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Resources Policy

Mineral resources and localised development: Q-methodology for rapid assessment of socioeconomic impacts in Rwanda

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ABSTRACT

The regional impacts of large development projects often require rapid appraisal in confined geographies. Impacts have largely been studied at country level, which have often neglected a finer granularity of analysis at sub-national level, which has specific relevance in Africa, since many mineral conflicts on the continent are highly localised. This study applies Q-methodology to quantitatively analyse qualitative perspectives regarding impacts of mining-led development at a district level in Rwanda – a densely populated country with a high economic growth rate. This approach revealed three classes of shared perspectives regarding topics of greatest concern to stakeholders: (a) economic diversification and sustainable socioeconomic development; (b) employment, resettlement, and mining land-use; and (c) income, benefit distribution, and social impacts. The use of this method to consolidate qualitative data through a deliberative process to get an output that can be used for broader geographic comparisons holds much promise for researchers and practitioners alike working in geographies of rapid development.

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1. Introduction

The primacy of any sub-national economic development analysis should reside with an understanding of stakeholder perceptions and feedback which add a dimension to the analysis that facts and figures alone cannot provide. Often economic development analysis focuses on macroeconomic data and multipliers generated through input-output analyses that provide a good panoramic view of development but can often miss finer granularity at the sub-national level. For research on extractive non-renewable resources such as mining there has been some preliminary work done on developing sustainable development indicators but application and measurement is often at national level (Azapagic, 2004).

Our research uses Q-methodology[1] as a novel means of assessing the impact of mining development at the sub-national level in a way that blends qualitative feedback from stakeholders with quantifiable metrics of development impact. Such an approach allows policy-makers to gauge the level of informed consent for mining projects, which is becoming increasingly salient to ensure development conflicts can be averted. The aim of this research is,

therefore, to identify key impact areas of mining and sub-national development and quantitatively analyse perceptions of stakeholders about those impacts in order to draw impact areas that are shared by a significant number of people. Those indicators identified in this research will then be part of a bigger research project that aims to develop rapid assessment framework of indicators for mining and sub-national development.

Our approach is predicated on a theory of deliberative democracy (Fishkin, 2009; Gutmann and Thompson, 2009) and subsidiarity governance (Colombo, 2012) that has particular relevance in post-conflict areas that require higher level of engagement at the local level to build trust with the central government and multinational interests. The approach incorporates the varied interests, perceptions, knowledge, expectations, values, and desired management options regarding mining activities and its impact on sub-national development. Engagement of stakeholders makes sure that impacts are adequately identified and measured, providing an important basis for informed policy making. In addition, increased knowledge of relevant stakeholders regarding the range of impacts ensures that a solid grounding is provided for informed communication among the relevant stakeholders. This supports a proactive and coherent measure to realise the contribution of mining to sustainable development at a time when mining activities are considered an integral part of the region's economic prospects.

Rwanda's economy has been largely based on agriculture, which remains the mainstay of livelihoods contributing to 36

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[1] A method used to quantitatively and qualitatively measure subjectivity within a discourse.

percent of total Gross Domestic Product (GDP) on average from 1999 to 2012. However, the country has set off on a larger scope of economic development planning, expanding to other sectors including extractives and service sector delivery for East Africa. More than a decade after the Rwandan genocide, the country has made remarkable progress on most development metrics, though often at the cost of full pluralistic democracy (Crisafulli and Redmond, 2012). Rwanda provides an important opportunity for research, with the high population density of the country and situation of villages around mine sites. In such coexistence, mining and a range of other economic activities that can be linked to development outcomes, provide important baseline data for research.

2. Mining activity in Rwanda's Rulindo District

Mining activity has been increasing in Rwanda, especially over the last five years. According to Rwanda Natural Resources Authority (RNRA, 2014), the mining sector contributed to average 30 percent of total export earnings in the last decade and currently employs in excess of 30,000 people. The mining sector is one of the key strategic priorities of Rwanda's phase two Economic Development and Poverty Reduction Strategy (EDPRS-2)[2], setting a target of tripling the 2012 export earnings to US$400 million by 2017 (MINIRENA, 2013).

The Rulindo District is one of five districts in the Northern Province of Rwanda (Fig. 1). It has a population of 288,452 and population density of 507.6 inhabitants per square kilometre (Rulindo District, 2013). Around 77 percent of persons above 16 years of age are engaged in agriculture, with coffee and tea being the principal crops (Rulindo District, 2013). Poverty is prevalent, with 43 percent of the district's population categorised as either poor or extremely poor and only 2.6 percent of households having access to electricity (National Institute of Statistics of Rwanda, 2012). In a district with a high population density and substantial dependency on subsistence agriculture, mining coexists with human settlements and agricultural land. Mining and quarrying employs 5.3 percent of persons above 16 years of age in the district and the expansion of this activity carries implications for both social structure and land use.

While mining activities in many parts of the country mainly involve artisanal small-scale mining (ASM), the Rutongo Mines in the Northern Province have been a major producer operating at semi-industrial scale. These cassiterite mines are operated by the privately-owned South African company, Tinco. The mines have been operational since the 1930s, with major developments made by a Belgian company before being nationalised by the Rwandan Government in 1986. Currently owned 100 percent by Tinco, the Rutongo Mines produce over 100 t of 71 percent tin concentrate a month that is exported to Malaysia (TINCO, 2014). In 2013 alone, the Rutongo Mines accounted for 11.3 percent of the total 6842 t of cassiterite produced in the country (Cook and Mitchell, 2014). The mines are the largest private sector employer in Rwanda currently employing 3475 people, mainly through subcontracting to local miners who are paid per extracted minerals.

Tinco is in the process of renewing its license with a long-term plan of expanding and industrialising its operations. At present, it covers a concession area of 9432 ha in the Ntarabana, Cyinzuzi, Murambi, and Masoro Sectors of the Rulindo District with estimated reserves of 52,000 t of tin (Wilson, 2013). As part of the long-term plan, the company aims to produce between 200 and
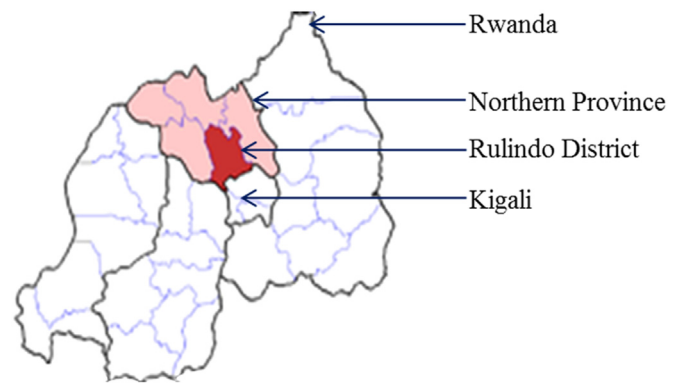

Fig. 1. The Rutongo District Map (adapted from Northern Province Government website).

250 t of tin concentrates per month. With industrialisation and further expansion, social and environmental impacts are inevitable. According to interview with Tinco management, the mines coexist with the 70,415 population in all the four sectors where the mining concessions are located, and many people live within the concession areas. Initial site observation and consultations with the Ministry of Natural Resources authorities and the Rutongo Mines management team revealed impacts relating to population pressure and land issues, conflicts between illegal miners (subcontracted miners who illegally sell minerals) and the company, land degradation, aggregate mining, employment and training of locals, and company support for community.

Given these prevailing impacts and considering future activities at a larger scale, it is important to understand the main concerns and expectations of relevant stakeholders. This research engaged relevant stakeholders in the Rulindo District to gauge their understanding, perspectives, concerns and expectations about the existing activity and future expansion of the Rutongo Mines and the impact this holds for sub-national development. While the Rutongo Mines are by far the largest mining activity in the area, it is important to recognise that ASM activities either organised in cooperatives or run by family or individuals also play a role in the social and environmental impacts in the district.

3. Method

This research utilises Q-methodology, which is a scientific method of analysing opinions, concerns, perceptions, and standpoints about a certain topic. It combines both quantitative and qualitative research approaches in that it examines participants' subjectivity using a "factor analysis"[3] technique (Brown, 1996). A heterogeneous sample of qualitative content is ranked along a standardised ranking distribution, allowing for quantitative analysis (Watts and Stenner, 2005). It allows similar response patterns to be identified, discerning general perspectives or points of view amongst respondents (Shinebourne, 2009).

Q-Sort methodologies join a range of tools that have been used to garner community perception data through a participatory and engaged process. Roloff (2008) has highlighted the importance of "issue-focused" rather than "organisation focused" management approaches to improving corporate engagement with society. A variety of methods have been suggested to glean data on issues that are most relevant to communities. Linear surveys of community perception are often the simplest method but have

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[2] EDPRS is a 5 year strategy with objective of improving the quality of life for all Rwandans moving towards the Vision 2020 goal of becoming a middle income country. EDPRS is implemented in two phases namely, EDPRS-1 (2008–2012) and EDPRS-2 (2013–2018).

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[3] A statistical method that correlates Q-sort responses into groupings or factors. Each grouping of statements is mathematically unique from other groupings.

limitations in terms of accuracy of data due to respondent exhaustion; response bias due to extant factors over which the researchers have little control; and the static nature of the respondent – researcher relationship. Qualitative interviews can supplement surveys to address some of these problems but can also introduce their own set of biases (Weiss, 1995).

Focus groups can be more dynamic in the data acquisition process by allowing for feedback loops to refine the output but need to be carefully managed to ensure equal representation of voices. Cultural inhibitions and hierarchies can also lead to self-censorship in focus groups more so than anonymous respondent methods. Furthermore, the challenge of balancing qualitative data with nuance versus quantitative data with clarity remains an imponderable for many social scientists. To address these various challenges, a hybrid approach is in order, and Q-sort methodology supported by interviews and focus groups provides a way forward in this vein.

The capability to detect and define general sentiments among a large sample has led to the application of Q-sort methods in various fields. Examples of applications in other areas include in health related issues (Risdon et al., 2003), public perspectives (Webler et al., 2001), and social and environmental issues and policy (Addams and Proops, 2000; Kroesen and Bröer, 2009). Research in relation to the management of resources has used the Q-methodology in such a way to inform policy decision-making. This includes Ellis et al. (2007) who applied the method to understand public acceptance of wind farm proposals, Gruber (2011) who studied the perspectives of effective and sustainable community-based natural resource management and Raadgever et al. (2008), who used the method to identify stakeholder perspectives of future flood management. The focus on the "person" in this methodology enables it to be applied across various fields where perspectives of stakeholders are significant.

Within a development context, the temporal dimension of research also makes Q-sort attractive as it can be adapted to a Rapid Assessment approach to data acquisition. The term "Rapid Assessment" can be traced back to the "Rapid Rural Assessment (RRA)" framework that was developed at the Institute for Development Studies in Sussex (Chambers, 1981). The Q-methodology certainly shares some of the RRA characteristics in that data collection technic involves directly talking to people and the exercise contains simple guidelines and technics of data collection that stimulates thinking. However, our connotation for rapid assessment in this context uses the development project itself as the locus of analysis rather than a community settlement. Therefore, the stakeholder network can be more dispersed than in a traditional rapid rural assessment. The augmentation of Q-sort prioritisation framework can also help with this broader and more diverse set of stakeholders and issues.

While the methodology is popular in the social and natural sciences, its application in studying the mining industry has been limited. The literature that does exist on the subject has examined stakeholder concerns, interests, and opinions regarding oil and gas development in Colorado (Clement and Spaulding, 2013). In this study, we apply the Q-methodology as an instrument to understand the value people place on certain benefits of mining activity, perspectives on the management of resources for sustainable development, and views on whether or not they support major mining developments. The primary objective is to identify the key stakeholder issues pertaining to mining and sub-national development. While prior interviews and document analysis provide primary understanding of the issues, the application of the Q-methodology, accompanied by focus group discussions, provides quantitative evidence and support in the identification of significant issues experienced by stakeholders.

The application of Q-methodology is expected to provide a useful starting point for proactive dialogue and help guide effective decision-making. Q-methodology involves the intercorrelation of participants' responses, revealing shared configurations (Watts and Stenner, 2005). These shared configurations are interpreted as shared perspectives amongst respondents. The major contribution of the method, therefore, lies in its ability to unveil perspectives that are widely shared amongst a varied group of respondents. The methodology's strength in pulling out key areas of interests and concerns provides useful insight that could inform proactive measures for sustainable development.

3.1. Construction of the concourse

The first step in the application of the Q-methodology is to construct the "concourse" (Brown, 1993). This is a collection of numerous statements reflecting a wide range of perspectives relating to the topic of study. In this study, researchers worked with a local contact to identify key stakeholders within the Rulindo District. These included the community and representatives from Tinco (management and employees), the Ministry of Natural Resources, district and sector governments, and civil society organisations. An unstructured interview was conducted with the selected informant groups to gain insight into the key issues in and around the mining site, as well as across the district. This information, as well as online sources such as media items, government documents, and other publications, helped inform the construction of the concourse.

3.2. Selection of Statements (Q-Sample)

Statements from the concourse focused on the themes of the short and long term impacts, policy issues, and management options and were selected to represent the five types of capital; human, social, financial, natural, and physical. Based on Porritt (2007), *Human capital* refers to the knowledge, skills, motivation, and health of people that enable greater productivity; *Social capital* is about structures, institution, relationships, and networks of a group of people to work productively as a unit; *Financial capital* implies the income and financial resources impacting economic prosperity; *Natural capital* refers to the environmental resources (such as water, air, forestry, land, fisheries, waste) and services such as climate regulation; and *Physical capital* refers to forms of infrastructure including buildings, roads, land boundaries, communication, and transport. This strategic categorisation in the form of five capitals ensures that the study has a full representation of the concourse. The "five capitals" approach is often used in sustainability frameworks for sub-national development to capture the full range of potential project impact. It encourages better outcomes by providing a reference point for development of metrics and through structured dialogue among responsible parties (Brereton and Pattenden, 2007).

A total of 46 statements were selected across all categories of the five capitals, with some statements representing two to three categories (see Fig. 2). For example, Statements 25 and 35 represent social, financial, and human capitals. Statements were constructed in a manner that balanced positive and negative views of similar topics and the degree of extremity of views expressed so that there was minimal bias when sorting. The statements were translated into local language (*Kinyarwanda*) to ensure that participants had a clear understanding of each statement and the exercise.

3.3. Sample of Participants (P-Set)

As with any community-based research the definition of who constitutes a "stakeholder" remains a challenge (Freeman, 1984;
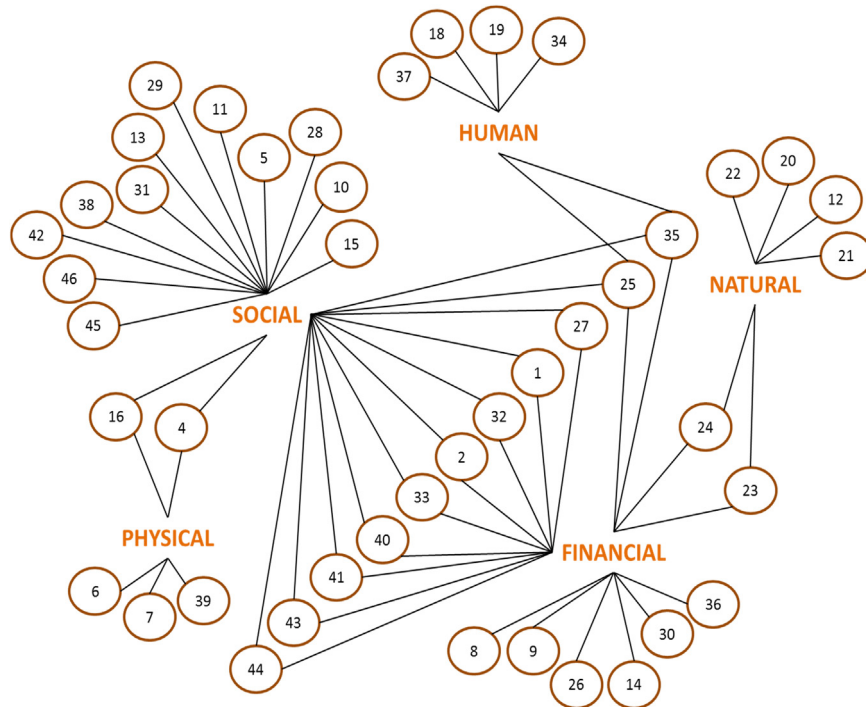
Fig. 2. Statements by category of the five capitals.

Freeman et al., 2010). We cast a fairly wide net to allow for a self-selection of stakeholders through our engagement with community leaders, the company, the government, and the University of Rwanda. It is, however, important to recognise that some stakeholders, such as illegal artisanal miners, may choose to remain absent from such an activity because of a fear of being apprehended in a public context. The veracity of information in this regard could also be questioned. For the purposes of this study, we engaged in small focus group discussions after the Q-sort exercise to try and garner further depth of data that could supplement the more structured prioritisation output. In most cases, based on conversations with law enforcement officials, the illegal miners are migrants and hence not as vested in the development path of the community. Hence their inclusion for the purposes of this exercise would also not be as consequential.

The initial interviews conducted with informant groups were instrumental in the selection of participant samples. Selection of participants for the Q-methodology was mainly based on sufficient representation across all relevant stakeholders and was cognisant of gender, age, and literacy balance. In total 49 participants took part in the Q-sort[4] exercise. Of these, two were from district government, nine from the Rutongo Mines (three management and six employees), three from the Rwanda Ministry of Natural Resources (MINIRENA), 35 from community (of which 17 were from Murambi Sector and 18 from Masoro Sector). A total of 15 women participated, of which three were mining employees, six from Murambi community, and six part of from Masoro community.

Various Q-methodology literature (example, see Webler et al. (2009); and Watts and Stenner (2005)) recommend participants are best sampled based on the breadth of opinion within a target population. As such, this study took into account a more representative sampling method without affecting the perspectives of the diverse categories while being aware of the difficulty in

drawing the line between categories of perspectives. In this regard, the impacted people and the impacting mine were considered as the main informers to the concourse, hence making up the majority of the participants. However, it is important to recognise that opinions can vary among informers within the same category giving rise to fairly distributed opinions that determine a factor.[5]

4. Q-sort administration

The researchers strategized the practical administration of Q-sort depending on the varied literacy and education levels of participants and the varied types of settings in which the exercise took place. The Q-sort exercise with the two sample groups of community was conducted over two days at each of their respective Sectors (Masoro and Murambi). A further two days were dedicated to conducting the Q-sort with the district government and the Ministry of Natural Resources, held at their respective offices, and with the Rutongo Mines representatives held at the mine site. Instructions were given in both English and Kinyarwanda to ensure participants understood each statement, the exercise itself, and what is expected to be achieved. This was also provided in an information sheet that was handed out to each participant, along with consent forms to be signed.

To enable ranking of statements, a fixed quasi-normal distribution ranging from "fully disagree" to "fully agree" was used (Fig. 3). Copies of the statements and the template of the distribution were handed out and participants were asked to pencil the statement number in the boxes of the diagram according to their preferred allocation. In the event of a changed mind, they were able to use erasers and change allocations of statements. In accordance with Brown (2008), researchers encouraged participants to adhere to the template so that participants are motivated to carefully think over each statement and reveal their preferences comparatively. To ensure participants discern meaningful

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[4] The placement of cards (number of statements) in the format featured in Fig. 3. Each card contains a statement that represents an opinion within a discourse.

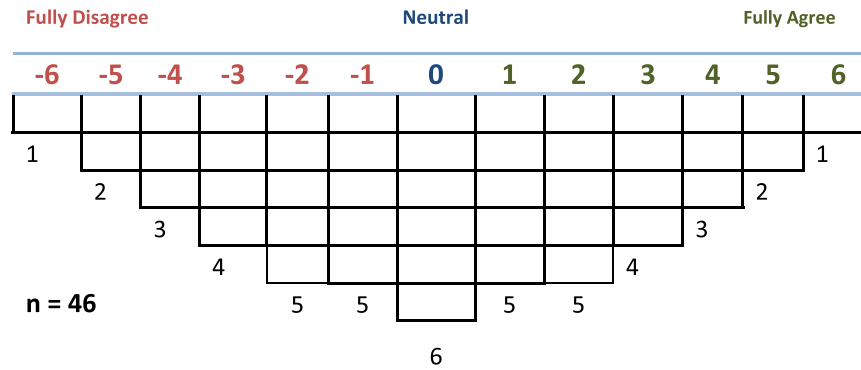[5] A statistically identified group of statements.

Fig. 3. Fixed quasi-normal distribution.

differences when comparing and allocating statements, researchers designed the template in such a way that is comprehendible by all participants and clearly outlined the difference between all levels of scores.

Despite the intention for all participants to stay within the structure of the template, some respondents deviated from the template, placing more than the allowable number of templates at a particular ranking. As all participants ranked every statement somewhere, this deviation from the quasi-normal distribution did not negatively impact the resulting factors (Brown, 1980). This study's experience highlights a challenge in administration that is not addressed in the methodology literature. Even when encouraging participants to adhere to the template, some feel they are unable to prioritise one issue over another. This raises the question as to whether the inclusion of this perspective outweighs strict adherence to the method. When, and to what extent, a researcher could allow participants to freely allocate their statements with a structured approach is an area of the literature that could be further developed.

After each of the Q-sorts, a focus group discussion was conducted with each of the groups of participants to gain information about their reflection on the exercise, issues they thought should be included, their expectations about mining impacts (both negative and positive), expected outcomes of the exercise, and recommendations or final comments. While there was some criticism of the need to adhere to the template, there was overall positive feedback on the method. Participants felt it provided a better environment to express opinion compared to other methods such as interviews and that it provided a good narration of key issues useful for focussed decision making.

5. Factor analysis

A total of 49 participants took part in the Q-sort exercise, representing all the stakeholders that contributed to the concourse development. A principal component factor analysis was carried out using the PQMethod software, which is specifically designed for conducting Q-sorts. The resulting factors are shared configurations of participants' responses, which can be interpreted as shared perspectives amongst stakeholders.

PQMethod extracted eight "unrotated" factors with eigenvalues[6] greater than one and a total of 63 percent variance explained. These factors were rotated using "varimax rotation"[7] to

maximise the dispersal of loadings amongst all factors. Pragmatically, this increases the likelihood that individuals will associate with just one factor or perspective. To emphasise the difference between the factors, three were chosen to be interpreted based on the criteria that each factor explains more of the total variance of each single Q-sort and each factor is composed of more than five Q-sorts at a statistical significance of $P < 0.05$. The three selected factors explain 41 percent of the overall variance and represent the perspectives of 43 individual Q-sorts.

6. Result

Table 1 presents the affiliation of the Q-sorts contributing to each factor. Factor A accounts for 74 percent of local community perspectives from the Masoro and Murambi Sectors, while also incorporating opinions from the national and district governments, as well as both management team and employees from the mining company. Within factor B, 56 percent of perspectives are from the Rutongo Mines employees and management team, with the rest shared by national government and local community. Factor C is predominantly (93 percent) shared by local community with the majority coming from Murambi, and is not shared by government representatives.

Factor scores are the weighted average scores for each statement defining that factor. These were used to calculate Q-sort values in a spectrum ranging from 6 to −6 to show an optimal distribution for that factor. The three factors show high composite reliability and low standard error (Table 2), indicating a high validity of scores of the three factors (Brown, 1980). More than 15 statements fulfilled a unique role for each factor (*significantly defining statements*), and seven statements were significant in all three factors (*consensus statements*). This gives some degree of correlation between factors and indicates that there is some agreement among the three perspectives. This could be useful in determining issues that are important across multiple views and, therefore, are significant to a greater number of people.

As can be observed in Fig. 4, some statements were found significant in defining more than one factor both in the agreement and disagreement sides of the spectrum. For example, a statement (such as (1) and (6)) can define one factor from the positive range of the spectrum and the other factor from the negative range, in which case it is significantly distinguishing both factors. However, those statements (such as (15)) that were found to be defining more than one factor in only one range of spectrum (positive or negative) imply that those factors tend to have some degree of correlation. While there is some overlap between factors because of these statements, each one did emphasis a different theme. Factor A has an optimistic view of mining with respect to economic diversification and sustainable socioeconomic development

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[6] Eigenvalue is "characteristic value" which is simply the sum of squared factor loadings for that factor.

[7] Rotation is needed to give the resulting factors meaning and relevance, and in order to avoid judgement entering into the factor creation a computer-generated rotation known as "varimax rotation" is used.

Table 1
Significant Factor Q-sorts and their respondent affiliations.

	Affiliation						
	Government (District)	Government (National)	Community (Masoro)	Community (Murambi)	Rutongo (Management)	Rutongo (Employees)	**Total**
Factor A	1	2	9	5	1	1	**19**
Factor B	0	1	2	1	2	3	**9**
Factor C	0	0	4	10	0	1	**15**
Total	**1**	**3**	**15**	**16**	**3**	**5**	**43**

Table 2
Factor quality indicators and correlation.

		Factor A	Factor B	Factor C
	Composite Reliability	0.99	0.98	0.97
	S.E. of factor Z-scores	0.114	0.128	0.164
Factor Correlation	**Factor A**	1		
	Factor B	0.58	1	
	Factor C	0.59	0.45	1

and environment. Factor B emphasises on employment impact of mining and the need for resettlement and mining land. Factor C is concerned about mining's impact on inequality in income earned and benefit distributed and other major negative social impacts.

The interviews and group discussions were used to inform the interpretation of these factors. The following section explores the three perspectives in depth.

7. Interpretation

7.1. Factor consensus statements

While three distinct perspectives were derived from the results, some statements were found to be significant across the three (Table 3). Overall, the three perspectives found mining across the Rulindo District to be important, but differed on what they feel the largest impacts are and how these impacts should be managed. Within the consensus statements, there is little emphasis on issues of gender proportion in mining and the impact of population pressure on mining development (statement nos. 35 and 46). The lack of urgency about gender balance in mining and development is reflected during post Q-sort discussions when most participants did not have much to say about the issue. However, a comment from one female in the community sample group explained that there are fewer opportunities for women, given the general perception that women are physically weak. As such, some women are denied labour jobs at the mines despite their willingness to do those jobs.

The three perspectives believe that mining benefits outweigh the losses from possible environmental degradation and refute any social upheaval resulting from new large-scale mining projects (12 and 45). Moreover, they expect that the technical skills of local miners will have long-term transferability (34). As such, people are optimistic about aligning the contribution of mining with economic development strategies such as EDPRS-2 (41). Despite this general optimism about mining, the three perspectives differ in the degrees with which they regard the positives and negatives of mining in relation to sub-national development. These differences are discussed in the sections that follow, making references to statements numbers in Table 4 below.

7.2. Perspective A: diversified economy and sustainable development

*(long term benefit oriented optimistic view)*

The shared perspective in Factor A highly values mining's contribution to long-term positive social impact, but emphasises the need for a diversified economy (Table 4, statement nos. 1 and 43). It differs from the others in that it sees the government playing an active role in economic diversification through investment in non-resource sectors, which should continue alongside a booming mining sector (44). It advocates for mining to exist as long as all appropriate measures, particularly environmental preservation, are in place to ensure a mining programme which is socially and ecologically sustainable (24). In addition, this perspective highly values consultation with local communities on mining and sub-national development decision making (42). Consultation in the mining development has often surfaced as either a missing or inadequate and mistimed process.

Regarding the Rutongo Mines thus far, this perspective acknowledges the contribution of Tinco to social development through financially supporting the pro-poor government programmes, such as The One Cow One Family – Girinka Program, managed by Heifer International and World Vision (38). The value of building and maintaining roads, and investing in other infrastructure, such as clean water, electricity, and housing were also articulated (16). In terms of the income benefits for the region, this perspective does not agree that well-paying positions at the Rutongo Mines are taken by foreigners and in-migrants (10). However, it is ambiguous about whether economic benefits are being spread widely or creating income inequalities in the region (31). The perspective presented is also unclear whether government revenues from mining are translated in local development (40).

In addition to acknowledging the positive short-term contributions of the mines, this perspective denies some of the negative impacts raised. Unlike the other views, it does not believe that the Rutongo Mines have caused alcohol and drug motivated social issues (15). It also does not share the view that the mining area has increased pregnancies among young local women (13). While the mines are not believed to be responsible for these specific impacts, it is acknowledged within this perspective that there have been some negative impacts in the region. One such impact is the progressive damage on community houses caused by company explosives and blasting (7). This perspective also sees the lack of clear concessional boundaries of the mines as part of the causes for conflict and social issues (4).

Looking into the future, this perspective reaffirms that the economic future of the Rulindo District lies in the mining sector. Nevertheless, it is of the view that mining can coexist with other sectors such as the agricultural sector which it strongly asserts has not suffered workforce crisis as a result of attractive financial benefits from mining employment (26). To enhance the mining sector, community groups during group discussions recommend that geological studies and reserve exploration should be conducted to identify mining potential in the area for better exploitation of resources. They underline the need for improved salary and better payment security, given that payments depend on minerals extracted. They also feel a system should be

Factor A - Variance explained: 17%; Defining statements (*): 19 (p<0.05)
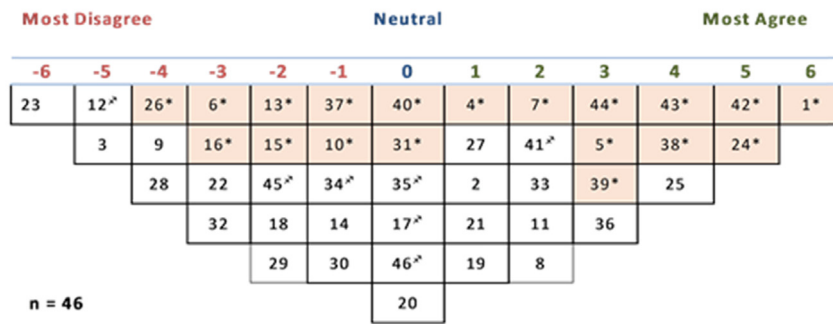
Factor B - Variance explained: 10%; Defining statements (*): 23 (p<0.05)
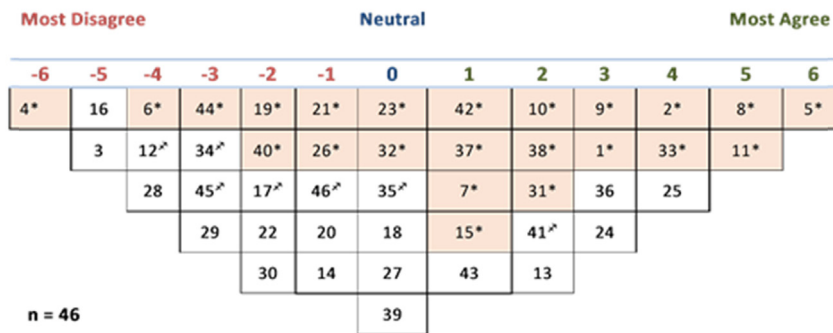
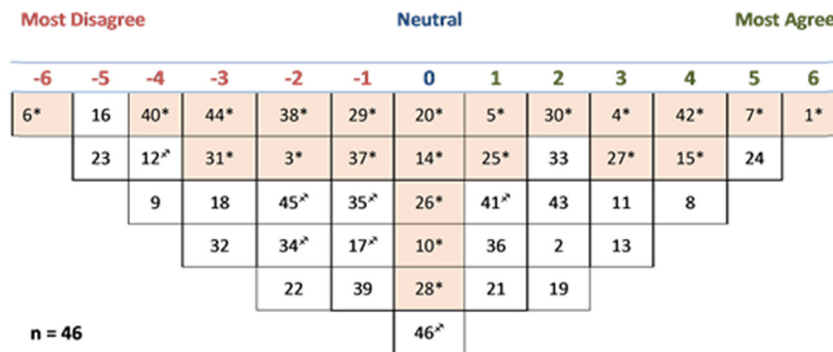Factor C - Variance explained: 14%; Defining statements (*): 22 (p<0.05)

Fig. 4. Optimal Q-scores for Factor A, B and C (Note (↗) denotes Consensus Statements).

Table 3
Factor consensus statements.

Consensus statements	Factor A	Factor B	Factor C
12. The value of the degraded environment due to mining in Rutongo is much higher than benefits from mining operations. **(Negative Environmental impact)**	−5	−4	−4
17. The role of the district in the negotiation of contracts and enforcement of contractual agreement is unclear. **(Role of sub-national government)**	0	−2	−1
34. The skills and technology of the majority of local miners (workers) are rudimentary and can't be transferred to other economic activities. **(technical skills and transferability)**	−1	−3	−2
35. A lack of gender proportion exists in mining employment and training that women are disadvantaged. **(Gender Issue)**	0	0	−1
41. The national and district governments need to align contributions from mining development with the sub-national EDPRS-2. **(Alignment with sub-national development plan)**	2	2	1
45. New large-scale mining projects contribute to social upheaval and a range of social problems. **(Mining and social problems)**	−2	−3	−2
46. Population pressure is the main issue in the way of resources development and could result in social issues. **(Population pressure)**	0	−1	0

Table 4
Statements and their rankings by the factors.

Statements	Factor A	Factor B	Factor C
1. Resource-led development creates great economic opportunities in the long- term reducing poverty. (**Mining-development-poverty**)	6*	3*	6*
2. Resource-led development should be encouraged even through transfer of sizable land from agriculture for a better and long-term quality of life. (**Mining-agriculture-quality of life**)	1	4*	2
3. As licenses are issued at Ministry level, local governments (district and sector) lack authority over mining activities and are hindered from promoting sub-national development priorities. (**governance issue**)	−5	−5	−2*
4. The lack of clear boundaries of the Rutongo mining concession is the main reason for conflict with illegal miners. (**conflict**)	1*	−6*	3*
5. Resettlement of people from within the mining concession is essential to avoid conflict and other social issues. (**Resettlement**)	3*	6*	1*
6. Land utilised for agriculture is more beneficial than for mining activity. (**Competition for land**)	−3*	−4*	−6*
7. Community houses within the concession area are affected by progressive damage caused by company explosives and blasting. (**Infrastructure damage**)	2*	1*	5*
8. The main contribution of industrial mining is through employment. (**employment**)	2	5*	4
9. Large-scale development provides enough long-term jobs that we don't need to worry about economic diversification. (**Economic diversification**)	−4	3*	−4
10. Well paying positions at the mine are taken by foreigners and people coming from other localities. (**Local Vs. migrant workers**)	−1*	2*	0*
11. Illegal mining and trading in the area of Rutongo concession are causing serious insecurity and conflict between company and individuals. (**Illegal mining and trading – conflict**)	2	5*	3
12. The value of the degraded environment due to mining in Rutongo is much higher than benefits from mining operations. (**Negative Environmental impact**)	−5	−4	−4
13. Mining activity has caused an increased number of pregnancies among very young women in the Rutongo area. (**Prostitution**)	−2*	2	3
14. Capital gains in the form of equity participation in the Rutongo mining activity are limited making economic gains impossible. (**Equity participation**)	−1	−1	0*
15. Mining activity has caused alcohol and drug motivated social disruption and violence. (**Alcohol and drugs motivated social issues**)	−2*	1*	4*
16. The Rutongo mine is not contributing to infrastructure development, such as clean water, electricity, and housing. (**Infrastructure**)	−3*	−5	−5
17. The role of the district in the negotiation of contracts and enforcement of contractual agreement is unclear. (**Role of sub-national government**)	0	−2	−1
18. Mining contributed to the higher rate and prevalence of HIV/AIDS and other sexually transmitted diseases in the Rutongo area compared to other Sectors. (**Health impact**)	−2	0	−3
19. Mining in the Rutongo area is responsible for the dust containing harmful chemicals such as silicon which are inhaled resulting in the high prevalence of respiratory diseases mainly cirrhosis. (**Health**)	1	−2*	2
20. Mining activities have disastrous impact on agricultural crops due to the hilly topography causing chemicals from tailing dams to flow over and bury crops. (**Mining and agriculture**)	0	−1	0*
21. Industrial mining has adverse impacts on water bodies around the mine site. (**Impact on water**)	1	−1*	1
22. District government is not consulted in the approval process of environmental impact assessment and audit reports. (**Consultation between national and local governments**)	−3	−2	−2
23. Providing jobs is more important than environmental sustainability. (**environmental sustainability**)	−6	0*	−5
24. Preserving the environment is important for community sustainability and economic diversification. (**Environment**)	5*	3	5
25. Financial benefits earned through employment with Rutongo are utilised on basic needs such as shelter, education for children, and medical needs; as well as for investing on agricultural land. (**Employment and livelihood change**)	4	4	1*
26. Attractive financial packages from employment in mining pull workforce from the agriculture sector adversely affecting the sector. (**Employment and industry concentration**)	−4*	−1*	0*
27. Salaries paid to local miners by the company are below the normal salaries causing illegal buying and selling. (**Salary payments**)	1	0	3*
28. Working at the Rutongo mine is extremely risky and workers do not have insurance cover despite that it is deducted from their salaries. (**Health and safety**)	−4	−4	0*
29. Raising grievances about safety and other issues by workers at the Rutongo mine are discouraged by the fact that whoever complains is expelled. (**Grievances**)	−2	−3	−1*
30. Mining contributes to high cost of living with rising food and housing prices. (**Cost of living**)	−1	−2	2*
31. Industrialised resource projects provide economic benefits that are spread amongst all community members (i.e. no income in-equality is created). (**Income inequality**)	0*	2*	−3*
32. Industrialised projects benefit the government more than the local community. (**Benefit to communities Vs. government**)	−3	0*	−3
33. There is a strong need for a system to be implemented enabling long term saving for sustainable use of financial benefits from mining. (**Saving of financial benefits**)	2	4*	2
34. The skills and technology of the majority of local miners (workers) are rudimentary and can't be transferred to other economic activities. (**technical skills and transferability**)	−1	−3	−2
35. A lack of gender proportion exists in mining employment and training that women are disadvantaged. (**Gender Issue**)	0	0	−1
36. Industrial mining is crucial in creating new small businesses such as "waste from mine" activities (stone cutting). (**small businesses**)	3	3	1
37. The standard of education at the district level is low that there is a lack of skills matching mining jobs. (**Education**)	−1*	1*	−1*
38. The Rutongo Mine contributes to social development through supporting pro-poor government programmes. (**Social development**)	4*	2*	−2*
39. The Rutongo mine has done well in building and maintaining roads and supporting government infrastructure programmes. (**Infrastructure development**)	3*	0	−1
40. Adequate amounts of government revenue earned from this region are being reinvested in the region. (**Revenue investment**)	0*	−2*	−4*
41. The national and district governments need to align contributions from mining development with the sub-national EDPRS-2. (**Alignment with sub-national development plan**)	2	2	1
42. Local communities need to be consulted and be part of decision making in mining and sub-national development. (**Consultation with communities**)	5*	1*	4*
43. While resources are booming, our community should be investing in developing non-resource related industries. (**Economic diversification**)	4*	1	2
44. Government support and investment for non-resource related sectors is evident in this community. (**Government role in diversification**)	3*	−3*	−3*
45. New large-scale mining projects contribute to social upheaval and a range of social problems. (**Mining and social problems**)	−2	−3	−2
46. Population pressure is the main issue in the way of resources development and could result in social issues. (**Population pressure**)	0	−1	0

Asterisk (*) indicates significance at *P < 0.05*); ranges from 6 (most agree) to – 6 most disagree.

implemented to support better saving and investments of benefits by miners. With the belief that the district's standard of education is capable of up-skilling for mining employment take-up, this perspective is optimistic about future mining and sub-national development (37).

7.3. Perspective B: employment, resettlement and mining land (short-term direct benefit oriented view)

The second perspective sees more benefit from mining than other economic sectors and does not give much value to diversification (Table 4, Statement nos. 9 and 6). It advocates for mining to the extent that sizable amounts of agricultural land should give way for mining to enhance quality of life (2). Employment in mining appears to be the main motive behind its advocacy for mining, which is not surprising given over half of its respondents represent the Rutongo Mines management team and employees (8). It is due to the importance placed on employment benefits that this perspective is concerned about the competition posed by foreign workers for well paying positions at the mines (10). However, the lack of domestic skills matching mining jobs is acknowledged as a constraint (37). In addition to employment, it makes a case of short-term direct financial and in-kind support provided by mining companies. As such, it recognises the contribution of the Rutongo Mines to social development through short-term financial provisions and support for government-led programmes (38).

As one of the conditions for mining development, resettlement of people from mining areas is pointed out as a necessary step to avoid conflict and social issues (5). The perspective has a firm stance that conflict with illegal miners at the Rutongo Mines is not caused by lack of clear boundaries around the concessions, but by the presence of residents within the concession area which allows for illegal mining and trading (4 and 11). Although consultation with affected communities is one of the key aspects of resettlement process, it is not adequately emphasised (42). This is a scenario often experienced by mining communities in many parts of the world where grievances regarding the lack of adequate and timely consultation are well documented in the decision making involving not only mining development but also sub-national development projects.

To justify its argument for mining, this perspective disqualifies some of the negative impacts raised. One of these impacts relate to the environmental sustainability which is regarded as a low priority (23). Adverse impacts of industrial mining on water bodies are disputed by this perspective, as are impacts of dust containing harmful chemicals in the case of the Rutongo Mines (21 and 19). Like the first, this perspective also denies adverse impact on the agricultural sector through the pulling of workforce into mining (26). However, it does admit that mining may contribute to increased alcohol and drug related social issues and progressive housing damage due to explosives (15 and 7). Overall, there is a sense that the negative impacts attributed to mining are unfounded and that local communities are the beneficiaries of a fairly equal distribution of economic benefits from mining, a notion contested by the other perspectives (31 and 32). To enable sustainable utilisation of these benefits, it recommends that a system be implemented to support long-term saving (33).

Despite evidently making a case of the positives of mining through the more direct benefits such as employment and financial support of social programmes, this perspective tends to pitch the benefits as contributing to long-term economic opportunities and poverty reduction (1). In fact it points at the government's failure in reinvesting revenues earned locally as the main constraint from achieving long-term maximisation of mining benefits (40). Moreover, government's lack of support and investment in non-resource related sectors is brought as a case in point for the lack of diversified economy that is a foundation for sustainable development (44). This might imply that private mining companies have low trust on government's role in implementing mining benefits on sub-national development. Given that this perspective is mainly represented by mining employees and company management, it is possibly pointing out that mining does provide benefits but it is not sure whether those benefits are realised by local communities, something that it believes is not company's role but government's.

7.4. Perspective C: income, benefit distribution and social impacts (dissatisfied and impact-concerned view)

The final perspective is supportive of mining activity but expresses strong concerns about the negative impacts. Like the first perspective, it expects mining-led development to create great economic opportunities in the long-term thereby reducing poverty (Table 4, Statement no. 1). For this reason, it strongly disagrees with the notion that land utilised for agriculture is more beneficial than for mining development (6). At group discussions, participants explained that cassiterite mining has been an important part of livelihood in the region. Despite expectations of long-term positive outcomes from mining, the current financial contributions and income earnings are described as merely fulfilling basic needs such as shelter, education for children, medical needs, and finances for agricultural activities (25). In fact, the Rutongo Mines's financial contributions to government's social development programmes are denied (38). While Tinco's corporate social responsibility statement as well as the other two perspectives suggest that there is indeed funding support provided, this perspective's stance possibly entails that incentive-based financial donations have little impact on sustainable socioeconomic development.

Even more pressing concerns at the centre of this perspective are the negative impacts pronounced in relation to the present Rutongo mining activity as well as future fears. In particular, it underlines the adverse impacts including alcohol and drug motivated social disruption, progressive damage on houses by company explosives and blasting, high cost of living, and income inequality caused by unequal distribution of benefits (15, 7, 30, and 31). Although not sharing the view that new large-scale mining contributes to social upheavals, it stresses that the aforementioned impacts are deeply concerning (45). Adverse health and safety impacts are one of the immediate concerns raised during group discussions by participants who fear the potential collapse of mining tunnels killing workers, explosives damaging dwellings, and water pollution causing diseases. They complained that miners are not provided with insurance to cover them from highly potential dangers (28). Although people are yet to see company response to these complaints, they did not feel grievances are discouraged by the company (29).

Additional negative impacts that this perspective underscores relates to conflicts between illegal miners and Tinco. These miners are subcontracted by Tinco but get involved in illegal selling of minerals to buyers from town at a higher price than that offered by Tinco (27). According to this perspective, this trend which often results in clashes between illegal miners and Tinco is made possible due to the lack of concessional boundaries around the mines (4). Although it slightly agrees on the need for resettlement of people to avoid conflicts, group discussions with the participants imply that this is merely due to the fear of damages caused by explosives.

This perspective, which is not shared by any government representative, emphasises weaknesses in governance regarding the implementation of mining benefits in local development (40). No evidence is witnessed suggesting government's efforts in

supporting investment in diversified economy (44). It is felt that consultation with local communities should be prioritised, making them part of the decision-making process regarding mining and sub-national development (42). Post Q-sort discussions clarify that consultation should take place at all stages of mining lifecycle, including during negotiations for new licenses, in order to max-imise the benefits and minimise the negative impacts of mining on sub-national development. By the same token, cradle-to-grave consultation process with the impacted people is conducive for a successful sustainable sub-national development projects.

8. Q-methodology's place in sub-national policy

The use of Q-methodology in this context demonstrates its utility in the policy making process, particularly in regards to the mining industry. The range of impacts that this economic activity holds and the various groups that it affects can make policy planning difficult, given the potential of competing agendas of stakeholders and power differentials between these parties. Q-methodology overcomes these hurdles by taking numerous in-dividual views and revealing areas that are shared amongst many. Where these are areas of concern, policy can be directed to prioritise these issues. In cases where it represents shared support for how an issue is being addressed, it can ensure the continuance of current practices and demonstrate ways in which other issues can be addressed.

In this particular case, it came across that the stakeholder groups supported mining across the Rulindo District and the po-tential it holds for poverty reduction and economic development. The differences of opinions in regards to the positive and negative impacts and the roles of different actors highlights the need to ensure that economic planning and investment in the community contributes to realising these goals. One component of this could be support for skills training and technical education, as this was also found between all groups to be a long-term benefit from the mining activity. Another relates to the utilisation of revenues from the mining development for sustainable social development pro-grammes such as investing revenues to create multiplier effect in other more durable sectors.

In addition to the issues for which there is consensus across large groups, Q-methodology also reveals perspectives that are shared amongst a smaller contingent of respondents. All responses are treated equally, regardless of the social status or gender of the respondents. This is particularly useful in developing countries, where social status or gender may act as a barrier to ensuring equal opportunity to voicing one's opinion. While these divides may influence a respondent's personal views, they are all treated in the same systematic manner. Examining the demographics of the respondents who aligned with each of the final components or perspectives may help explain why certain issues were highlighted and help explain how specific issues impact certain stakeholder groups.

These aspects of demographic alignment with issues high-lighted by each perspective can be identified in this study, both in the focus group discussions and the Q-method itself. Female par-ticipants noted lack of opportunities for women to work at the mines. This experience of gender discrimination was evidently visible from the order of interactions during the group discussions, which entails women's lack of opportunity to be consulted directly or provide opinions about impacts and gender specific grievances. Another aspect is seen in Factor C, which did not represent the views of any government representatives. The demographics did not affect the outcomes of the factor, but it is not surprising to find no government representatives aligned with a perspective that points to weakness in governance of the region.

9. Concluding remarks

This research sought an in-depth understanding of stakeholder perspectives in relation to mining, the expansion of mining, and sub-national development. By introducing the Q-methodology in the field of mining, the research quantitatively analysed perspec-tives of participants about identified mining and sub-national development impacts and revealed three factors that shared per-spectives of those represented reflecting the views of the stake-holders that respondents were affiliated with. To consolidate the results of the Q-methodology analysis, focus group discussions were conducted following Q-sort exercises with each group.

Overall, the three shared perspectives in the resulting factors were in agreement about the importance of mining for sub-na-tional development. However, they differed in their prioritisation of aspects of mining and sub-national development as well as in the degree of acceptance of mining project impacts (negative and positive). Perspective A, dominated by communities but also re-presented by government and company, was quite enthusiastic about mining and its positive impact on sub-national development with awareness of some of the negative environmental and social impacts which it believes are addressable. Perspective B was dominated by mining employees and company personnel and was promotional of mining's positive contributions disagreeing on a number of negative impacts. Perspective C, predominantly com-munity with no government representation, was reluctant about mining and reiterated its strong concerns about the negative impacts.

The use of Q-methodology has proven instrumental in scien-tifically identifying, structuring, and measuring perspectives of relevant stakeholders about mining and sub-national develop-ment issues. While methodological limitations were encountered in relation to practical application of the Q-sorting exercise which could have affected the finding, complementing the results with findings from focus group discussions proved useful. We note that all methods need to be constantly re-evaluated for context and where possible triangulation of findings should be undertaken with other methods, particularly ethnographic research for higher granularity of responses on the process by which development trajectories may be reached. Structured themes of the three per-spectives and the degree of their variance in agreeing and dis-agreeing about each indicator provided topical subjects that can be explored for policy and decision-making. The shared and differing values, orientations, and interests can be important discussion points as mining projects get approved. The information extracted from the analysis regarding impact indicators are expected to be useful in the development of a rapid impact assessment frame-work for mining and sub-national development.

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