



# The governance-gender intersection in global mining and its socio-environmental impacts

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## ARTICLE INFO

### Keywords:

Gender  
Governance  
Impact assessment  
Mining  
Sustainability

## ABSTRACT

Governance and gender are concepts that are scientifically and institutionally recognized as essential analytical keys for understanding and monitoring major contemporary socio-environmental dynamics, to which global mining is a major contributor. The intersection between governance and gender as determining factors in the socio-environmental impacts of global mining is explored in this study. We also intend to contribute to the understanding of such elements as drivers in the sustainable performance of global mining. A systematic review of the specialized literature (SLR) is applied in order to describe in detail the main topics involved in such interactions, as well as to reveal the latent structure of content in this structural network of influences. The analysis reveals a transversal presence of health, its characteristics and causality, but also more generic or complex aspects, such as health policies, public health and health promotion. The two big models of mining, industrial and artisanal, appear in the semantic structure crossed by 'health' and their respective risks and impacts: corporative ESG (internal and external) elements, the first, and local sustainable development concerns. Governance and politics, as well as gender, take different senses in each context. As a main conclusion, the use of SLR has facilitated the joint understanding of the governance - gender - mining impacts conceptual triad, assuming a hypothesis of socio-environmental complexity of the context. This assumption and joint understanding is considered necessary for the sustainable design and management of mining projects.

## 1. Introduction

In this work we aim to explore the intersection between governance and gender as determining factors in the socio-environmental impacts of global mining. Such factors are recognized as key issues for understanding and monitoring major contemporary socio-environmental dynamics (Issa and Hanaysha, 2023; Pothisarn et al., 2023), to which global mining is a major contributor. With the analysis of this thematic intersection (governance-gender-mining impacts) we also intend to contribute to the understanding of such elements as drivers in the sustainable performance of global mining. Underpinning this overall objective is the hypothesis that the complexity of the socio-environmental impacts of mining is best addressed using a parallel approach of epistemological complexity (Aledo-Tur and Domínguez-Gómez, 2017). It is a complexity that has to do both with the contemporary socio-environmental context (speed of social change, globalization, climate crisis) and with the conceptual diversity (and often confusion) in the analysis and understanding of both dimensions.

In other words, understanding and monitoring the socio-

environmental risks and impacts of mining involves understanding the interactions between the various dimensions of sustainability in the specific territory where a given mining project is designed, implemented and/or dismantled. Here we focus on interactions between governance and gender because they are usually treated separately, as if the socio-political and cultural determinants of sustainability exerted their influence independently, and not simultaneously or interactively (as in reality). These dimensions are theoretically grounded in the political basis of power management, on the same basis that both favors and hinders development projects in general, and mining projects in particular: that of social structures and processes relating to the management of power (Flyvbjerg et al., 2003).

The main global stakeholders in the mining sector place increasing importance on sustainability for the success of their current and future performance. Representatives of governments, industry, international institutions, NGOs and communities are not in doubt about this, as they emphasized in November 2022 at the Geneva Intergovernmental Mining Forum (IGF, 2022). International mining industry raise these issues to the ethical level of 'corporate principles' and 'performance

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<https://doi.org/10.1016/j.jclepro.2024.143176>

Received 4 February 2024; Received in revised form 2 July 2024; Accepted 15 July 2024

Available online 18 July 2024

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expectations' for their members. The special attention to gender diversity in its internal management and its social impacts, transparency in mineral benefits and governance of production processes are some textual examples (ICMM, 2024). From their side, the United Nations, OECD and the European Union point out similar criteria as essential for modern and sustainable mining (OECD, 2014; UNECE, 2021) in a scenario of increased need for raw materials for energy technological development (Wouters, 2023). However, these are theoretically complex and multidimensional criteria.

Consensus around this stance does not imply its immediate implementation, nor an absence of complexity or criticism. For example, at the Geneva forum, industry representatives called on national governments to be more willing to develop and, above all, apply stringent regulations, specifically in social and environmental respect. Government representatives, meanwhile, requested international institutions to develop and apply management and assessment standards for a number of processes in the interaction between mining and society (e.g. social and environmental protocols for decommissioning disused mining facilities, development plans featuring alternatives to mining, and so on). The UN's global sustainability strategy (2030 Agenda and SDGs) currently serves as a model for many governments and industries, including mining (Cole, 2023). SDGs find difficulties in its applications in the corporate sphere; some of them are its conceptualization of the state (country) framework, problems posed by the different sizes and scopes of companies, and strictly methodological factors related to systems of objectives, targets and indicators that bear no direct relation to the corporate world (Alaimo, 2020; Edouard and Bernstein, 2016; Macfeely, 2020).

These methodological problems reflect how controversial the definition of governance is. It is difficult to find any area of agreement with sufficient critical weight when defining what we call "governance" in the mining sector, although there is no doubt about the importance of this factor as a driver of sustainable performance. Governance is composed of structural elements in the design and execution of large mining projects, such as laws and regulations, which involve bureaucratic administrative processes. It also refers to other processes, such as social participation in decision-making, and to relationships, such as those that many projects establish with external stakeholders to encourage social acceptance. Governance also includes factors with a more territorial focus (local and regional governance, for instance). Furthermore, it encompasses ethical nuances ("good governance"), since the ethical positioning of decision-makers in the sector is an increasingly important factor in the context of the acute climate crisis. This semantic diversity and multi-dimensionality are evident in the voluminous academic output on the topic, which has grown constantly since its beginnings in the last third of the 20th century.

Interest in the issue of gender also continues to grow in academic production in general and in mining sustainability studies in particular, although less so in terms of theoretical depth and diversification (Connell, 2013; Connell and Messerschmidt, 2005). As gender is the most salient historical factor in social inequality, its importance in the analysis and understanding of sustainability is clear, whatever the field of research or application of knowledge may be (for example, socio-environmental relations in mining). There is agreement in the literature that the impacts of mining projects in developing countries are more numerous and more important for women (Ahmad et al., 2023; Huang and Ali, 2015; Mancini et al., 2021). As they are in most cases the family breadwinners in subsistence economies, the consequences for the community are aggravated. The gender factor in the context of industrial mining is represented by matters such as the feminization of the sector and the different jobs now accessible to women. These issues are related to women's double shift, the structural constraints imposed by mining work and indirect impacts in the area of gender-based violence, both in the workplace and in the family.

The proliferation of works on governance and gender in mining, from the point of view of impacts, does not occur to the same extent at the

intersection between these analytical dimensions. In other words, although interest in the two topics as catalysts of sustainability for mining performance is booming, there are few studies addressing the question of whether there is an interaction between governance and gender in terms of the socio-environmental risks and impacts of mining. Some studies cite the scarce attention paid to the intersectional effects of mining performance on the dimensions of sustainability (Ivic et al., 2021), and others clearly point to the interest of such intersectionality. Munir (2023) demonstrates that legislation, one of the main formal tools of governance, can change the context of mining performance and maintain power inequalities unfavorable to women. From the gender point of view, new pro-industrial legislation proposed directly by transnational corporations (in collusion with local and national governments) has replaced the old power structure, based on tradition, heteropatriarchy and the formal and informal regulations attached to it. Such process generates new forms of discrimination on new bases of inequality, while withdrawing rural women's economic agency in their context. Shifting the perspective to the corporate side, but in a similar territorial context, Chikosi and Mutezo (2023) demonstrates that greater gender diversity in the ownership and occupational risk management of mining companies is positively related to workers' health (at the time of writing one of the factors that, in the framework of corporate responsibility and sustainable performance, is of most concern to the mining sector).

From a sociological point of view, we can assume that these two key factors interact in important ways to influence sustainable mining performance. Thus, in this paper we set out to address the complexity of the relationships between mining projects and activities and the territories where they are carried out. By means of a systematic bibliographical analysis, we begin to answer the question posed in the previous paragraphs, by describing the topics linked to the governance-gender intersection and proposing a thematic structure of its contents.

## 2. Theory

### 2.1. Governance and mining: complexity and multidimensionality

When one tries to establish a definition of governance, in order, for example, to provide adequate grounding for a highly specific analysis (as is the case here), one encounters a major difficulty: that there is no clear agreement in the literature as to what exactly governance is (Colebatch, 2014). The first theoretical works summarizing definitions of governance appeared in the late 1970s, and in the 1990s there was a boom in such studies. In the late 20th century, extremely diverse areas of knowledge adopted the concept: institutional economics, international relations, organization studies, development studies and political science, for example. It seems that all these approaches share the reference to a framework whose main purpose is to understand the changing processes involved in governing organizations. In other words, the term "governance" serves to summarize or simplify the accelerating complexity of the global (but mainly Western) socio-political and economic context of the last third of the 20th century.

Governance refers to institutions and actors dealing with power, but also beyond this, it identifies grey areas in which responsibilities need clarification when addressing issues of a social or economic nature. It has a clear significance in terms of relations and processes, focusing on power exchanges and pressures, tensions and dependencies in networks. It highlights the nuances of the collective actors at play in the full sociological-political sense, which becomes even more evident now that "old-style" government, one which uses its power to subdue and impose, is of decreasing importance. This represents a paradigm shift in the form of governance, in which its adaptive nature, procedural elements, the (relative) autonomy of network actors, and new tools and techniques "to direct and guide" all gain in importance (Stoke, 1998).

The diversity of approaches to governance referred to above is still with us, reflected in a proliferation of adjectives, sometimes dualistic but

not necessarily antagonistic: public and private governance, market and regulatory governance; network and authoritarian governance, and so on. Definitions are bound together along various thematic strands, and ethical nuances are added. For example: good private governance, participatory public governance, networked local governance, and so on, in countless combinations that, while they help define the noun (governance), also generate further debates of all kinds. Among those of most interest for large projects intervening in the environment, such as industrial mining, we could cite the discussions arising from the territorial contextualization of corporate governance when designing or carrying out a mining project in a given location. This form of territorial governance is polycentric (Morrison et al., 2019) and applicable to contexts with a high level of complexity and change, and particularly stresses the management of environmental challenges (Perks and Schulz, 2020).

Domínguez-Gómez and González-Gómez (2021) identify four models through which the concept of governance is applied to mining. The first (model 1) is applied to, and functions in, the internal corporate dimension of the large-scale mining industry. In this model, governance is particularly related to strategic management decision-making, oriented towards efficiency of economic performance, returns on capital and resources ..., within the rules of the game set by political and regulatory frameworks. Although this first model is also nuanced towards governance as a component of social responsibility (commitment to stakeholders, reporting and sustainable performance), it is model 2 that has the strongest semantic relationship with sustainable development, corporate social responsibility and respect for the environment. In this second model, corporate governance, more “external” in meaning than the first, includes the management of the social and environmental consequences of mining in its territorial context, attaching importance to national and international institutional factors (with reference to environmental standards and institutional frameworks for sustainable development). The third model focuses mainly on epistemological and axiological factors: transparency, accountability, social participation, community development, social inclusion, and so on. It is characterized by a strong ethical position, critical of the exploitation of resources by large-scale mining and its collusion with national and global political elites. Finally, the fourth model focuses clearly on environmental and ecological management and its economic interest for mining; i.e., how best to manage water, the soil, the landscape, minerals and even communities through a pragmatic engineering approach.

## 2.2. Gender and mining: transversality and vulnerability

Similarly to governance, from the 1970s and 80s on, there is increasing academic work relating gender inequalities to structural inequities in access to power and the manifest or latent exercise of power in everyday social relations. Connell (2013), Foucault (1995), Lukes (2005) are accepted as contemporary models in the explanation of social relations in terms of power, and their analyses are therefore also relevant to gender inequalities (Lombardo and Meier, 2009). The three ways of exercising power in social relationships formulated by Lukes can be applied to gender relations: power over someone (which emphasizes conscious, individual or collective action), non-decisions (avoiding proactivity in reducing power inequality) and influence over people that prevents them from defining situations of inequality or conflict as a problem (which legitimizes inequality). Foucault’s approach is more structural and can be related mainly to Lukes’ second two forms. The normalization of (gender) inequality as non-problematic, or in the form of inaction over particular issues, points to hidden or latent mechanisms of power legitimized by their normalization through not being questioned. Other classics of power and gender studies (Connell, 1985; Connell and Messerschmidt, 2005) also draw attention to male hegemony, achieved through culture, institutions and persuasion. In this latent, structural sense, for example, the predominance of men in the mining industry normalizes the masculinity of the sector, and means

that this is not perceived as an issue of unequal power, even by women themselves.

In mining, women have traditionally been marginalized and excluded from any development opportunities offered by the activity (Keenan et al., 2016). The specialized literature on mining and gender shows that women are more frequently and more harshly affected by mining than men, and that they find it more difficult to enjoy the positive impacts of mining on the territory (Grieco, 2016; Reichart, 2010). The aggressiveness of exploitation, the hard physical work and high health risks involved have excluded women from the productive core of the activity, pushing them back into their traditional social roles as mothers and breadwinners. By extension, in the context of mining, they have been relegated to supporting activities for the productive core (Lahiri-Dutt, 2019). The relationship of the core activity to the external or support activity is reflected in the relationship of productive activity (economic, material profitability) to unproductive (unprofitable or not directly materializable), which feeds back into the structurally unequal symbolic system. This effective parallelism of the productive structure with the cultural-symbolic gender structure not only makes women invisible in the mining sphere, but also works hand-in-hand with this invisibilization in the local socio-cultural structure where mining is carried out. Furthermore, mining tends to monopolize the economic structure in areas where it is performed, making other activities revolve around it. This means that its social and cultural impact, as far as the gender dimension is concerned, may also have the effect of transmitting gender roles, reproducing the system and invisibilizing women in the other activities linked to mining, as well as, beyond the material level, in the local socio-cultural system (Agenjo-Calderón, 2016). This is Foucault’s legitimization by normalization, and the third of Lukes’ dimensions of the exercise of power (non-definition of situations of inequality).

This more sociological-political approach implies assuming strong complexity in the analysis of sustainable mining performance. However, the analysis of complexity as a requirement for the adequate understanding of socio-environmental impacts is a key that is not new. Socio-environmental impact assessment methodologies are based precisely on this assumption and, as in all fields, it can be found ‘state of the art’ papers (Esteves et al., 2012; Vanclay, 2020). But it is difficult to find antecedents of intersectional sociological analysis applied to the impact assessment of global mining, and there is no precedent in the literature similar to our proposal: a bibliographic meta-analysis to improve the understanding of intersections between governance and gender in the framework of global mining performance. Lahiri-Dutt (2022) makes a state of the art on gender as a topic of sustainability in the extractive industry, and indirectly touches on aspects that relate gender and governance, but without the joint perspective that is addressed in this our proposal. In the field of governance, we can cite the work of Domínguez-Gómez and González-Gómez (2021), modeling governance as a sustainability topic for mining, but with a similar objection.

## 3. Material and methods

In this study our exploratory objective entails a certain degree of complexity. The two main issues addressed, governance and gender, involve theoretical problems (as just indicated in the previous section), but are also of proven importance for identifying the impacts caused by mining. This is therefore an ideal area for a systematic review of the specialized literature (SLR) (Grant and Booth, 2009). SLR methodologies, first applied in medicine (Ramey and Rao, 2011), are currently used in almost all areas of knowledge, and serve mainly to ensure systematicity, transparency and reproducibility when summarizing the state of the art on a given research objective. In this case, we will adopt the method of (Onwuegbuzie and Frels, 2016), in the phase they define as “properly systematic”: meta-analysis, meta-summary, rapid review and meta-synthesis.

The SCOPUS database was chosen as a source of information for this

work. SCOPUS shares with Web of Science the leadership in the academic world as a reference source for research in most areas of knowledge, and specifically for bibliographic reviews in the transversal field of sustainability (Thottoli et al., 2022). A search was performed on May 2, 2024 using the “Title-abs-key” field (Title, abstract and keywords). The inclusion criterion for compiling bibliographical references was formulated in a search string using Boolean operators. This string was justified by the terms whose relationship is the focus of our exploratory objective. Thus, it was expressed as follows:

mining AND (impact OR impacts OR change OR changes) AND (governance OR government OR policy OR policies) AND (gender OR wom\*n)

The resulting bibliographical list was filtered by applying two exclusion criteria: (1) only publications in English were retained, as this is the predominant language of scientific production; (2) publications on methodological topics were also eliminated, as they were inappropriate for the purpose of the study. The final list consisted of 212 BRs, published between 1980 and 2024, with a total of 257 different keywords.

The relational structure was obtained using VOSviewer (VOSviewer, 2021). This is a tool that specializes in BR analysis and includes each reference as a case in its input matrix. The structural-semantic analysis was supported by the cluster or community analysis used by VOSviewer as the basis of its operation. Its clustering system is based on the co-occurrences of the keywords in each BR (Eck and Waltman, 2009). Seeking the most efficient analytical solution (i.e., the most explanatory network structure, with the lowest number of groups or clusters), a minimum of two co-occurrences between each pair of keywords was set for inclusion in the analysis. For data normalization, Van Eck and Waltman (2009) advocate applying strength of association (the default method in VOSviewer). Both cluster analyses and their representation in graph form are accepted and recommended techniques for condensing and summarizing large amounts of information in the most diverse areas of knowledge (Lozano et al., 2019).

#### 4. Results

For our descriptive analysis, we took into account only keywords repeated a minimum of twice, and we grouped them into coherent categories of meaning. For instance, the keyword “infant” included “infant, child, newborn, birth weight, child health, child care, infant health, infant mortality”. After applying these criteria, a total of 68 keywords were considered for descriptive analysis.

Using this approach, interesting contents emerged around the four main concepts of the bibliographical search. We call these contents “emerging” because the search string did not include them as required terms in the “keywords” field: mining, women-gender, governance-policy and impacts (in red in Fig. 1 the keywords directly linked to such terms). Four of the six most referred topics (marked in dark blue in Fig. 1) have this emerging character (“management”, “occupational health”, “resources” and “social-economic conditions”). “Management” refers to all those aspects linked to management of business processes and operations, such as “firm performance”, “human resources management” or “benchmarking”. The third position, “occupational health”, includes working conditions in general, particularly disorders stemming from heat and exposure to a harmful working environment. While the topic “management” can be clearly related to corporate mining performance, “occupational health” could be understood as overlapping in both industrial mining and ASM. Resources (typology and location), socioeconomic conditions in local and regional environments, and the impacts of mining activity in these environments, make up the other topics that we find among the most interesting for the literature.

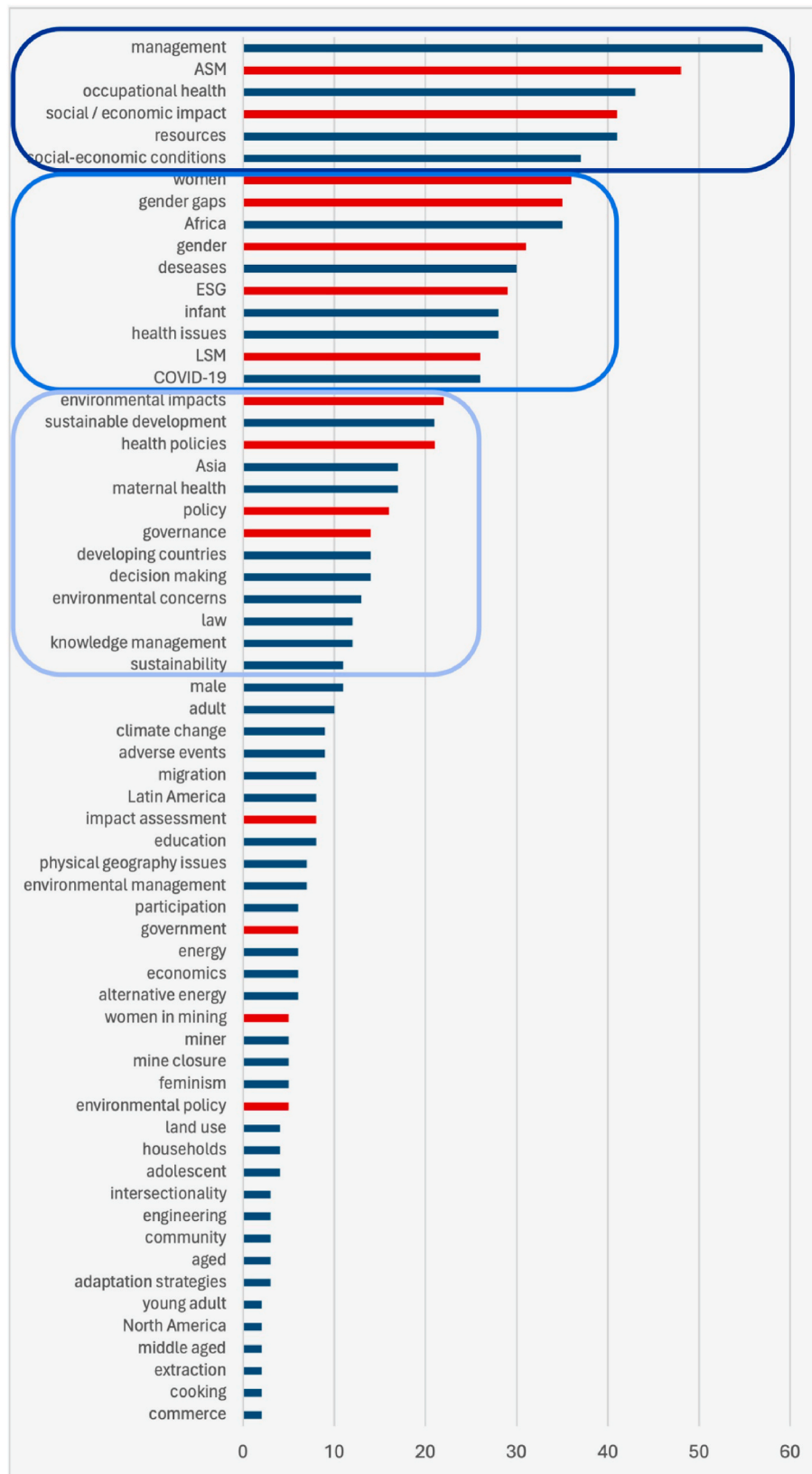
If we continue to pay attention to emerging content, going down the frequency hierarchy, interest in topics that include socio-environmental and health aspects can be observed (marked in medium blue in Fig. 1). In addition to what might be expected (women and gender in textual terms, as they are in our search criteria), we find problems linked to gender as a

matter of social burden (“gender gaps”, “infant”) and health (“health”, “diseases”). LSM (that is, Large Scale Mining) and COVID-19 close a group of topics that point to the results of the structural analysis that we show later: the semantic intersection of governance-gender-mining-impacts in the literature was occupied by some major topics, namely, *management* as a work area in the corporate industrial field, and *health*, represented within the mining sector (LSM and ASM -that is, Artisanal Small Mining) in the form of the workers’ health, and outside it in its environment, with particular reference to social conditions and gender inequality. In the external socio-environmental dimension, health policies also appeared (public health, health planning and services), with especially in terms of children’s health and family planning. Clearly, women play a key role in both latter due to their traditional gender role, and this became visible in the category of ‘gender gaps’, which contained keywords directly relating to gender discrimination and socio-structural imbalances.

The semantic composition of the next group of categories (marked in light blue in Fig. 1) was similar to the one previously discussed, although it may be seen as having a transitional relationship between artisanal and industrial mining. The topic of health is still prominent, in the specific terms of this study referring particularly to maternal health and health policies. The contextual dimension was also notable, although with a broader focus, with sustainable development as an important topic. Large-scale mining appeared jointly with ‘decision-making’, with encompassed keywords from the technical or management approach (decision tree, evidence-based decisions). This may be related to the monitoring and assessment of the impacts of mining activity. ‘Policy’ and ‘law’ bring together the more institutional aspects of mining governance (policy-making and implementation, law and legislation, bans), including specific gender issues (laws on discrimination, gender-responsive legislation). The most cited territorial contexts were the African countries, followed by those in Asia and Latin-America. The group of categories that closes the list with the fewest repetitions reiterates the semantic model of those previously discussed.

The cluster analysis arranged the 257 keywords into seven groups whose distribution in the overall network can be seen in three large, relatively heterogeneous topic areas (see Fig. 2). Thus, the upper central area (1) mainly brings together bibliographical references to factors related to health, its characteristics and causality, infections and specific diseases, but also more generic or complex aspects, such as health policies, public health and health promotion. The cluster in which Covid studies are located is included here. The lower right area (2) maintains the overall theme of health, but in this case with clear to environmental risks and impacts connected with mining. The lower left area (3) includes nodes relating to ASM and its links to social development and the role of this type of mining in rural and community areas, sustainability, social structure and gender relations. The nodes included in this area develop thematically as we move to the right, increasingly focusing on environmental relations in mining: engineering, environmental policies, environmental impacts, pollutants of the different elements of the environment, specific pollutants (mercury), and so on.

Going into more detail, the red cluster (RC) is the most numerous, with 87 keywords. It includes the nodes most closely linked to **social problematization of gender** (women status, wage gap, gender disparity, gender equality ...). A numerous group of nodes involving ASM is the other big component in meaning within this cluster, i.e., the most cited keywords in the bibliography under study, and also the most densely related to the rest of the network. Local development; social, community, and environmental factors; and regional land resources for mining make up a cluster with strong content in terms of sustainability in socio-economic and environmental development. In this group, terms theoretically related to governance (such as “leadership”, “governance approach”, “laws and regulation”, “policy discussion”), can be found isolated and relatively little cited (i.e., with few co-occurrences). Also interesting is the situation of “communities”, which is located in a peripheral position (the algorithm places it as an outlier) but is densely



**Fig. 1.** List of keywords, ranked by frequency.

(Red = keywords that includes our search terms). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Source: own elaboration.





during the expansion and closure of mining projects), increase the likelihood of domestic violence. In the case of female workers, being able to balance work and motherhood is essential to ensuring that the mining project does not exacerbate structural gender inequalities (Lu, 2012; Macdonald, 2017). In the area of health facilities, projects should ensure reasonable use of (or appropriate compensation for) public health services, avoiding overloading them. On the governance level, there is a need for participatory management of the health risks and impacts of industrial mining projects; thus, we would highlight the benefits of constructive interaction between the government agencies responsible for health, the community and the company itself, through a horizontal distribution of power relations, with relationships based on transparency, honesty and accountability.

Amongst our findings, **the distinction between industrial and artisanal mining** appears as a further emerging analytical key to the governance-gender-impacts intersection. In particular, the most important cluster (RC) highlights **ASM in its relationships with sustainable development, local socio-economic conditions and gender issues**. These are complex relations, in which political management plays a crucial role. Thus, on the one hand, ASM is usually approached within the framework of the developing world, where it is generally seen as an informal sector, with low yields, high levels of insecurity, health problems, low technology and high (and very hard) labor intensity. It is frequently a traditional activity that has monopolized and molded the local cultural, political and social structure for centuries. The arrival of industrial mining in these contexts has major impacts, as it marginalizes ASM as an economic activity and erodes long-established social and economic structures and roles, including those of authority and gender. The highly diverse activities linked to traditional mining are threatened and gradually eliminated. Extraction, washing, transport, the commercial and accounting management of minerals, finance, supplies, small mechanics, hotels and catering: these activities represent a whole socio-economic system, with its own prevailing gender conditions, which had previously placed women in many of these tasks, often legitimizing a certain capacity for entrepreneurship, autonomy and responsibility outside the home-management, reproduction and caring for children and the elderly (Grieco, 2016). In these contexts, the arrival of industrial mining involves the imposition of an alien governance system, defined by actors with their own interests; actors who are foreign to, and ignorant of, the local reality, disregarding and discriminating against it. National governments and large companies implement similar “civilized” governance systems, which are oriented towards national and corporate profits and destroy the balance of the traditional system. Thus, an entire socio-cultural and economic structure is condemned to illegality and marginalization, in pursuit of a concept of development that has nothing in common with contemporary models of sustainability (Bush, 2009; Bush and Stroup, 2023; Ivic et al., 2021).

In the contexts just described, building sustainable development should start by taking the *emic* perspective into account, which shows us that traditional ASM has provided sustenance for centuries on the most basic level, with female empowerment rooted in traditional cultures. Hilson and Maconachie (2020) for example, criticize the UN for disregarding this potential role of ASM and instead pushing for LSM at a time of a “crisis of creativity” in solving, or at least addressing, the major issues of economic, cultural and socio-environmental vulnerability in the developing world, especially in the (increasingly large) regions of interest for mining. The World Bank also supports foreign-invested industrial mining as a model for economic development in these areas. At the same time, regional governments develop policies consistent with this model, mainly due to its profitability for the national economy (concession fees, exploitation licenses, taxes on profits). On the local level, however, such policies often take the form of a *de facto* expropriation of the local community’s mining resources, going against local or community authorities who have no regulatory tools or legal powers to prevent this (Hilson and Maconachie, 2020; Keovilignavong, 2019). So far, the consequences have seen growth in centers of export-oriented

mining production, with high levels of autonomy from and low profitability for local economies.

In addition, it has been shown that the arrival of industrial mining has a clearly negative impact on the basic minimums that ASM provided. Orleans-Boham et al. (2020) gives the example of massive migration, in its twofold aspect. On one hand, immigration to the “new” industrial mining areas because of their economic and occupational appeal. On the other hand, emigration of the local population which, finding no place in the new industrial activity, leaves in search of other means of sustenance, such as traditional mining in adjacent areas (now probably illegal), or further away from their original homes, for example in nearby cities, which then grow in a disorganized and disproportionate way. The paradigmatic context is Sub-Saharan Africa, where these migratory movements are proven to cause impacts such as cultural uprooting, child de-schooling, psychological problems, alcohol and drug addiction.

We can observe contradictory approaches to sustainable development, then, since as noted above, **LSM also appears across the board and emerges in our findings as closely linked to the concept of sustainability**. This occurs in diverse areas, such as occupational health, impacts on the external biophysical environment and corporate management in terms of internal and external responsibility (OC and GC) (Academy of Science of South Africa et al., 2019; Appleton et al., 2005). The developmentalist approaches adopted by international institutions stress the role of large-scale mining in boosting local sustainability, in its broadest (and most meaningful) sense. In the late 1990s and early 2000s, the emergence of the corporate social responsibility discourse brought about a revolution in sustainable industrial performance management; and during the 2010s and 2020s the discourses of world institutional actors regarding such sustainable performance have crystallized into a global consensus: the mining industry should take up an ethical posture of total commitment to both respectful, fair relations with the social and natural environment and the proactive fight against climate change.

Actually, mining companies seem to be increasingly proactive, for example in developing internal governance tools such as protocols, guidelines and good practices to combat gender inequality both within the companies themselves and in their interaction with the community (Kemp et al., 2010; Pimpa and Moore, 2018). From a gender perspective, the most critical approaches to these initiatives emphasize the socio-structural influence of a culturally male sector, to which female workers are consciously or unconsciously subjected. Although the percentage of women directly employed in LSM is increasing, it typically ranges from 10% to 20% (International Institute for Sustainable Development, 2023). These governance tools are also being put in place to regulate internal management and decision-making processes (Hopkins and Kemp, 2021); and, as in the case of gender, there is no doubt that both the development of standards and their application – whether directly or indirectly, expressly or tacitly – involve political factors, i.e. those shaped or influenced by the prevailing power relations between the social actors in play. Even in paradigmatic cases for the governance-gender relationship, the power relations between social positions are evident. For example, it is common for women who reach managerial positions to proudly defend their achievements in the face of obstacles that men do not have to deal with; but it is also common for them to exercise their leadership by defending the same patriarchal symbolic structure that hindered their progression, ignoring the latent conditioning factors inherent to the unequal social structure (Laplonge, 2016). Similar conditioning factors apply to the design and execution of companies’ socio-environmental actions.

Women’s capacity for collective participation in organization around, and resistance to, corporate or governmental decisions appears as an influential vector in the impacts of mining. Current mining industry CSR (that is, Corporate Social Responsibility) and sustainable performance standards normally take into account the views and positions of external and internal stakeholders in order to improve

organizational performance in the social and political dimensions of sustainability (and indirectly its environmental dimension) (Keenan et al., 2016; Tobalagba and Vijayarasa, 2020). Women's organization in associations defending their interests is shown to be a factor boosting sustainable performance, in cases where the company or legislator is less sensitive to their needs and preferences (Munir, 2023). At this point, local cultural conditioning factors reappear, since a more democratic culture is related to associations that are more empowered and better positioned to influence the authorities responsible for mining legislation (Domínguez-Gómez and González-Gómez, 2021).

Our semantic structure, taken as a whole, would demonstrate the potential impact of including women in private and public decision-making processes and in mining governance tools in general. Women's occupational health, gender conditioning factors (relationships with children, their health, their schooling), impacts on the family and on rural women's informal economic activities, the conditioning factors and collective impacts of women working in LSM. Chikosi and Mutezo (2023) demonstrate that greater gender diversity in ownership and corporate governance bodies in mining companies is positively related to the major factor of concern in the sector: occupational health. This factor is ubiquitous in all standards for measuring sustainable industrial performance. For all these reasons Sinclair (2021) proposes overcoming the victimization of women in sustainability analyses of mining activity, which would represent a prior step towards their gaining a more prominent role in the sector and, indirectly, in the reshaping of the territory that the arrival of LSM projects entails.

## 6. Conclusion

The results of the analysis just presented can be understood as the product of a 'revelation' process. That is, both our descriptive and our analytical (structural-semantic analysis based on network analysis) results, discover (reveal) key themes to have a more realistic perspective of global mining sustainability performance about the interaction between two dimensions that are rarely understood together. This joint understanding is considered necessary for the sustainable design and management of mining projects.

The different cross-cutting topics we have found could be reformulated into three areas of intervention for the improvement of sustainability performance in the mining sector: (1) social and human development, with worker and community health as fundamental factors; (2) economic growth based on the fair exploitation of mining resources; and (3) the elimination or, at least, reduction of the industry's environmental impacts on the air, water and land. They are of an "emergent" nature; that is, they are composed of topics linked to the interrelationships between governance, gender and impacts in mining, but these topics do not include any of the terms from the bibliographical search string. Both the transversality and the emergent nature of the three strands are of interest for embracing and understanding the complexity of sustainable mining performance, especially as it relates to the governance and gender. The local contextualization can be rounded out by taking into account the global socio-political and economic dynamics shaping the sector, in both its ASM and LSM forms, when addressing risk and social impact assessment in mining projects and activities.

Comparing the governance models in mining identified by Domínguez-Gómez and González-Gómez (2021), with a methodology similar to that used here, the introduction of gender and the impacts of mining in the bibliographic search equation makes them appear some of the most important themes for the semantic structure revealed with our work. This is the case of the issues most directly related to health, at the level of public policies and management, and also occupational health (corporate level), community health, women's health and children's health). Another examples are ASM, sustainable development (in its more 'bottom-up' meaning, more linked to what is understood as community development from the communities' own perspective), and

the role of women in socio-political structures rooted in local traditional culture. Considering all this, we can conclude that the addition of the gender factor from the perspective of impacts drew a more realistic and integrative map of mining sustainability. This map will better guide decision makers who want to understand in depth the aforementioned corporate governance models, as they are understood by LSM.

Furthermore, the literature clearly indicates that power inequalities in gender relations are closely related (with high-density relationships in our graph) to other risks in sustainable performance, such as disregard for human rights, expropriation and overexploitation of natural resources, and the lack of protection of children and their special development needs. Encouraging participatory processes that include the social actors in the local territorial context (i.e., the women's associative movement and the community in general) in public and private decision-making appears as another potential key to managing socio-environmental risks in mining (Sutcliffe-Braithwaite, 2021; Yakovleva, 2007).

A critical review of the literature would give rise to a proposed governance system that would be capable of making traditional systems of authority in ASM areas compatible with the new sustainability standards established in international agendas, with the 2030 Agenda and the SDGs as a shared model. This multilevel governance would make inter-gender power relations visible and take them into account within a contemporary ethical human rights approach, since the positive impact of this perspective on the social, cultural and economic processes involved in mining has been proven (Johansson and Ringblom, 2017). These positive impacts occur both in factors affecting LSM internal organization and the specific territorial areas where ASM is carried out (also applicable, given its impact, to LSM). Thus, taking territorial cultural specificities into consideration is recommended as the main guideline for the bottom-up articulation of gender-inclusive governance systems.

## CRedit authorship contribution statement

**J. Andrés Domínguez-Gómez:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The authors are unable or have chosen not to specify which data has been used.

## Acknowledgements

The author's would like to acknowledge the following funders for this research: Universidad de Huelva. Proyectos de apoyo a la integración de la perspectiva de género. Modalidad Proyectos de investigación. Código EPIT6422020. Universidad de Huelva. Proyectos de I+D+i UHU-FEDER 2018. Código UHU-1261659.

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