2021**, *18*, 9445. [[CrossRef](#)] [[PubMed](#)]
286. Díez-Martín, F.; Blanco-González, A.; Prado-Román, C. The intellectual structure of organizational legitimacy research: A co-citation analysis in business journals. *Rev. Manag. Sci.* **2021**, *15*, 1007–1043. [[CrossRef](#)]
287. Kim, H.J.; Jeong, Y.K.; Song, M. Content- and proximity-based author co-citation analysis using citation sentences. *J. Informetr.* **2016**, *10*, 954–966. [[CrossRef](#)]
288. White, H.D.; Griffith, B.C. Author cocitation: A literature measure of intellectual structure. *J. Am. Soc. Inf. Sci.* **1981**, *32*, 163–171. [[CrossRef](#)]
289. Hilson, G.; Maconachie, R. Artisanal and small-scale mining and the Sustainable Development Goals: Opportunities and new directions for sub-Saharan Africa. *Geoforum* **2020**, *111*, 125–141. [[CrossRef](#)]
290. Maconachie, R.; Binns, T. ‘Farming miners’ or ‘mining farmers’?: Diamond mining and rural development in post-conflict Sierra Leone. *J. Rural Stud.* **2007**, *23*, 367–380. [[CrossRef](#)]
291. Bryceson, D.F. The Scramble in Africa: Reorienting Rural Livelihoods. *World Dev.* **2002**, *30*, 725–739. [[CrossRef](#)]
292. Hilson, G.; Ackah-Baidoo, A. Can Microcredit Services Alleviate Hardship in African Small-scale Mining Communities? *World Dev.* **2011**, *39*, 1191–1203. [[CrossRef](#)]
293. Spiegel, S.J.; Savornin, O.; Shoko, D.; Veiga, M.M. Mercury Reduction in Munhena, Mozambique: Homemade Solutions and the Social Context for Change. *Int. J. Occup. Environ. Health* **2006**, *12*, 215–221. [[CrossRef](#)]
294. Spiegel, S.J.; Veiga, M.M. Building Capacity in Small-Scale Mining Communities: Health, Ecosystem Sustainability, and the Global Mercury Project. *Ecohealth* **2005**, *2*, 361–369. [[CrossRef](#)]
295. Castilhos, Z.C.; Rodrigues-Filho, S.; Rodrigues, A.P.C.; Villas-Bôas, R.C.; Siegel, S.; Veiga, M.M.; Beinhoff, C. Mercury contamination in fish from gold mining areas in Indonesia and human health risk assessment. *Sci. Total Environ.* **2006**, *368*, 320–325. [[CrossRef](#)] [[PubMed](#)]
296. Telmer, K.H.; Veiga, M.M. World Emissions of Mercury from Artisanal and Small Scale Gold Mining. In *Mercury Fate and Transport in the Global Atmosphere*; Springer: Boston, MA, USA, 2009; pp. 131–172.
297. Bose-O’Reilly, S.; Drasch, G.; Beinhoff, C.; Rodrigues-Filho, S.; Roeder, G.; Lettmeier, B.; Maydl, A.; Maydl, S.; Siebert, U. Health assessment of artisanal gold miners in Indonesia. *Sci. Total Environ.* **2010**, *408*, 713–725. [[CrossRef](#)] [[PubMed](#)]
298. Drasch, G.; Böse-O’Reilly, S.; Beinhoff, C.; Roeder, G.; Maydl, S. The Mt. Diwata study on the Philippines 1999—Assessing mercury intoxication of the population by small scale gold mining. *Sci. Total Environ.* **2001**, *267*, 151–168. [[CrossRef](#)]
299. Hinton, J.J.; Veiga, M.M.; Veiga, A.T.C. Clean artisanal gold mining: A utopian approach? *J. Clean. Prod.* **2003**, *11*, 99–115. [[CrossRef](#)]
300. Spiegel, S.J.; Veiga, M.M. International guidelines on mercury management in small-scale gold mining. *J. Clean. Prod.* **2010**, *18*, 375–385. [[CrossRef](#)]
301. Velásquez-López, P.C.; Veiga, M.M.; Hall, K. Mercury balance in amalgamation in artisanal and small-scale gold mining: Identifying strategies for reducing environmental pollution in Portovelo-Zaruma, Ecuador. *J. Clean. Prod.* **2010**, *18*, 226–232. [[CrossRef](#)]
302. Sousa, R.N.; Veiga, M.M.; Klein, B.; Telmer, K.; Gunson, A.J.; Bernaudat, L. Strategies for reducing the environmental impact of reprocessing mercury-contaminated tailings in the artisanal and small-scale gold mining sector: Insights from Tapajos River Basin, Brazil. *J. Clean. Prod.* **2010**, *18*, 1757–1766. [[CrossRef](#)]



303. Basu, N.; Horvat, M.; Evers, D.C.; Zastenskaya, I.; Weihe, P.; Tempowski, J. A State-of-the-Science Review of Mercury Biomarkers in Human Populations Worldwide between 2000 and 2018. *Environ. Health Perspect.* **2018**, *126*, 106001. [[CrossRef](#)]
304. Obiri, S. Determination of Heavy Metals in Water from Boreholes in Dumasi in the Wassa West District of Western Region of Republic of Ghana. *Environ. Monit. Assess.* **2007**, *130*, 455–463. [[CrossRef](#)]
305. Basu, N.; Nam, D.-H.; Kwansaa-Ansah, E.; Renne, E.P.; Nriagu, J.O. Multiple metals exposure in a small-scale artisanal gold mining community. *Environ. Res.* **2011**, *111*, 463–467. [[CrossRef](#)]
306. Styles, M.T.; Amankwah, R.K.; Al Hassan, S.; Nartey, R.S. The identification and testing of a method for mercury-free gold processing for artisanal and small-scale gold miners in Ghana. *Int. J. Environ. Pollut.* **2010**, *41*, 289. [[CrossRef](#)]
307. Li, P.; Feng, X.; Qiu, G.; Shang, L.; Wang, S.; Meng, B. Atmospheric mercury emission from artisanal mercury mining in Guizhou Province, Southwestern China. *Atmos. Environ.* **2009**, *43*, 2247–2251. [[CrossRef](#)]
308. Qiu, G.; Feng, X.; Wang, S.; Fu, X.; Shang, L. Mercury distribution and speciation in water and fish from abandoned Hg mines in Wanshan, Guizhou province, China. *Sci. Total Environ.* **2009**, *407*, 5162–5168. [[CrossRef](#)] [[PubMed](#)]
309. Feng, X.; Dai, Q.; Qiu, G.; Li, G.; He, L.; Wang, D. Gold mining related mercury contamination in Tongguan, Shaanxi Province, PR China. *Appl. Geochem.* **2006**, *21*, 1955–1968. [[CrossRef](#)]
310. Ping, L.; Feng, X.; Shang, L.; Qiu, G.; Meng, B.; Liang, P.; Zhang, H. Mercury pollution from artisanal mercury mining in Tongren, Guizhou, China. *Appl. Geochem.* **2008**, *23*, 2055–2064. [[CrossRef](#)]
311. Meng, B.; Feng, X.; Qiu, G.; Cai, Y.; Wang, D.; Li, P.; Shang, L.; Sommar, J. Distribution Patterns of Inorganic Mercury and Methylmercury in Tissues of Rice (*Oryza sativa* L.) Plants and Possible Bioaccumulation Pathways. *J. Agric. Food Chem.* **2010**, *58*, 4951–4958. [[CrossRef](#)]
312. Qiu, G.; Feng, X.; Wang, S.; Shang, L. Mercury and methylmercury in riparian soil, sediments, mine-waste calcines, and moss from abandoned Hg mines in east Guizhou province, southwestern China. *Appl. Geochem.* **2005**, *20*, 627–638. [[CrossRef](#)]
313. Feng, X.; Li, P.; Qiu, G.; Wang, S.; Li, G.; Shang, L.; Meng, B.; Jiang, H.; Bai, W.; Li, Z.; et al. Human Exposure To Methylmercury through Rice Intake in Mercury Mining Areas, Guizhou Province, China. *Environ. Sci. Technol.* **2008**, *42*, 326–332. [[CrossRef](#)]
314. Iwata, T.; Sakamoto, M.; Feng, X.; Yoshida, M.; Liu, X.-J.; Dakeishi, M.; Li, P.; Qiu, G.; Jiang, H.; Nakamura, M.; et al. Effects of mercury vapor exposure on neuromotor function in Chinese miners and smelters. *Int. Arch. Occup. Environ. Health* **2007**, *80*, 381–387. [[CrossRef](#)]
315. Li, P.; Feng, X.; Qiu, G.; Li, Z.; Fu, X.; Sakamoto, M.; Liu, X.; Wang, D. Mercury exposures and symptoms in smelting workers of artisanal mercury mines in Wuchuan, Guizhou, China. *Environ. Res.* **2008**, *107*, 108–114. [[CrossRef](#)]
316. Moya-Anegón, F.; Herrero-Solana, V.; Jiménez-Contreras, E. A connectionist and multivariate approach to science maps: The SOM, clustering and MDS applied to library and information science research. *J. Inf. Sci.* **2006**, *32*, 63–77. [[CrossRef](#)]
317. Veiga, M.M.; Angeloci, G.; Hitch, M.; Colon Velasquez-Lopez, P. Processing centres in artisanal gold mining. *J. Clean. Prod.* **2014**, *64*, 535–544. [[CrossRef](#)]
318. Gunson, A.J.; Klein, B.; Veiga, M.; Dunbar, S. Reducing mine water network energy requirements. *J. Clean. Prod.* **2010**, *18*, 1328–1338. [[CrossRef](#)]
319. Veiga, M.M.; Angeloci, G.; Ñiquen, W.; Seccatore, J. Reducing mercury pollution by training Peruvian artisanal gold miners. *J. Clean. Prod.* **2015**, *94*, 268–277. [[CrossRef](#)]