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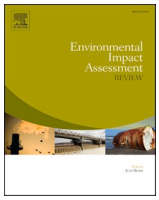

An exploratory methodological approach to enhancing public health policy in Ghana's mining operations

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ABSTRACT

Industrial mining significantly contributes to the economies and public revenues of numerous low- and lower-middle-income nations, with its importance set to grow due to the increasing demand for critical minerals in the energy transition. Concurrently, the negative externalities associated with large-scale mining are set to escalate if not rigorously managed. Among these adverse impacts, the negative effects on public health have long been disregarded in the governance of large-scale mining projects. This study examines the regulatory and policy landscape governing public health within impact assessment practices in large-scale mining operations, highlighting the inadequacy of current regulatory approaches, particularly the limited attention given to public health within Environmental Impact Assessments (EIAs). Focusing on mineral-rich Ghana, we investigate stakeholder perceptions regarding the adequacy of current EIA policy frameworks in safeguarding public health. Applying Q-methodology, we explore diverse perspectives on policy action, priorities, and the involvement of relevant actors in shaping progressive public health regulation within the mining sector. Our findings offer valuable insights into the policy space and potential strategies for strengthening public health in mining activities, with implications for EIA environmental management practices. Moreover, our findings suggest that the divergent policy preferences uncovered in Ghana highlight key obstacles to greater public health consideration through the inclusion of Health Impacts Assessment (HIA), especially in contexts with limited administrative resources. Our study reveals how roles, responsibilities, and authority over impact assessment and mine licensing processes can significantly shape stakeholder policy preferences toward HIA.

1. Introduction

Recent research has revealed the intricate impact of large-scale mining ventures on public health, unveiling a spectrum of possibilities spanning positive and negative outcomes (see, for example, Cossa et al., 2022; Lyatuu et al., 2021; Zabré et al., 2021). While industrial mining projects have considerable potential to contribute to the health-related targets of the 2030 Sustainable Development Agenda, experience shows that, in the absence of regulatory safeguards, adverse impacts from mining projects on health tend to prevail (Dietler et al., 2022; Himmelsbach et al., 2023; Leuenberger et al., 2021). This issue takes on a critical dimension in Africa, where the deficiency of comprehensive regulation and oversight often results in an inadequate consideration of health impacts. While various policy measures exist to address negative health impacts in the context of large-scale mining, most notably the health impact assessment (HIA) approach, no African country provides clear regulations for considering public health in the licensing process for large-scale natural resource extraction projects. Although many countries have mandated environmental impact assessments (EIAs) to mitigate environmental harm (Richard, 2012; UN Environment, 2018), public health impacts often receive inadequate attention (Winkler et al., 2020). In the absence of regulatory requirements, mining companies in Africa typically direct limited attention to public health (Dietler et al., 2020; Engebretsen and Brugger, 2021). The void left by the absence of HIAs, health management plans, and monitoring mechanisms tends to magnify adverse health effects (Knoblauch et al., 2020; Leuenberger et al., 2019; Siquan et al., 2022). Moreover, limited transparency in EIA processes, coupled with the frequent confidentiality of environmental

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management plans, often hinders local civil society actors and affected communities from filing complaints or pursuing litigation to address adverse health impacts caused by resource extraction. The absence of specific regulations and clear accountability for health impacts—especially secondary or social impacts—further limits public access to legal recourse. Even when health considerations are included, they are often restricted to the biophysical environment, focusing on pollution, without addressing the broader range of health determinants. Consequently, litigation is rendered challenging not only by a lack of transparency but also by the absence of robust public health provisions within EIAs and their corresponding management plans. Therefore, clear and comprehensive HIA regulations, including requirements for publicly accessible (health) management plans, are essential for enabling complaints and fostering corporate accountability.

Early insights from cases like Zambia's Trident copper mine, marked by the implementation of thorough HIAs, suggest encouraging health outcomes (Knoblauch et al., 2020; Farnham et al., 2022). Notably, both scholarly discourse and international development organizations, including the World Health Organization (WHO), the Asian Development Bank (ADB), and the World Bank's International Finance Corporation (IFC), strongly advocate for the incorporation of HIA (ADB, 2018; IFC, 2009; WHO, 2023). This advocacy has been accompanied by a surge in HIA guidance documents issued by various international bodies, including those within the extractive sector, such as the International Council on Minerals and Metals (ICMM) and the International Petroleum Industry Environmental Conservation Association (IPIECA), as well as the International Association for Impact Assessment (IAIA) (Lamprecht et al., 2024).

Concurrently, there has been increasing momentum to integrate various impact assessments and broaden the scope of EIAs to address global challenges such as climate change and biodiversity loss. However, revisions to EIA frameworks often concentrate narrowly on mitigating greenhouse gas emissions, neglecting other significant dimensions of climate change impacts (Mayembe et al., 2023). While tools and datasets for evaluating climate-related environmental impacts are relatively advanced, those for assessing public health impacts remain underdeveloped. This imbalance has resulted in the insufficient integration of public health considerations into EIA processes, particularly with respect to long-term or cumulative effects.

The lack of baseline health data in affected communities, combined with limited efforts to assess and quantify indirect or long-term health effects—such as mental health impacts or the cumulative burden of chronic diseases—has contributed to the underrepresentation of health considerations in EIAs. Furthermore, social determinants of health, such as access to healthcare and socioeconomic disparities exacerbated by mining projects, are rarely central to EIA discussions. Thus, while a broader trend toward aligning EIA frameworks with contemporary challenges presents an opportunity to incorporate HIAs, achieving this will require more comprehensive frameworks that extend beyond traditional environmental concerns (Fischer and Cave, 2018).

Despite growing advocacy and increasing awareness of the need to address public health impacts from large-scale natural resource extraction, particularly in resource-rich developing countries where future investments are expected and vulnerable communities are at risk of bearing the brunt of negative effects, a significant gap remains in understanding local stakeholder sentiments toward progressive health regulation in mining and the available policy space to implement HIA as part of a broadened framework for impact assessment.

Taking the case of Ghana, we investigate stakeholder policy preferences on public health regulation as part of a larger resarch project on the interaction between industrial mining and public health in Sub-Sahara Africa (Winkler et al., 2019). In Ghana, the mining and quarrying sector plays a significant role, contributing 7.7 % to the GDP in 2022 (GHEITI, 2024). Additionally, the country has experienced significant negative health impacts from both large- and small-scale mining operations, particularly in gold mining (Adei et al., 2011; Akpalu and Normanyo, 2017; Asante and Owusu-Agyei, 2013; Emmanuel et al., 2018). Compared to other Sub-Saharan African countries, Ghana has a relatively long history of including public health considerations within EIA, a practice often attributed to civil society and media pressure (Asante and Owusu-Agyei, 2013; Engebretsen and Brugger, 2021). However, public health remains underrepresented in Ghana's environmental regulations and EIA framework, where HIA is neither consistently mandated nor institutionalized, lacking clear methodological guidance. Consequently, impact assessments in Ghana have generally been limited to specific large-scale infrastructure and extractive projects, with a narrow focus on mitigating environmental impacts rather than adopting a comprehensive public health perspective that addresses multiple health determinants. Despite growing awareness among health professionals, NGOs, and civil society about the need to advance HIA, progress has stalled, with HIA neither systematically integrated into the EIA framework nor firmly embedded in legislation. "HIA seems to be low on the agenda of those establishing projects and businesses. Probably because of the competing interests of various stakeholders…" (Asante and Owusu-Agyei, 2013, 282).

Against this background, we employ Q-methodology to investigate whether stakeholders from various branches of government, the private sector, and civil society perceive a necessity for policy action. Even when stakeholders acknowledge the importance of public health and share a commitment to safeguarding it, their opinions on the best approach to achieve this goal can vary considerably. This is expected, as different stakeholders have unique mandates, concerns, interests, priorities, and preferences. These differences lead to varied policy positions on how to address public health issues related to industrial mining. For instance, there may be disagreements over how responsibility for public health should be divided among mining companies, local and central government, who should bear the costs, and the role of community involvement. Given the range of potential approaches and policy positions on public health regulation in mining, our study seeks to understand stakeholders' preferences concerning the desired level of regulatory stringency and institutional responsibilities. By identifying both shared and divergent viewpoints among different stakeholder representatives, we aim to contribute to informed discussions on policy development.

The following section introduces Q-methodology, selected for its suitability in systematically analysing subjective viewpoints and its value in understanding how small-n groups perceive specific issues. Section three then presents the results from factor analysis, followed by their interpretation in section four. Section five discusses the findings and limitations, and section six concludes.

2. Methodology

Q-methodology is a research approach that combines qualitative and quantitative techniques to systematically study subjective opinions, allowing for the exploration of diverse perspectives within a given population (Brown, 1980; McKeown and Thomas, 2013; Stephenson, 1993; Watts and Stenner, 2005, 2012). Q-methodology is a valuable tool for systematically capturing how different stakeholders approach a particular issue, enabling a methodical characterization and understanding of their diverse perspectives. This approach has been applied across various disciplines and is gaining increasing attention in policy research due to its ability to generate insights that directly inform policy-making processes (Brown, 2019; Dieteren et al., 2023). Q-methodology has been widely applied in environmental studies, planning, and management, including in strategic environmental assessments (SEAs) and EIAs (Cotton and Mahroos-Alsaiari, 2015; Forrester et al., 2015; Siangulube, 2024; Sneegas et al., 2021). It often serves as a participatory tool, enabling stakeholder consultation and fostering an understanding of diverse stakeholder perceptions regarding environmental risks and mitigation expectations (Seghezzo et al., 2024; Walker et al., 2024). Additionally, Q-methodology has been applied to research EIA practice, capturing practitioner and scholar perspectives on its

evolving theory and application (van Staden and Retief, 2022).

This study builds on the tradition of using Q-methodology in environmental studies and impact assessments but differs from previous research in the field by focusing on the potential for progressive policy development for including health considerations into impact assessment practices. It aims to understand stakeholder priorities and the levers and constraints that influence the advancement of HIA, shedding light on the policy space to incorporate health more effectively.

In Q-studies, participants are provided with a predefined set of statements that are considered representative of the full range of relevant viewpoints or opinion domains on the topic of interest (Watts and Stenner, 2005, 2012). These statements are typically presented on cards, and participants are asked to rank them along a continuum according to their preferences, as shown in Fig. 1. To guide the expression of preferences, the sorting continuum or grid is usually designed as a forced normal distribution (Webler et al., 2009).

The rankings of statements provided by participants, known as Q-sorts, are then analysed through a by-person factor analysis to identify patterns of rankings shared among participants. This process reduces a large number of variables into a smaller number of factors. Each factor is then qualitatively interpreted as a general viewpoint or perspective held by the group of participants who load most strongly onto that factor (Alderson et al., 2018; Brown, 1980; Stephenson, 1993; Watts and Stenner, 2012).

2.1. Generation and selection of statements

We employed a set of policy statements derived from a concourse analysis (Brown, 1980; Molenveld, 2020; Watts and Stenner, 2005, 2012), taking stock of relevant perspectives and contentious issues pertinent to our topic of research. Our analysis included a review of the current regulatory and institutional framework governing large-scale mining in Ghana. This review was enriched by key informant interviews conducted in 2020 with public officials specializing in mining sector governance and impact assessment, providing valuable insights into regulatory practice. Finally, the concourse analysis integrates insights obtained from focus group discussions carried out in 2020 at three industrial mining sites: Astufi, Ayanfuri, and Tarkwa. Participants included local health service representatives and community members directly affected (see Leuenberger et al., 2021). Data from these discussions, combined with key informant interview findings, were instrumental in achieving thorough coverage of relevant thematic areas and delineating the concourse's scope (McKeown and Thomas, 2013; Webler et al., 2009).

An initial Q-set of 234 statements was inductively developed from the analysis of the concourse (cf. Brown, 1980; Sardo and Sinnett, 2020; Watts and Stenner, 2012; Webler et al., 2009) and condensed into a subset of 40 statements covering different policy options, varying in scope, stringency, actors' responsibilities and accountability, and coordination (Proksik et al., 2023, 2024). These were tested in a pilot study for clarity and topical coverage, leading to the creation of a final revised sample (Q-sample) of $n = 40$ Q-statements (refer to Table 2).

2.2. Selection of participants

Study participants were purposefully selected based on their classification as policy stakeholders with a solid grasp of Ghana's public health and impact assessment regulatory framework. This was done to ensure participants' ability to comprehend and attribute meaning to Q-statements (Molenveld, 2020; Watts and Stenner, 2012). The selection aimed for diversity in backgrounds and professional roles, ensuring heterogeneity (Nguyen et al., 2018; Parry, 2022; Tuokuu et al., 2019; Watts and Stenner, 2005). The sample included 17 representatives ($P = 17$) from the public sector, encompassing executive government, legislative bodies, the private sector, and civil society (Table 1).[1]

2.3. Data collection

Data collection comprised participants ranking statements (Q-sorts), followed by brief complementary interviews. Before the study, participants received information on the study's background and purpose, ensuring prior informed consent and assuring anonymity. Data collection occurred in July and August 2021.

During Q-sort administration, participants ranked 40 policy statements based on their personal views. Initially, they sorted statements into three piles: most representative, least representative, and neutral. Then, participants placed statements on a distribution continuum (+5 to −5) using a Q-sorting grid (Fig. 1). Adjustments were permitted until satisfaction with the final distribution. Post Q-sorting, participants explained their choices, especially for statements ranked most representative (+5) and least representative (−5). These explanations aided in interpreting factors, offering insight into stakeholder perspectives and preferences.

3. Factor analysis

The analysis encompassed 17 Q-sorts, corresponding to study participants. Using KADE v1.2.1 software (Banasick, 2019), Principal Component Analysis was conducted on the Q-sort data. Initially, eight factors were extracted, and two were chosen for Varimax rotation. While various statistical criteria exist to aid factor selection, the process remains a matter of interpretative judgment (Brown, 1980; Molenveld, 2020; Watts and Stenner, 2012; Webler et al., 2009; Zabala et al., 2018). Factor selection was an iterative process based on theoretical interpretability and standard statistical criteria in Q-methodology: the Kaiser-Guttmann criterion, the significant loading test, the minimum variance test (requiring factors to explain >8 % variance individually and > 30 % cumulatively), and the scree test (Fig. 2) (Armatas et al., 2014; Watts and Stenner, 2012). Since there are no definitive rules for factor selection, interpretative judgment is essential (Brown, 1980; Watts and Stenner, 2012; Webler et al., 2009; Zabala et al., 2018). The two-factor solution was compelling, aligning with the local policy context and researchers' background knowledge while meeting the above statistical criteria. Solutions with additional factors showed high inter-factor correlations, complicating their interpretation as distinct perspectives (Watts and Stenner, 2012), or raised concerns about the validity of additional factors, suggesting they may be spurious.

Together, Factor 1 (F1) and Factor 2 (F2) account for 45 % of the study variance (34 % and 11 %, respectively). Correlation between factor scores is insignificant.[2] Factor loadings of 0.41 or above were deemed significant at the $p > 0.01$ level. Factor loadings indicate the relation between each participant's Q-sort and the factors (Zabala et al., 2018). Out of 17 Q-sorts, 16 significantly load on at least one of the two factors, while four Q-sorts are confounded, significantly loading on both factors. Since confounded Q-sorts represent more than 23 % of the data, we adjusted the threshold for considering a factor loading significant to 0.44, maximizing the number of participants with purely significant loadings (Watts and Stenner, 2005). This results in a solution where F1 is defined by eight Q-sorts, and F2 by five; the remaining three confounded Q-sorts and the null case are excluded from factor construction (Watts and Stenner, 2012; Zabala et al., 2018). For each statement in the Q-sample, factor z scores and composite ranking scores (Q-scores) for F1 and F2 are listed in Table 2 below.

[1] A full list of study participants (anonymized) is presented in Appendix A, *Table A.1*.

[2] Further factor characteristics are reported in Appendix A, *Table A. 2*.

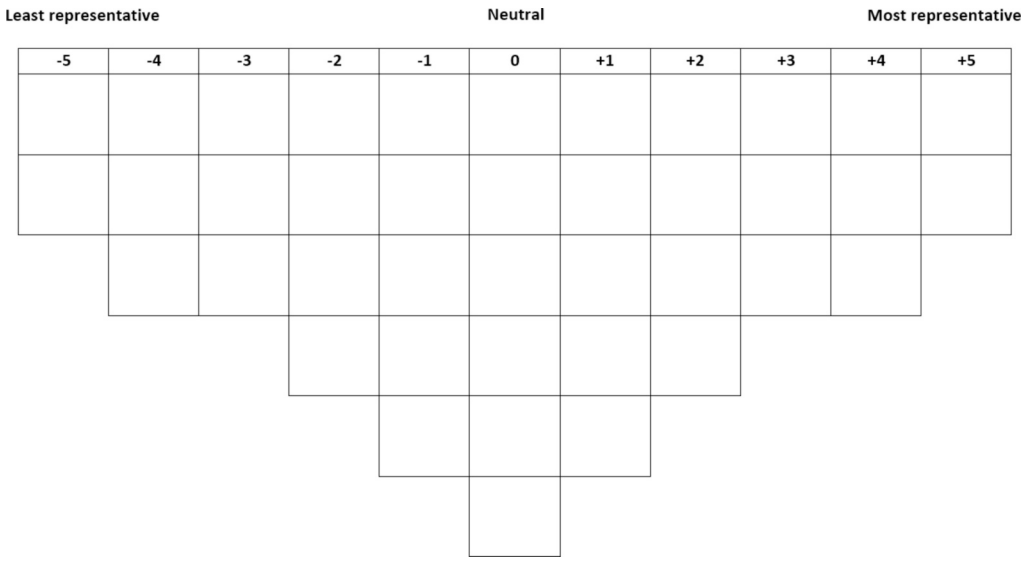

Fig. 1. Q-sorting grid (source: authors).

Table 1
Stakeholders and selected participants.

Stakeholders	
Public sector Executive ($P = 8$)	Ministry of Lands and Natural Resources (MLR) Minerals Commission (MC) Minerals Development Fund (MDF) Ministry of Health (MoH) Ministry of Environmental Science, Technology and Innovation (MESTI) Ghana Health Service (GHS) Regional Health Directorate (RHD) Environmental Protection Agency (EPA)
Public sector Legislative ($P = 2$)	Health Committee, Parliament of Ghana Mines and Energy Committee, Parliament of Ghana
Private sector ($P = 3$)	Ghana Chamber of Mines Private consultancy firm I Private consultancy firm II
Civil society ($P = 2$)	Local civil society organization Local civil society organization Local representation of international development NGO
Multi-stakeholder organization ($P = 2$)	Ghana Extractive Industries Transparency Initiative (GHEITI) Public Interest and Accountability Committee (PIAC)

Source: authors.

4. Interpretation

4.1. Perspective 1: Comprehensive reform

The interpretation of Factor 1 reveals a perspective that promotes comprehensive policy reform, placing emphasis on stringent regulation and compliance enforcement and favouring the introduction of a full-fledged HIA under the auspices of the Ministry of Health (MoH).

Participants within *Perspective 1* (*P1*) firmly reject industry self-regulation. Both proposals, advocating that mining companies independently decide how to address public health (S2, −5), and voluntarily disclose information on health impacts to local communities (S15, −5), are strongly opposed. As emphasized by a representative of a local civil society organization: "If they [mining companies] are allowed to decide on their own how to address public health issues and voluntarily disclose information on health impacts to local communities, it will be a good opportunity for the industry to maximise its profit by externalising the costs of operations to the state, and eventually, to the host communities who are already rendered vulnerable and cannot access medical care" (GH19). Similarly, the director of a Regional Health Directorate (RHD) argued, "you don't want to let a player be a referee in his own match" (GH23). Consistently, the idea that mining companies include additional (voluntary) measures to protect public health under the current EIA framework (S4, −4) is rejected. A member of the Parliamentary Health Committee stressed that "there is a need for some governmental influence to compel [mining companies] to do public health assessment in an organized and comprehensive way" (GH20).

This sentiment is also reflected in the strong support for the proposal to make a public health management plan a requirement for granting mining licenses (S8, +5). According to a senior MoH representative, "all mining companies should provide an extensive health management plan" and "the Ministry of Health and the Environmental Protection Agency [EPA] need to properly provide adequate standards" (GH14). A Ghana Health Service (GHS) official argued that the responsibility to "approve public health management plans" should lie with the MoH to address the public health impacts of mining operations (GH15). Similarly, a local NGO representative stressed that "it is important for mining companies to indicate the possible health impacts and how the impacts

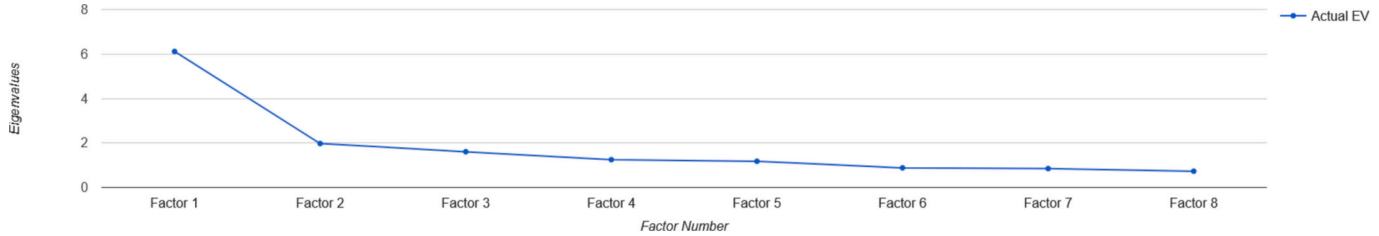

Fig. 2. *Scree plot.* Source: authors.

Table 2
Q-scores and factor z scores for each item in the Q-sample.

No.	Q-statement	Factor 1		Factor 2	
		Q-score	z score	Q-score	z score
S1	The existing EIA are sufficient. No need for additional measures for public health.	−3	−1.41	−3	−0.88
S2	Mining companies shall decide on their own how they want to address public health issues.	−5	−2.51	−4	−1.6
S3	Requiring a separate HIA would overburden mining companies and deter investment.	−4	−1.82	−1	−0.33
S4	With the current EIA requirements, companies are free to include public health considerations where relevant. This is sufficient.	−4	−1.85	−2	−0.77
S5	EIA requirements need to be revised to include comprehensive consideration of public health.	−2	−0.58	+5	2.51
S6	Requiring a separate HIA would overburden the licensing authorities and create additional bureaucratic barriers.	−4	−1.64	0	0.05
S7	The government must require from mining companies a standalone HIA (in addition to the EIA) to mitigate adverse health impacts.	+4	1.13	0	0.08
S8	Mining licenses must not be granted or renewed without a "public health management plan".	+5	1.3	+5	1.67
S9	Build up technical capacity in the EPA to assess the quality of public health aspects in EIAs.	0	0.1	+1	0.28
S10	Build up technical capacity in the MoH to assess the quality of public health aspects in impact assessments.	+4	1.08	−2	−0.82
S11	Baseline data on health indicators must be collected to assess the health impacts of mining projects.	+1	0.42	+4	1.58
S12	The MoH must provide companies with clear methodological guidelines for conducting HIA.	+1	0.52	+3	0.7
S13	Monitoring and technical staff must have protected tenure to prevent political appointments and shield regulatory institutions from political interference.	−1	−0.34	0	0.18
S14	A separate department needs to be created within the MoH to monitor the health impacts of large-scale mining projects.	+1	0.47	−3	−1.00
S15	Mining companies can voluntarily disclose information on health impacts to local communities.	−5	−1.88	+2	0.62
S16	The MoH requires more financial resources to monitor public health management of mining companies.	+1	0.36	−1	−0.19
S17	The MoH must publicly disclose annually the results from public health monitoring in mining areas.	+4	1.26	+2	0.69
S18	Only regular audits and inspections by public officials can ensure that mining companies adhere to public health protection measures.	−2	−0.35	+2	0.7
S19	The government must amend mining regulations to strengthen the monitoring of mining companies' health performance.	+2	0.67	+3	0.86
S20	Monitoring of public health impacts should be left to mining companies which can publish annual monitoring reports.	−3	−1.12	−4	−1.37
S21	Capacity to conduct smaller public health monitoring should be build up at district level and within regional administrations.	0	0.24	0	−0.09
S22	The GHS needs to be directly involved in regular mining-site inspections and the measurement of pollutants.	0	0.27	−5	−2.07
S23	The government must establish a clear sanctions framework to penalize non-compliance with public health regulations and standards.	+5	1.66	+3	0.80
S24	When mining projects are decommissioned, mining companies must present rehabilitation plans that include targeted measures that address public health.	+3	0.87	0	0.15
S25	Create a formalized forum for stakeholders from government, civil society, academia, and the private sector to ensure continuous discussion of health challenges related to mining.	0	0.33	+4	0.87
S26	Establish a centre of expertise at a university or research institution to train civil servants in HIA.	−1	−0.20	−1	−0.31
S27	Coordination between actors responsible for issuing licenses, and those responsible for monitoring must be greatly intensified.	+1	0.50	+1	0.30
S28	The MoH must have a formal role in the licensing process to ensure the inclusion of HIA in current EIA.	+3	0.95	−2	−0.36
S29	The MoH must publish its technical advice on impact assessments to avoid being disregarded during the final decision-making process.	+3	0.89	+2	0.63
S30	Strengthen the technical commission in which all actors responsible for issuing licenses coordinate (health, environment etc.) so that their findings cannot be overruled.	+2	0.82	−1	−0.13
S31	At the beginning of each impact assessment, companies must carry out consultations on health issues with local health professionals, women and civil society groups, and communities.	0	0.13	+1	0.26
S32	Companies must share the results of their HIA in a simplified format to make it intelligible for ordinary citizens and illiterate community members.	+2	0.78	+1	0.35
S33	The government is responsible to invest in public health services in mining areas to provide equipment, medicines, and training for health personnel.	0	0.23	+1	0.33
S34	The government must establish a platform for coordination between the local health system and mining companies to ensure that voluntary health projects of companies benefit local communities.	−1	−0.18	0	0.11
S35	Mining companies should be encouraged to communicate an annual application window for corporate social responsibility projects so that health system actors can submit proposals.	−1	−0.07	−2	−0.38
S36	Mining companies shall be required to finance regular health monitoring surveys in mining areas.	+2	0.78	−4	−1.55
S37	Mining companies shall be obliged to conduct regular awareness	−2	−0.48	+4	1.56

(continued on next page)

Table 2 (*continued*)

No.	Q-statement	Factor 1		Factor 2	
		Q-score	z score	Q-score	z score
	campaigns on (mining related) health risks and promote best health practices.				
S38	Mining companies must be obliged to finance goods and equipment to local health services, including ambulances and a medical laboratory for health testing.	−2	−0.49	−3	−1.06
S39	Mining companies shall be required to run a health facility open to the public.	−3	−0.88	−5	−2.02
S40	Mining companies should publicly communicate their responses to (health-related) grievances and complaints.	−1	0.05	-1	−0.35

would be addressed in their public health management plans ahead of mining operations. If the health impacts are such that the company's mitigating measures cannot address the health impacts, the company must not be granted the licence to operate" (GH19). The representative also pointed out that a management plan could also serve as a useful reference point to implement the concept of 'Free Prior and Informed Consent' on the basis of which, "for example, a mining community can reject a mining operation based on the health impacts that had been raised in a public health management plan." The interlocutor further cautioned that "it should be anticipated that the mining companies will oppose making […] a public health management plan a requirement for the granting of a mining lease" (GH19). However, it is worth highlighting that the strong support for mandating a public health management plan under *P1* is not unanimous. A senior EPA official (GH16) and a member of the Parliamentary Health Committee (GH20) both provide moderately negative rankings of −2, indicating diverging priorities.

Calls for stringent regulation are complemented by widespread support for establishing a comprehensive sanction framework to penalize non-compliance (S23, +5), with all participants under *P1* providing either positive or neutral rankings. Sanctions are viewed as a crucial coercive measure to supplement the newly introduced regulatory provisions on public health in impact assessment practice: "If that is done, government must come out with clear sanctions to punish mining companies when they fail to follow or comply with these public health regulations", as emphasized by member of Parliamentary Health Committee (GH20). Moreover, a senior RHD official viewed sanctions as an important deterrent against companies infringing on health regulations: "If mining companies know the consequences for not complying with regulatory laws, then they will take actions to avoid being punished. If mining companies know the sanctions, it will serve as a disincentive to non-compliance" (GH23).

Alongside mandating a public health management plan and establishing a sanctions framework, most proponents of *P1* strongly advocate for requiring a standalone HIA from mining companies, in addition to the EIA (S7, +4). All but one participant under *P1* favour requiring a standalone HIA over revising the existing EIA (S5, −2) requirements to incorporate public health. Consistently, the notion that requiring a separate HIA would either overburden the licensing authorities (S6, −4) or mining companies, deterring investment (S3, −4) is strongly rejected. Comments from a Parliamentary Health Committee member indicate that mandating a standalone HIA is seen as a way to promote the establishment of standardized procedures in assessing health impacts: "There is a need for us to do health impact assessment and therefore the government should make sure that mining companies standardize mining impact assessments. The environmental aspect is okay but the health aspect is not comprehensive" (GH20). A senior GHS official is explicit in his opposition to integrating HIA into the current EIA process: "I am fundamentally against the integration of HIAs into the existing EIA process. […] Currently, the EPA conducts the EIA and may insert in the permitting conditions a requirement to assess health impacts. However, this process is not efficient as the health impact reports go to the EPA who in turn forwards them to health [MoH/GHS] for their review and comments. This clearly shows that the EPA does not have the technical capacity to review HIA. The MoH should therefore be able to independently commission standalone HIAs to be implemented by licenced private assessors and issue standalone HIA licenses to companies, and independently generate monitoring reports" (GH15). The official further claimed that previous attempts to establish a cooperation between the GHS and EPA had failed due to conflicts over financing:

> Some years back, the Occupational and Environmental Health Unit of GHS attempted to implement a partnership to join forces with a team of officers from the EPA, the Energy Commission, and the Petroleum Commission to jointly monitor and supervise compliance of companies with EMP [Environmental Management Plan] requirements. Unfortunately, the partnership could not be sustained. After just one joint monitoring visit, all the institutions involved went back to individual monitoring. The lesson learnt by the health officers was that the EPA and other regulatory agencies were not ready to bear the expenses of the health officers in the team. It is therefore more important that, going forward, MoH establishes a regulatory agency that will be responsible for standalone HIAs. Such an agency is more likely to be financially self-sufficient and can then partner with other sister impact assessment regulatory agencies like the EPA, as and when necessary to carry out joint field missions (GH15).

Correspondingly, composite rankings under *P1* indicate a strong preference for strengthening the role of the MoH in public health regulation, impact assessment, and monitoring in the industrial mining sector. The proposals to build up capacity in the MoH (S10, +4) and to have it annually disclose public health monitoring results from mining areas (S17, +4) both receive notable support. Likewise, proposals advocating the MoH's formal role in the mine licensing process (S28, +3) and the publication of technical advice on impact assessment to prevent disregard in the final decision-making process (C29, +3) enjoy notable support. As argued by an RHD director, "The Ministry of Health must publish its technical advice on health impact assessment because it needs to be known by the public. Once it is known, it will motivate mining companies to be more responsive. This will also assist other interested parties, such as NGOs, civil society organizations, and community members, in putting pressure on mining companies to ensure total compliance with such issues" (GH23).

The analysis does not associate *P1* with specific stakeholder groups. Representatives from various public sector institutions, including the EPA, GHS, MESTI, MoH, RHD, and the parliamentary committees on Health and Mines and Energy, as well as representatives from civil society, define this perspective. Therefore, *P1* reflects a cross-cutting view that transcends different institutions and stakeholders. However, it should be pointed out that private sector representatives are not represented within *P1*, which is dominated by various health professionals from both the central and regional levels. As a result, *P1* is not equally defined by all stakeholder groups.

4.2. Perspective 2: Limited overhaul

The interpretation of Factor 2 reveals a perspective that equally endorses regulatory reform, improved monitoring, and compliance enforcement but favours a limited overhaul of the current regulatory framework to include health in current impact assessment practice and strengthening health monitoring.

Participants defining *Perspective 2* (*P2*) clearly reject industry self-regulation (S2, −4). As noted by a senior executive of a private

consulting company, "allowing mining companies to decide on their own how to address public health issues would mean giving them the opportunity to pollute the environment and get away with it, for example, by underestimating or hiding any public health hazards created by them" (GH17). In alignment with *P1*, proponents of *P2* strongly endorse the introduction of a mandatory public health management plan as a mine licensing requirement (S2, +5), seeing this as crucial measure to mitigate adverse health impacts. In contrast, *P2* clearly favours revising the existing EIA requirements to include a comprehensive consideration of public health (S5, +5). "Health impacts of development projects in Ghana are under-assessed despite their importance in public health matters because there is no comprehensive consideration in the current EIA requirements" (GH17). From this viewpoint, revising the EIA framework while strengthening health monitoring and stakeholder coordination is preferred over mandating a standalone HIA.

Consequently, participants under *P2* place emphasis on the collection of baseline data to assess the health impacts of mining projects (S11, +4), stressing the importance of creating the conditions for independent monitoring and oversight. To this end, *P2* calls for an amendment of mining regulations to strengthen the monitoring of companies' health performance (S19, +3). Moreover, the notion that the monitoring of health impacts should be left to mining companies is clearly opposed (S20, −4). "There should be a mechanism whereby the performance of mining companies is audited by an independent entity annually to forestall adverse health impacts. Monitoring offers the opportunity for early mitigation or complete stopping of projects in the event of imminent adverse impacts" (GH17). Proponents of *P2* also gather behind the proposal that mining companies must conduct regular awareness campaigns on health risks and promote best health practices within affected communities (S37, +4).

These preferences clearly indicate a policy reform perspective that builds on the existing framework for governing impacts assessments while strengthening monitoring and compliance enforcement in area of public health. Correspondingly, the idea of establishing a sanctions framework to penalize non-compliance is generally supported (S23, +3). However, participants under *P2* clearly do not see it as the responsibility of mining companies to directly provide health services to local populations (Q-score − 5) or to contribute financially to local health services (S38, −4). Additionally, the proposal that mining companies finance regular health monitoring surveys in mining areas is rejected (S36, −3). This suggests a policy stance that views the state as the main actor responsible for the provision and financing of health services and monitoring.

Also *P2* cannot clearly be associated with a particular stakeholder group. Representatives from various public sector and oversight institutions, including the Ministry of Lands and Natural Resources (MLR), Public Interest and Accountability Committee (PIAC), and the Ghana Extractive Industries Transparency Initiative (GHEITI), along with private sector representatives from a private consultancy firm and the Ghana Chamber of Mines, define this perspective. However, it is important to point out that *P2* does not include public health professionals, who all align with *P1*, nor representatives from civil society groups. While not necessarily indicative of a view prevalent among large-scale companies, this suggests that, overall, *P2* is more closely aligned with the views held by industry stakeholders and regulators.

4.3. Stakeholder perspectives: Consensus, dissent, and diverging voices

To explore the question concerning shared and divergent stakeholder preferences, in the following we analyse the areas of consensus and dissent among the two stakeholder perspectives identified. This analysis gives room to individual viewpoints and accentuates diverging voices, thereby providing further nuance to our examination.

Analysis of individual Q-sorts and factor interpretation reveal that participants representing different stakeholder groups acknowledge the need for policy action to address public health impacts in industrial mining areas. There is a widespread consensus that the current situation needs improvement, and that relying solely on industry self-regulation is deemed unacceptable. This is also illustrated by a comparison of the composite rankings (factor *z* scores) of the top five 'least representative' statements within *P1* and *P2* (*Fig. 3*). A broad consensus also exists on the principal feasibility of strengthening public health considerations in impact assessment practice, rejecting the notion that introducing a separate HIA would overburden mining companies and deter investment (S3). Similarly, composite ranking scores indicate a consensus that providing public health services is not the responsibility of mining companies (S39).

However, individual comments reveal that some stakeholders would welcome additional financial contributions from mining companies to support public health service provision. As noted by an MoH official, "though it is the responsibility of the government to create an enabling environment for the entire population and to provide healthcare personnel with the required logistics, I think this should not be wholly a government affair. Corporate institutions, like mining companies, should also be made to contribute to healthcare delivery through various ways, such as [allocating] some percentage of their profit to infrastructural development. We cannot only rely on the government if Ghana is to achieve the universal health coverage targets by 2030″ (GH14). Similarly, an RHD official opined that "there should be a policy to force mining companies to commit some percentage of their resources or profit to take care of health issues" (GH23). Yet, diverging preferences between *P1* and *P2* regarding the proposal that mining companies should be required to finance regular health monitoring surveys in mining areas (S36) or conduct regular awareness campaigns (S37) suggests that willingness to place additional (financial) burdens on mining companies to safeguard public health differs across stakeholders.

Comparing the composite rankings of the top five "most representative" statements further reveals areas of consensus and dissent between *P1* and *P2* (Fig. 4). As mentioned earlier, both perspectives strongly advocate for mandating a public health management plan as a mine licensing requirement (S8), suggesting it as a potential policy measure with broad stakeholder support. Likewise, the proposal to establish a sanctions framework (S23), enjoys support under both perspectives, indicating broad agreement that improved public health regulations need to be accompanied by a clear enforcement mechanism. However, it is important to emphasize that support for sanctions is lower under *P2*, attributable primarily to a (moderately) negative ranking (−2) from a representative of the Ghana Chamber of Mines, suggesting less support from the mining industry.

Shared support also exists for the collection of baseline data on health indicators (S11) to clearly establish health impacts in mining areas. As stressed by a parliamentary Health Committee member, this would also contribute to advancing policy reform: "There is a need to conduct research because policy should be based on research findings. If research reveals adverse health outcomes associated with large-scale mining, we can mobilize and advocate for improvements in our policies; otherwise, it would be difficult" (GH20).

Both perspectives clearly see the need for a strengthened role of the MoH in safeguarding public health standards in mining areas and agree that the MoH should regularly disclose health monitoring results from mining areas (S17). Likewise, *P1* and *P2* support the idea that the MoH should publish technical advice on impact assessment to avoid being disregarded during the final decision-making process (S29, +3, +2, respectively). Additionally, there is basic agreement that the MoH should provide clear methodological guidelines to mining companies for conducting HIA (S12, +1, +3, respectively). However, policy preferences on the role and responsibilities of the MoH in impact assessment only partially align. Preferences diverge regarding granting the MoH a formal role in the mine licensing process (S28), endorsed under *P1* (+3) but rejected under *P2* (−2). Similarly, the establishment of technical capacity within the MoH to assess the quality of impact assessments is

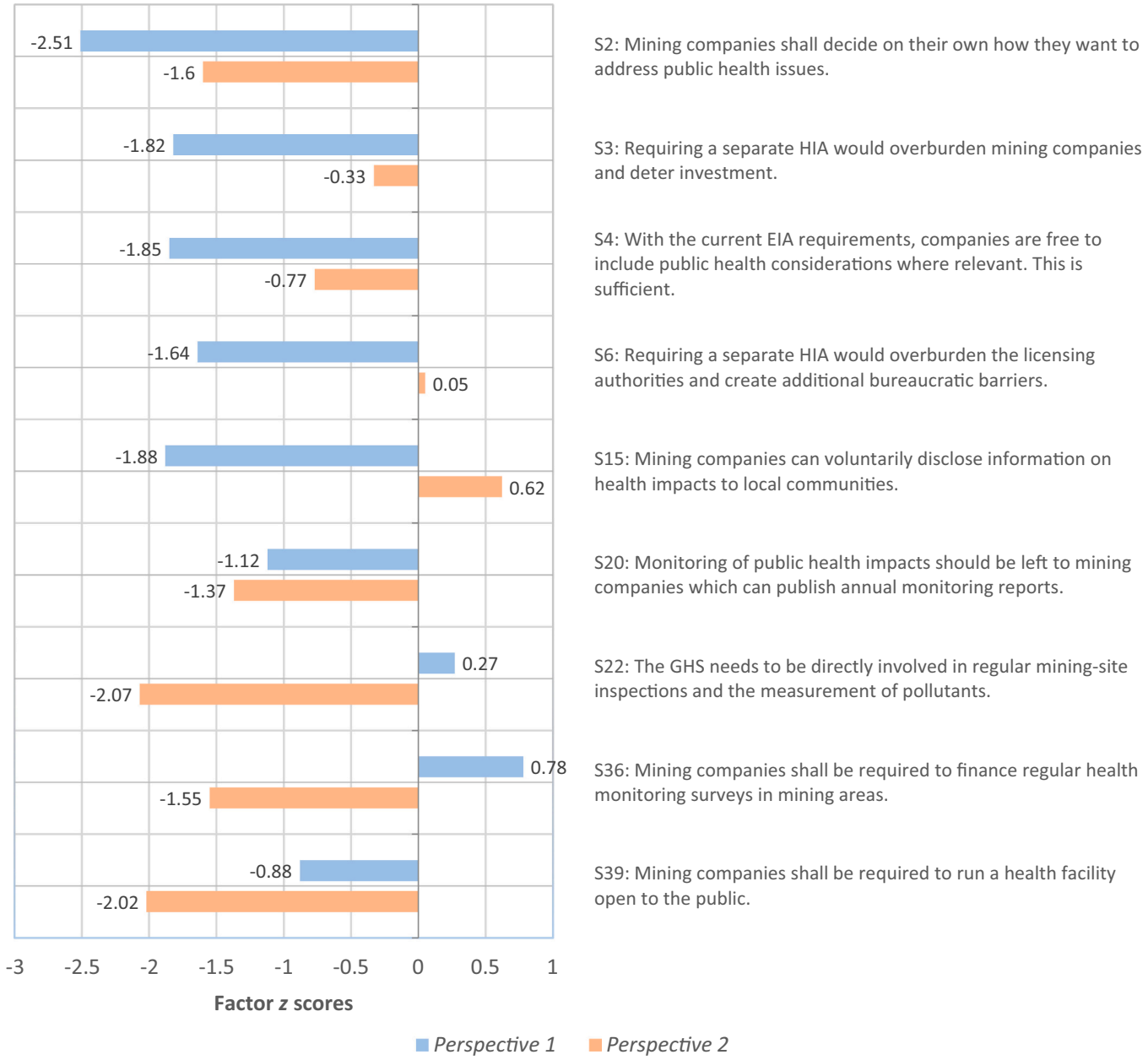

Fig. 3. Top five least representative statements in *Perspective 1* and *2*.

only supported under *P1* (S10).

Considering the dominance of health professionals in *P1*, a group absent from *P2*, the emphasis of *P1* on strengthening and capacitating the MoH may not be surprising. However, given the diverging regulatory preferences revealed under the two identified perspectives, the findings also point to a broader disagreement over the depth of regulatory reform and the extent to which new structures and regulatory authorities should be introduced into the current impact assessment framework. The disagreement over granting the MoH a formal role in the mine licensing process echoes the broader disagreement over whether a standalone HIA should be introduced in addition to the EIA (S7) or if the existing EIA should be revised (S5). While *P2* favours adapting the current EIA framework with additional guidance from the MoH, this does not necessarily include sharing or expanding institutional ownership and authority over the impact assessment process. Comments provided under *P1* clearly suggest that such an arrangement is regarded as unfavourable. As argued by a GHS official, "in general, HIA should not be integrated into the EIA process so as to avoid conflicts of interest and minimize corrupt practices. Integration of HIA into the EIA will most likely lead to health issues being overlooked, as currently happens in the EIA process. […] Any attempt to merge the EIA and HIA processes under the auspices of EPA will only compound the status quo whereby health issues are not prioritized, but are largely ignored during the permitting process" (GH15). Consequently, the official was adamant that "the lines of command for the HIA process remain with the health sector", arguing that "this will be vital to ensure that health impacts will not be ignored" (GH15).

Finally, under both perspectives, participants recognize the benefits of establishing a formalized forum for stakeholders to ensure continuous discussion of mining-related health challenges (S25). Creating a coordination body to facilitate dialogue may thus be seen as a relatively uncontroversial policy measure likely to garner widespread acceptance. However, a GHS official cautioned that, while it is principally "a good idea," there is likely to be "a challenge of securing sustainable financing to organize such forums" (GHS15).

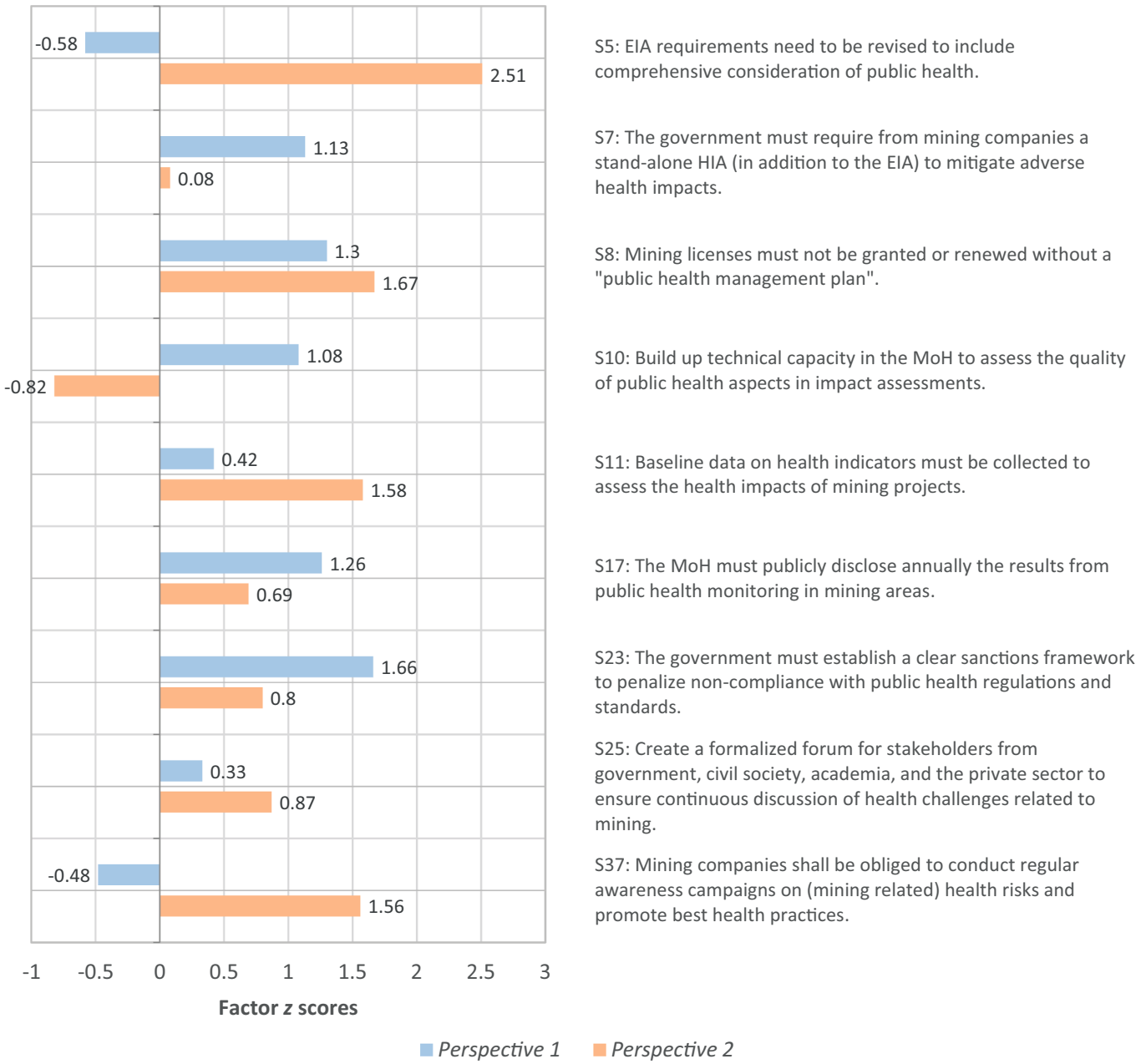

Fig. 4. Top five most representative statements in Perspective 1 and 2.

5. Discussion

Factor interpretation and the analysis of consensus and dissent among stakeholders reveal a broad agreement on the need to strengthen public health in impact assessment practice and initiate regulatory reform to include HIA in Ghana. However, there are divergent views on the scope and focus of reform, the institutionalization of HIA, and the allocation of responsibilities between the public sector and mining companies in public health financing. Research findings from other country contexts, debates among HIA practitioners, and the academic discourse on the institutionalization of HIA indicate that the issues surrounding divergent policy preferences among stakeholders extend beyond the local policy discourse. This suggests that the disagreements and diverging preferences identified in Ghana are reflective broader tensions and interest cleavages transcending the wider policy debate on HIA and public health in mining beyond the case of Ghana.

A significant point of disagreement centres on whether to revise the existing EIA framework to incorporate HIA provisions or to establish a separate, standalone HIA framework. The study findings indicate that public health professionals, prominently featured in the first stakeholder perspective, lean toward advocating for the creation of a standalone HIA framework under the auspices of the MoH. This preference reflects concerns about the comprehensiveness and effectiveness of an integrated approach, a long-standing view echoed in the academic literature on HIA in Ghana. As Asante and Owusu-Agyei (2013, 283) argue, only a standalone HIA "will avoid health issues being buried within the EIA." This claim is supported by the findings of a review of impact assessment practice in Sub-Saharan Africa, which found that there is often a lack of rigour and scope when health is integrated in other forms of impact assessment (Dietler et al., 2020). Additionally, study participants representing the first stakeholder perspective emphasized that a standalone HIA framework allows for the mitigation of potential conflicts of interest among various institutions involved in the EIA process. On the contrary, the second perspective distinctly leans toward adapting the current

impact assessment framework, utilizing existing institutional structures and processes. This is in line with previous research and initiatives promoting the integration of health in other forms of impact assessments rather than promoting standalone HIA (Bhatia and Wernham, 2008; Nowacki, 2018; Hacon et al., 2018).

It is worth pointing out that the observed dissent regarding the regulatory approach toward HIA reflects a long-standing international debate among impact assessment practitioners concerning the integration of HIA into EIA. Over time, this debate has evolved, influenced by shifting regulatory practices, international policy developments, and practical experience. Early discussions highlighted the importance of health as a crucial, yet often neglected, aspect of EIAs, prompting efforts to incorporate health considerations within EIA frameworks and promoting the integration of HIA (Banken, 1998; Bhatia and Wernham, 2008; Birley, 2003; Breeze and Lock, 2001). However, the integration of HIA into existing EIA frameworks is far from straightforward. As a result, the question of whether HIA should be integrated into the existing EIA or established as a separate approach has given rise to a "large controversy" (Iglesias-Merchan and Domínguez-Ares, 2020: 300). In part, this controversy stems from how impact assessment is conceptualized and the extent to which terms like HIA are interpreted as signifying either distinct, institutionalized processes or methodological labels within an integrated impact assessment model (Lamprecht et al., 2024; Winkler et al., 2020). At the same time, varying perspectives on the essence of HIA, shaped by practitioners' diverse disciplinary backgrounds and the objectives they associate with HIA exist, adding further complexity to the connection between HIA and the broader spectrum of impact assessment approaches and methods (Morgan, 2012).

In addition to conceptual and disciplinary differences in impact assessment, debates over the best approach—integrated or standalone—are also driven by practical considerations. Several (case) studies from various countries highlight both the benefits and challenges of integration, showing how political, institutional, and financial constraints often limit the effective incorporation of HIA (McCallum et al., 2018; Ahmad, 2004). Advocates of an integrated approach argue it optimizes resource use, leverages synergies, and avoids duplication (Birley, 2003; Bhatia and Wernham, 2008; Nowacki, 2018; Hacon et al., 2018), and point to the established EIA process as a crucial gateway for incorporating HIA (McCallum et al., 2018). However, integrating different impact assessments can be challenging due to limited institutional capacity, as institutions often operate independently, hindering cooperation. Additionally, these institutions may lack the technical or financial resources to address multiple aspects simultaneously (Fischer and Cave, 2018). Proponents of standalone HIA argue that integrating it into existing EIA processes often results in incomplete or omitted health information (Dietler et al., 2020) and can lead to "low-cost HIAs, which appear to be desktop exercises" (Iglesias-Merchan and Domínguez-Ares, 2020: 300), with a focus on environmental issues and inadequate health guidance for stakeholders (Harris-Roxas et al., 2012; Linzalone et al., 2019; McCallum et al., 2018). Moreover, multi-dimensional integrated impact assessments often involve trade-offs between social, economic, and environmental factors, and these trade-offs may lack transparency, particularly when prioritization is unclear. Without transparency, integrating various assessments can obscure these trade-offs from public view (Fischer and Cave, 2018).

Indeed, the comments from public health professionals provided under the first perspective, in favour of a standalone HIA, echo similar sentiments. They express concerns about the quality of HIA when integrated within the established EIA framework. The institutional independence of public health professionals and competence of the MoH in assessing HIA and public health management plans is seen as crucial to ensure effectiveness of HIA. On the other hand, the composite ranking choices presented under the second perspective favouring the integration of HIA into the existing EIA frameworks, place a greater focus on health monitoring and stakeholder coordination to ensure an effective consideration of health impacts. This focus is consistent with the observation that an integrated EIA framework must involve a range of government agencies and coordination across stakeholders beyond the health sector as public health is largely influenced by factors outside the health sector (Roundtable, 2019). However, whether this position is driven by a conviction of efficiency or a limited appetite for far-reaching reform remains unclear. Conflicting views on how to ensure the effectiveness of HIA may also stem from differing institutional interests regarding ownership and control authority in impact assessment and mine licensing, beyond practical concerns over implementing HIA. In Ghana, diverging preferences on the institutionalization and regulation of HIA raises questions about the delineation of competencies and authority between the MESTI and the EPA, responsible for overseeing EIA, and the MoH, GHS, and health professionals. This highlights relevant challenges that extend beyond Ghana, especially in contexts with limited administrative resources as questions regarding the allocation of roles, responsibilities, and authority over impact assessment and the mine licensing process can play a significant role in shaping stakeholder policy preferences toward HIA.

Finally, the question of public versus private sector responsibilities in public health monitoring, financing and service provision is a recurring issue in mining sector governance where different stakeholders often have divergent views (Agyemang-Duah et al., 2019; Rice et al., 2023; Osewe, 2015). While stakeholders in Ghana generally agree that providing and monitoring health services in mining areas is primarily a public responsibility, opinions differ on whether mining companies should be required to contribute financially. Qualitative interview data suggests that health practitioners and regional officials, who are familiar with public health realities, remain sceptical about the sufficiency of government efforts alone and demand more from mining companies. This sentiment is echoed by findings from Burkina Faso, where stakeholders equally acknowledge public health service provision and financing as key government duty but where environmental and health practitioners are more open to hybrid models for health service provision and financing. In contrast, other stakeholders strongly advocate for a clear separation between private and public sector responsibilities, displaying a more rigid stance (Proksik et al., 2023). These differences may stem from stakeholders' professional roles and their proximity to health issues in mining communities.

5.1. Limitations

By elucidating policy preferences of different stakeholder representatives from government, public administration, the private sector, and civil society on different policy options for regulating public health, our Q-study provides important insights into policy positions within the context of Ghana. We contribute to a deeper understanding of the available policy space and potential building blocks to promote public health in the context of large-scale mining in Ghana. Still, it is important to acknowledge the limitations when interpreting and utilizing Q-study findings for progressive policy development. Firstly, Q-methodology provides a comprehensive overview of relevant viewpoints, delineating shared and divergent perspectives among the included stakeholder representatives. However, by design, Q-methodology is not geared toward generating generalizable findings for an entire stakeholder population, akin to a representative survey. Consequently, while highly relevant to the broader discourse on policy options for strengthening health in impact assessment practice, differences in perspectives may emerge within public institutions and professional organizations between management levels. Mid-level practitioners and specialists often hold distinct viewpoints compared to high-level executives or senior

representatives, who may not be subject-matter experts. Ghana's large-scale private mining sector participated with a senior representative from the Ghana Chamber of Mines, which represents the collective interests of companies involved in mineral exploration, production and processing in Ghana. Yet, we were unable to recruit additional representatives from individual mining companies for the study. Their inclusion could have added nuance to the private sector's viewpoint, especially given the considerable diversity within Ghana's industrial mining sector, which includes large-scale mining of gold, diamonds, manganese, bauxite, and iron ore, as well as emerging activities in lithium.

Secondly, caution is warranted in interpreting the factors. Low Q-scores do not necessarily imply that stakeholders disregard an issue; rather, they may indicate a stronger preference for other policies based on individual sorters' perspectives, as partly suggested by qualitative comments. Furthermore, when utilizing the study findings, it is essential to bear in mind that all participants (and their Q-sorts) carry equal weight in factor construction and interpretation. However, participants in policy processes may not all possess the same level of influence.

6. Conclusion

Taking the case of Ghana, our Q-methodology study explores different stakeholder positions on regulating public health in large-scale mining and examines the potential for policy reform. The study identifies both consensus and dissent, providing valuable guidance for progressive policy development. The qualitative insights into stakeholder views and preferences offer further information for policy discussions on public health and large-scale mining in Ghana.

Our analysis reveals an overarching agreement among stakeholders on the need for policy action to address adverse public health impacts in industrial mining areas. Stakeholder perspectives converge in highlighting the inadequacy of the current regulatory framework to address health impacts associated with large-scale mining projects, which is highlighted by the shared recognition of the need for policy reform and progressive public health measures. This includes the rejection of industry self-regulation, advocating for revising the existing regulatory and impact assessment framework to integrate public health considerations. Notably, there is strong support for mandating a public health management plan, enhancing health monitoring and compliance enforcement, and granting the MoH a more significant role in shaping impact assessment practices. This broad agreement signifies a shared understanding among various stakeholder groups regarding the fundamental elements crucial for effectively regulating public health impacts.

Our factor analysis and interpretation reveal two distinct stakeholder perspectives. The first advocates for comprehensive policy reform, emphasizing stringent regulation and compliance enforcement, and supports the introduction of a full-fledged, standalone HIA. The second perspective supports regulatory reform, improved monitoring, and compliance enforcement but favours a limited overhaul of the current regulatory framework, incorporating health into existing impact assessment practices and strengthening health monitoring. While stakeholders share common ground on some key aspects, our analysis of their policy preferences reveals three main areas of disagreement: the scope and focus of reform measures, the institutional anchoring of HIA to ensure its effectiveness and the institutional independence of health actors, and the allocation of responsibilities between the public and private sectors in financing public health monitoring and service provision.

A significant point of contention is whether to revise the existing EIA framework to incorporate HIA provisions or to establish a separate, standalone HIA. Public health professionals, prominently featured in the first stakeholder perspective, lean toward advocating for a standalone HIA framework under the MoH's auspices. Conversely, the second perspective favours adapting the current impact assessment framework, utilizing existing institutional structures and processes. This raises questions about institutional ownership, particularly regarding the delineation of competencies, especially among health professionals from the MoH and the environmental authorities overseeing the current EIA process.

To accommodate varying perspectives, a flexible approach could be considered where HIA is adapted to fit within the existing EIA framework while also functioning as a standalone assessment in high-risk cases. This aligns with McCallum et al. (2018), who recommend an adaptable HIA framework capable of serving as both an independent protocol and an integrated component of EIA by closely aligning its structure and terminology with existing practices. Such flexibility could facilitate the gradual incorporation of additional health determinants into the EIA framework, avoiding sweeping legislative changes that, while desirable, may be unfeasible in the short to mid-term due to limited political momentum. Ultimately, it must be local policymakers, administrators, and professionals in the environmental, health, and mining sectors who determine the most suitable approach for Ghana. In any case, ensuring decision-making autonomy and adequate support for health professionals is essential to ensure that HIA is conducted independently and impartially.

The allocation of roles, responsibilities, and authority over impact assessment and licensing processes plays a significant role in shaping stakeholder policy preferences toward HIA. Disagreements over the appropriate approach and ownership of the impact assessment process may influence or limit the available policy space, potentially stalling initiatives within institutions. In this way, such dynamics can act as forces that preserve the status quo. However, the systematic institutionalization of HIA in Ghana also faces broader challenges, including limited awareness among health professionals, uneven public pressure, and a corresponding lack of political initiative among policymakers. So far, HIA in Ghana has been primarily implemented in the context of high-profile projects that have garnered significant public attention and civil society scrutiny. This pattern suggests that the broader establishment of HIA may, to some extent, depend on heightened societal demand. However, such demand is less likely to emerge from routine mining operations, where public scrutiny is typically limited.

To address this limitation, public discourse should focus more on the long-term structural health consequences of neglecting HIA in mining areas, highlighting its preventive and mitigating potential. Without this shift, HIA risks suffering from a "lack of political capital," often associated with preventive measures that fail to generate immediate political gains in the absence of a visible crisis. Policymakers may hesitate to prioritize HIA implementation when no urgent health crisis demands action. This dynamic, we believe, extends beyond Ghana and reflects a broader challenge faced by preventive measures in similar contexts.

Our findings indicate that the institutionalization of HIA presents multifaceted challenges that go beyond capacity-building and broad-based stakeholder support for public health in mining areas. These challenges encompass technical, administrative, and institutional complexities, as well as barriers to political initiative and policy action. Further research should examine the structural, cumulative, and long-term impacts of large-scale mining on public health in Ghana, addressing a wide range of health determinants. Such efforts could enhance transparency and provide robust scientific evidence to inform public debate and policy dialogue on health impacts and HIA. Additionally, exploring diverse pathways for the institutionalization of HIA would help address the institutional and political dynamics that influence regulatory decisions.

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CRediT authorship contribution statement

Joschka J. Proksik: Conceptualization, Methodology, Validation, Formal analysis, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Fritz Brugger:** Conceptualization, Methodology, Validation, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Martin A. Ayanore:** Investigation, Formal analysis, Writing – review & editing. **Philip B. Adongo:** Investigation, Formal analysis, Writing – review & editing.

Declaration of competing interest

None; the authors declare no conflict of interest.

Appendix A

Table A.1
List of study participants.

GH02	Senior public official, Minerals Commission (MC)
GH03	Research officer, Minerals Development Fund (MDF)
GH04	High-ranking public official, Ministry of Lands and Natural Resources (MLRN)
GH05	Senior public official, Ministry of Environmental Science, Technology and Innovation (MESTI)
GH06	Senior executive, private consultancy firm I
GH07	Senior representative, Ghana Extractive Industries Transparency Initiative (GHEITI)
GH08	Senior representative, The Ghana Chamber of Mines
GH09	Senior representative, Mines and Energy Committee, Parliament of Ghana
GH10	Senior public official, Public Interest and Accountability Committee (PIAC)
GH13	Local program officer, international development organization
GH14	Senior public official, Ministry of Health (MoH)
GH15	Senior public official, Ghana Health Service (GHS)
GH16	Senior public official, Environmetnal Protection Agency (EPA)
GH17	Senior executive, private consultancy firm II
GH19	Senior executive, local civil society orgaization
GH20	Senior representative, Health Committee, Parliament of Ghana
GH23	Senior representative, Regional Health Directorate (RHD)

Table A.2
Factor characteristics.

	Factor 1	Factor 2
Number of defining variables	8	5
Average relative coefficient	0.80	0.80
Composite reliability	0.97	0.952
Standard error of factor *z* scores	0.173	0.219

Data availability

Data will be made available on request.

References

ADB, 2018. Health Impact Assessment: A Good Practice Sourcebook. Asian Development Bank (ADB), Manila.

Adei, D., Addei, I., Kwadjosse, H.A., 2011. Study of the effects of mining activities on thehealth status of people: a case study. Res. J. Appl. Sci. Eng. Technol. 3 (2), 99–104.

Agyemang-Duah, W., Arthur-Holmes, F., Kewku Sobeng, A., Peprah, P., Mengba Dokbila, J., Asare, E., Okyere, J., Cheng, F., 2019. Corporate social responsibility in public health provision: Community members' assessment. Cogent Med. 6 (1). https://doi.org/10.1080/2331205X.2019.1622999.

Ahmad, B.S., 2004. Integrating health into impact assessment: challenges and opportunities. Impact Assess. Proj. Apprais. 22 (1), 2–4. https://doi.org/10.3152/147154604781766094.

Akpalu, W., Normanyo, A.K., 2017. Gold mining pollution and the cost of private healthcare: the case of Ghana. Ecol. Econ. 142 (2017), 104–112. https://doi.org/10.1016/j.ecolecon.2017.06.025.

Alderson, S., Foy, R., Bryant, L., Ahmed, S., House, A., 2018. Using Q-methodology to guide the implementation of new healthcare policies. BMJ Qual. Saf. 27 (9), 737–742. https://doi.org/10.1136/bmjqs-2017-007380.

Armatas, C.A., Venn, T.J., Watson, A.E., 2014. Applying Q-methodology to select and define attributes for non-market valuation: a case study from Northwest Wyoming, United States. Ecol. Econ. 107, 447–456. https://doi.org/10.1016/j.ecolecon.2014.09.010.

Asante, K.P., Owusu-Agyei, S., 2013. Health impact assessment in Ghana. In: Kemm, J. (Ed.), Health Impact Assessment: Past Achievement, Current Understanding, and Future Progress (Oxford, 2012; online edn, Oxford Academic, 24 Jan. 2013). https://doi.org/10.1093/acprof:oso/9780199656011.003.0030 accessed 7 Nov. 2024.

Banasick, S., 2019. KADE: A desktop application for Q methodology. J. Open Source Softw. 4 (36). https://doi.org/10.21105/joss.01360.

Banken, R., 1998. Public health in environmental assessment. Chapter 29. In: Porter, A. L., Fittipaldi, J.J. (Eds.), Environmental Methods Review: Retooling Impact Assessment for the New Century. Army Environmental Policy Institute / IAIA, Fargo, ND, USA, pp. 247–253, 1998.

Bhatia, R., Wernham, A., 2008. Integrating human health into environmental impact assessment: an unrealized opportunity for environmental health and justice. Environ. Health Perspect. 2008 (116), 991–1000.

Birley, M., 2003. Health impact assessment, integration and critical appraisal. Impact Assess. Proj. Apprais. 21 (4), 313–321. https://doi.org/10.3152/147154603781766158.

Breeze, C.E., Lock, K., 2001. Health impact assessment as part of strategic environmental assessment. In: A Review of Health Impact Assessment Concepts, Methods and Practice to Support the Development of a Protocol on Strategic Environmental Assessment to the Espoo Convention, which Adequately Covers Health Impacts. WHO Regional Office for Europe, Copenhagen.

Brown, S.R., 1980. Political Subjectivity: Applications of Q Methodology in Political Science. Yale University Press. https://doi.org/10.2307/3151542.

Brown, S.R., 2019. Q methodology in research on political decision making. In: Oxford Research Encyclopedia of Politics (Issue June). https://doi.org/10.1093/acrefore/9780190228637.013.980.

Cossa, H., Dietler, D., Macete, E., Munguambe, K., Winkler, M.S., Fink, G., 2022. Assessing the effects of mining projects on child health in sub-Saharan Africa: a multi-country analysis. Glob. Health 18, 7. https://doi.org/10.1186/s12992-022-00797-6.

Cotton, M.D., Mahroos-Alsaiari, A.A., 2015. Key actor perspectives on stakeholder engagement in Omani environmental impact assessment: an application of Q-methodology. J. Environ. Plan. Manag. 58 (1), 91–112. https://doi.org/10.1080/09640568.2013.847822.

Dieteren, C.M., Patty, N.J., Reckers-Droog, V.T., van Exel, J., 2023. Methodological choices in applications of Q methodology: a systematic literature review. Social Sci. Human. Open 7 (1), 100404.

Dietler, D., Lewinski, R., Azevedo, S., Engebretsen, R., Brugger, F., Utzinger, J., Winkler, M.S., 2020. Inclusion of health in impact assessment: a review of current practice in sub-Saharan Africa. Int. J. Environ. Res. Public Health 17 (11), 1–21. https://doi.org/10.3390/ijerph17114155.

Dietler, D., Farnham, A., Lyatuu, I., Fink, G., Winkler, M.S., 2022. Industrial mining increases HIV risk: evidence from 39 mine openings across 16 countries in sub-Saharan Africa. AIDS 36, 1573–1581. https://doi.org/10.1097/qad.0000000000003294.

Emmanuel, A.Y., Jerry, C.S., Dzigbodi, D.A., 2018. Review of environmental and health impacts of Mining in Ghana. J. Health Pollut. 8 (17). https://doi.org/10.5696/2156-9614-8.17.43.

Engebretsen, R.E.H., Brugger, F., 2021. Divergent corporates: explaining mining companies divergent performance in health impact assessments. Res. Policy 74, 102355. https://doi.org/10.1016/j.resourpol.2021.102355.

Farnham, A., Winkler, M.S., Zabré, H.R., Divall, M.J., Fink, G., Knoblauch, A.M., 2022. Spatial mobility and large-scale resource extraction: An analysis of community well-being and health in a copper mining area of Zambia. Extr. Ind. Soc. 9. https://doi.org/10.1016/j.exis.2021.101016.

Fischer, T.B., Cave, B., 2018. Health in impact assessments – introduction to a special issue. Impact Assess. Proj. Apprais. 36 (1), 1–4. https://doi.org/10.1080/14615517.2017.1363976.

Forrester, J., Cook, B., Bracken, L., Cinderby, S., Donaldson, A., 2015. Combining participatory mapping with Q-methodology to map stakeholder perceptions of complex environmental problems. Appl. Geogr. 56 (2015), 199–208. https://doi.org/10.1016/j.apgeog.2014.11.019.

GHEITI, 2024. GHEITI Report on Mining Sector (2021-2022). Accra, Ghana.

Hacon, S.D., Perisse, A.R.S., Simos, J., Cantoreggi, N.L., Winkler, M.S., 2018. Challenges and prospects for integrating the assessment of health impacts in the licensing process of large capital project in Brazil. Int. J. Health Policy Manag. 2018 (7), 885–888.

Harris-Roxas, B., Viliani, F., Bond, A., Cave, B., Divall, M., Furu, P., Harris, P., Soeberg, M., Wernham, A., Winkler, M., 2012. Health impact assessment: the state of the art. Impact Assess. Proj. Apprais. 30 (1), 43–52. https://doi.org/10.1080/14615517.2012.666035.

Himmelsbach, G.S., Zabré, H.R., Leuenberger, L., Knoblauch, A.M., Brugger, F., Winkler, M.S., 2023. Exploring the impact of mining on community health and health service delivery: perceptions of key informants involved in gold mining communities in Burkina Faso. Environ. Res. Public Health 20, 7167. https://doi.org/10.3390/ijerph20247167.

IFC, 2009. Introduction to Health Impact Assessment. International Finance Corporation, Washington, DC.

Iglesias-Merchan, C., Domínguez-Ares, E., 2020. Challenges to integrate health impact assessment into environmental assessment procedures: the pending debate. Impact Assess. Proj. Apprais. 38 (4), 299–307. https://doi.org/10.1080/14615517.2020.1716161.

Knoblauch, A.M., Farnham, A., Zabré, H.R., Owuor, M., Archer, M., Nduna, K., Chisanga, M., Zulu, L., Musunka, G., Utzinger, J., Divall, M.J., Fink, G., Winkler, M.S., 2020. Community health impacts of the trident copper mine project in Northwestern Zambia: results from repeated cross-sectional surveys. Int. J. Environ. Res. Public Health 17 (20), 3633. https://doi.org/10.3390/ijerph17103633, 2020 May.

Lamprecht, N., Erlanger, T.E., Utzinger, J., Winkler, M.S., 2024. Prospects and perspectives of health impact assessment: A systematic review of the peer-reviewed literature from June 2007 to january 2023. Public Health Rev. Vol. 45, 2024. https://doi.org/10.3389/phrs.2024.1606649.

Leuenberger, A., Farnham, A., Azevedo, S., Cossa, H., Dietler, D., Nimako, B., Adongo, P. B., Merten, S., Utzinger, J., Winkler, M.S., 2019. Health impact assessment and health equity in sub-Saharan Africa: a scoping review. Environ. Impact Assess. Rev. 79 (2019), 106288. https://doi.org/10.1016/j.eiar.2019.106288.

Leuenberger, A., Cambaco, O., Zabré, H.R., Lyatuu, I., Utzinger, J., Munguambe, K., Merten, S., Winkler, M.S., 2021. "It is like we are living in a different world": health inequity in communities surrounding industrial mining sites in Burkina Faso, Mozambique, and Tanzania. Int. J. Environ. Res. Public Health 18, 11015. https://doi.org/10.3390/ijerph182111015.

Linzalone, N., Bianchi, F., Curzio, O., Serasini, L., Marinella, N., 2019. Theory and practice to integrating health in environmental assessment: Synthesis of an experience with stakeholders to deliver a national HIA guideline. Environ. Impact Assess. Rev. 77, 49–59. https://doi.org/10.1016/j.eiar.2019.03.004.

Lyatuu, I., Farnham, A., Winkler, M.S., Fink, G., 2021. Short- and long-term associations of national-level natural resource rents and health: evidence from cross-country panel data analysis. PLoS One 16, e0252336. https://doi.org/10.1371/journal.pone.0252336.

Mayembe, R., Simpson, N.P., Rumble, O., Norton, M., 2023. Integrating climate change in environmental impact assessment: a review of requirements across 19 EIA regimes. Sci. Total Environ. 869 (2023), 161850. https://doi.org/10.1016/j.scitotenv.2023.161850.

McCallum, L.C., Ollson, C.A., Stefanovic, I.L., 2018. An adaptable Health Impact Assessment (HIA) framework for assessing health within Environmental Assessment (EA): Canadian context, international application. Impact Assess. Proj. Apprais. 36 (1), 5–15. https://doi.org/10.1080/14615517.2017.1364026.

McKeown, B., Thomas, D., 2013. Q Methodology. In: Series: Quantitative Applications in the Social Sciences. SAGE Publications, Thousand Oaks. https://doi.org/10.4135/9781483384412.

Molenveld, A., 2020. Using Q methodology in comparative policy analysis. In: Handbook of Research Methods and Applications in Comparative Policy Analysis. Edward Elgar Publishing Limited, Cheltenham, pp. 333–347. https://doi.org/10.4337/9781788111195.00028.

Morgan, R.K., 2012. Environmental impact assessment: the state of the art. Impact Assess. Proj. Apprais. 30 (1), 5–14. https://doi.org/10.1080/14615517.2012.661557.

Nguyen, B.N., Boruff, B., Tonts, M., 2018. Indicators of mining in development: a Q-methodology investigation of two gold mines in Quang Nam province, Vietnam. Res. Policy 57 (March), 147–155. https://doi.org/10.1016/j.resourpol.2018.02.014.

Nowacki, J., 2018. The Integration of Health into Environmental Assessments – With a Special Focus on Strategic Environmental Assessment. WHO Regional Office for Europe, Copenhagen.

Osewe, P., 2015. Better Health in Mines and Mining Communities: A Shared Responsibiltiy. World Bank Blogs. March 6, 2015. https://blogs.worldbank.org/en/health/better-health-mines-and-mining-communities-shared-responsibility.

Parry, L.J., 2022. Q methodology. In: Ercan, Selen A., Asenbaum, Hans, Curato, Nicole, Ricardo, F. (Eds.), Research Methods in Deliberative Democracy. Mendonça, Oxford University Press. https://doi.org/10.1093/oso/9780192848925.003.0021.

Proksik, J.J., Brugger, F., Konkobo, H.M., Zabré, H.R., Diagbouga, S.P., 2023. Exploring the policy space for public health in large-scale mining in Burkina Faso: A Q-methodology study. Res. Policy 86, 104153. https://doi.org/10.1016/j.resourpol.2023.104153.

Proksik, J.J., Brugger, F., Cossa, H., Chavane, L., Macete, M., 2024. Using Q-methodology for policy research and stakeholder engagement to strengthen public health in large-scale mining in Mozambique. Sustain. Dev. https://doi.org/10.1002/sd.3175.

Rice, B., Buller, A.M., Boccia, D., et al., 2023. Establishing the health and wellbeing needs of mining host community in Brazil, Chile and Peru: a mixed-method approach to identify priority areas for action to help communities meet their SDG3 targets. BMC Public Health 23, 2218 (2023). https://doi.org/10.1186/s12889-023-17017-4.

Richard, K.M., 2012. Environmental impact assessment: the state of the art. Impact Assess. Proj. Apprais. 30 (1), 5–14. https://doi.org/10.1080/14615517.2012.661557.

Roundtable, 2019. Organised by: WHO RHN, WHO ECEH, Regional Government of Andalusia, EUPHA, (HIA) Chair persons: Francesco Zambon - WHO EURO, Piedad Martin-Olmedo - Spain, Round table: Health in Environmental Impact Assessment: getting serious about primary prevention. Eur. J. Pub. Health 29 (Supplement_4). https://doi.org/10.1093/eurpub/ckz185.725. November 2019, ckz185.725.

Sardo, A.M., Sinnett, D., 2020. Evaluation of the Q method as a public engagement tool in examining the preferences of residents in metal mining areas. Front. Commun. 5 (August), 1–10. https://doi.org/10.3389/fcomm.2020.00055.

Seghezzo, L., Sneegas, G., Jepson, W., Brannstrom, C., Beckner, S., Lee, K., 2024. The use and potential of Q methodology in environmental planning and management. J. Environ. Plan. Manag. 67 (12), 2721–2747. https://doi.org/10.1080/09640568.2023.2207727.

Siangulube, F.S., 2024. The role of multistakeholder platforms in environmental governance: analysing stakeholder perspectives in Kalomo District, Zambia, using Q-method. Environ. Manag. 74 (2024), 13–30. https://doi.org/10.1007/s00267-023-01806-z.

Siquan, D., Amuakwa-Mensah, F., Deyi, Yue, C., Yue, C., 2022. The impact of mineral resource extraction on communities: how the vulnerable are harmed. Extract. Indust. Soc. 10 (2022), 101090. https://doi.org/10.1016/j.exis.2022.101090.

Sneegas, G., Beckner, S., Brannstrom, C., Jepson, W., Lee, K., Seghezzo, L., 2021. Using Q-methodology in environmental sustainability research: A bibliometric analysis and systematic review. Ecol. Econ. 180, 106864. https://doi.org/10.1016/j.ecolecon.2020.106864.

Stephenson, W., 1993. Introduction to Q-methodology. Operant Subject. 17 (1/2), 1–13. https://doi.org/10.1163/9789004350168_004.

Tuokuu, F.X.D., Idemudia, U., Gruber, J.S., Kayira, J., 2019. Linking stakeholder perspectives for environmental policy development and implementation in Ghana's gold mining sector: insights from a Q-methodology study. Environ. Sci. Pol. 97 (March), 106–115. https://doi.org/10.1016/j.envsci.2019.03.015.

UN Environment, 2018. Assessing Environmental Impacts: A Global Review of Legislation. Nairobi, Kenya.

van Staden, F., Retief, F., 2022. Pluralism in EIA practice: a Q-method analysis of the economic growth-environment nexus. Impact Assess. Proj. Apprais. 40 (4), 342–352. https://doi.org/10.1080/14615517.2022.2084232.

Walker, H., Pope, J., Morrison-Saunders, A., Bond, A., Diduck, A.P., Sinclair, A.J., Middel, B., Retief, F., 2024. Identifying and promoting qualitative methods for impact assessment. Impact Assess. Proj. Apprais. 42 (3), 294–305. https://doi.org/10.1080/14615517.2024.2369454.

Watts, S., Stenner, P., 2005. Doing Q methodology: theory, method and interpretation. Qual. Res. Psychol. 2 (1), 67–91. https://doi.org/10.1191/1478088705qp022oa.

Watts, S., Stenner, P., 2012. Doing Q Methodological Research: Theory, Method, and Interpretation. Sage Publications, London. https://doi.org/10.4135/9781446251911.

Webler, T., Danielson, S., Tuler, S., 2009. Using Q method to reveal social perspectives in environmental research. Soc. Environ. Res. 01301 (January), 1–54. http://www.seri-us.org/pubs/Qprimer.pdf.

WHO, 2023. Implementation of health impact assessment and health in environmental assessment across the WHO European Region. GHEITI Report on Mining Sector (2021-2022). World Health Organization. Regional Office for Europe, Copenhagen.

Winkler, M.S., Adongo, P.B., Binka, F., Brugger, F., Diagbouga, S., Macete, E., Munguambe, K., 2019. Health impact assessment for promoting sustainable development: the HIA4SD project. Impact Assess. Proj. Apprais. 38 (3), 225–232. https://doi.org/10.1080/14615517.2019.1694783.

Winkler, M.S., Furu, P., Viliani, F., Cave, B., Divall, M., Ramesh, G., Harris-Roxas, B., Knoblauch, A.M., 2020. Current global health impact assessment practice. Int. J. Environ. Res. Public Health 17 (9), 2988. https://doi.org/10.3390/ijerph17092988.

Zabala, A., Sandbrook, C., Mukherjee, N., 2018. When and how to use Q methodology to understand perspectives in conservation research. Conserv. Biol. 32 (5), 1185–1194. https://doi.org/10.1111/cobi.13123.

Zabré, H.R., Farnham, A., Diagbouga, S.P., Fink, G., Divall, M.J., Winkler, M.S., Knoblauch, A.M., 2021. Changes in household wealth in communities living in proximity to a large-scale copper mine in Zambia. Res. Policy 74, 102395. https://doi.org/10.1016/j.resourpol.2021.102395.