Social Impact Assessment in Bauxite Mining for Alumina:

International Comparative Analysis

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1. Introduction

The mineral bauxite is the source of aluminium via a refining process. Aluminium is highly valued for light weight, strength, and minimal maintenance requirements and its significance extends across various sectors [1]. The global demand and production of aluminium have consistently increased since 1950 with projected significant expansion as a consequence of the green transition [2].

The adverse environmental impacts associated with bauxite mining and processing are multifaceted. It includes destruction of ecosystems and habitats caused by open pit mining, soil degradation [3] etc. with potentially devastating consequences for both natural ecosystems and the social fabric of affected communities. Social impacts can contribute to conflicts between local communities and mining developers [4] and poses significant risks in mining development processes, potentially leading to social unrest, project delays, and detrimental effects on a company's reputation. Therefore, mining companies should thoroughly assess and effectively mitigate social impacts [5].

Social Impact Assessment (SIA) processes have the potential to identify, mitigate and monitor negative social impacts, thus enabling better decision-making to foster sustainable development and social responsibility in mining development [6]. However, SIA often plays only a minor role in the environmental impact assessment (EIA) process and thus in the licencing procedure, which leads to the oversight of adverse impacts on the local economy, health, wellbeing, and communities in general [7].

This paper reviews three impact assessments of bauxite mining projects intending to understand how social impacts are assessed in three prominent bauxite-producing nations: Australia, Guinea and Jamaica. The assessments are analysed against a framework of social impact factors. The findings recommend on factors to include in future SIAs, thereby promoting more sustainable and socially responsible mining practices.

2. Methodology

2.1 Analytical framework

Traditionally the quality of SIA has been measured using various criteria derived from earlier works designed to evaluate the quality of EIA [8]. However, from 2002 quality criteria have been specifically developed for SIA quality assurance [9]. The analysis is structured using Vanclay's [10] conceptualisation of social impacts. As conceptualized, social impacts can be conveniently categorized as changes affecting one or more of the following factors: people's way of life, and their culture, community, political systems, environment, health and wellbeing, personal and property rights, as well as their fears and aspirations. The impacts of the list are gradually more intangibility of nature, following Scholtz and Slabbert [11], defining tangible social impacts as 'anything that is capable of being perceived, especially by the sense of touch', e.g. environmental and health impacts or specific social impacts such as income. Intangible social impacts are defined as something that is 'impalpable' or something that cannot physically be touched, but rather just experienced, e.g. the category "fear and aspirations". For this research, a comprehensive total of 35 distinct impacts have been diligently identified and classified into 9 cohesive groups inspired by Vanclays [10] framework, as illustrated in Fig. 1.

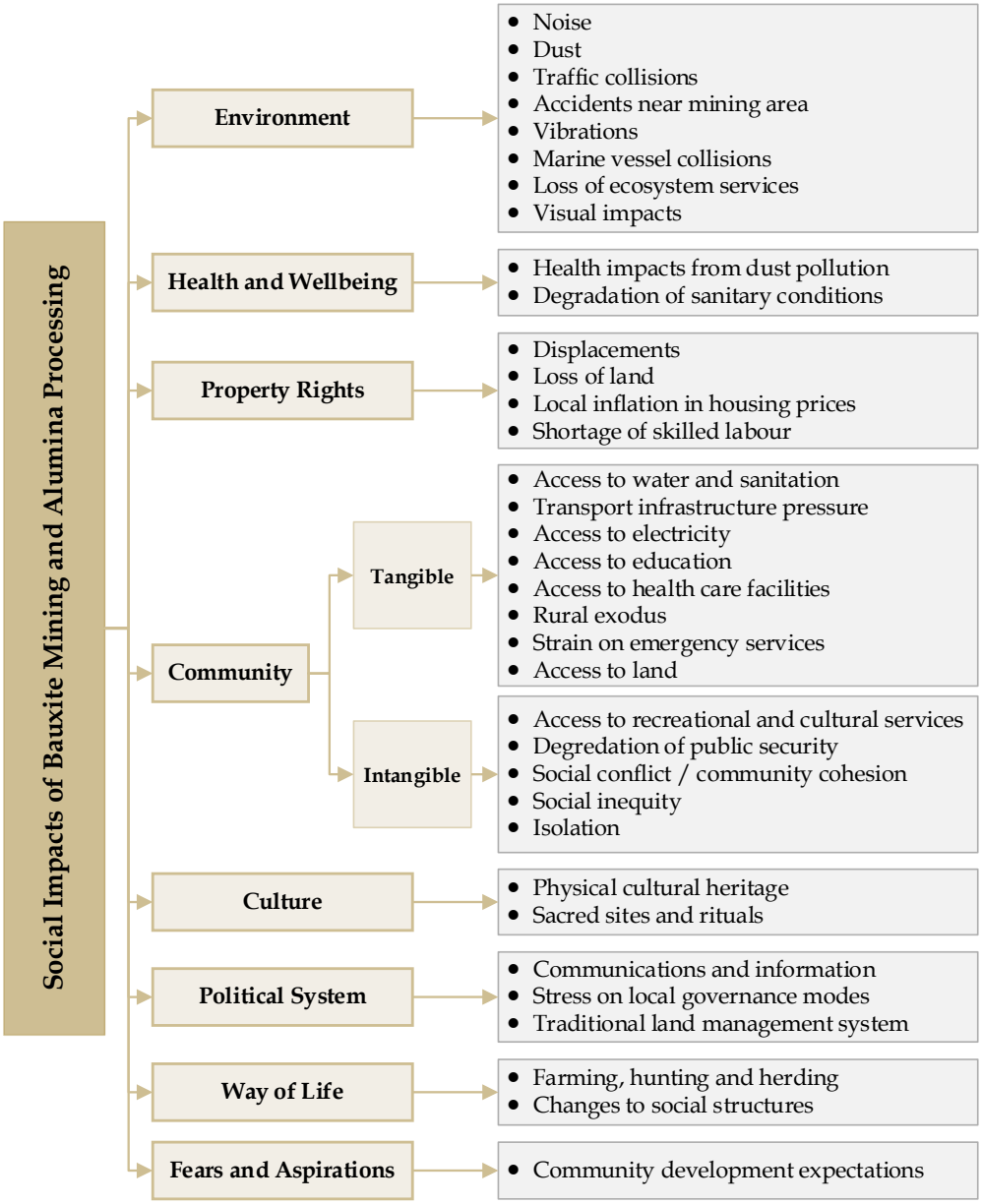

Fig. 1. Classification of social impacts, based on Vanclay [10], Scholtz and Slabbert [11].

2.2 Case Selection

The analysis encompasses cases of SIA of mining projects from 3 countries in different global regions conducted between 2016 and 2021. They were randomly selected, designed to provide an indication of prevalent practices employed in the impact assessment of bauxite mining. The cases serve as an indication, aiming to engage in a dialogue that resonates with other works on how social impacts are assessed particularly in Bauxite mining [12].

The mines considered are located in Australia, Guinea and Jamaica (rank 1, 3 and 10 in global 2022 bauxite production) [13]. They have mining experiences from the 1940s/50s but differs

in mining sector importance in of the national export and employments [14,15,16], as well as institutional capacity [17]. The national and institutional context is not further analysed but should be addressed for understanding and explaining differences in the comparison.

The SIAs considered are related to the Bauxite Hills Mines (BHM), Companie des Bauxites de Guinée (CBG) Mine, and Special Mining Lease 173 (SML173), detailed in Table 1 [18,19,20]. The SIAs were analysed to identify if the social impact factors in figure 1 were mentioned. The quality of the assessment of the factors beyond the mere mentioning is out of scope for this analysis and merits further investigation.

Table 1. *Details of selected cases*

Country	Mine	Company	Production (mill. MT/year)	Year of IA	Project type
Australia	Bauxite Hills Mine (BHM)	Metro Mining	3.5	2016	Mine
Guinea	CBG Mine	CBG (Halco Mining and Government of Guinea)	22.5	2015	Mine expansion
Jamaica	Special mining lease 173 (SML173)	Noranda Jamaican Bauxite Partners II (NJBP II)	6	2020	Mine

3. Analysis and findings

The analysis presents findings and comparisons of the impact assessments conducted for the mining projects CBG, BHM, and SML173. Table 2 presents a comprehensive overview of the scope of impact assessments for the three projects.

Table 2. Scope of impact assessment in the projects.

IMPACT CATEGORIES	IMPACTS	CBG	BHM	SML173
ENVIRONMENT	Noise	X	X	X
	Dust	X	X	X
	Traffic collisions	X	X	X
	Accidents near mining area	X	X	
	Vibrations	X	X	
	Marine vessel collisions		X	
	Loss of ecosystem services		X	
	Visual impacts	X		X
HEALTH AND WELLBEING	Health impacts from dust pollution	X	X	X
	Degradation of sanitary conditions	X		
PROPERTY RIGHTS	Displacements	X		X
	Loss of land	X		
	Local inflation in housing prices		X	
	Shortage of skilled labour		X	
TANGIBLE COMMUNITY	Access to water and sanitation	X	X	X
	Transport infrastructure pressure	X	X	X
	Access to electricity	X		X
	Access to education	X	X	
	Access to health care facilities	X	X	
	Rural exodus	X		
	Strain on emergency services		X	
	Access to land			X
INTANGIBLE COMMUNITY	Access to recreational and cultural services	X	X	
	Degradation of public security	X	X	
	Social conflict / community cohesion	X	X	
	Social inequity	X		
	Isolation	X		
CULTURE	Physical cultural heritage	X	X	X
	Sacred sites and rituals	X	X	X
POLITICAL SYSTEM	Communications and information	X		
	Stress on local governance modes	X		
	Traditional land management system	X		
WAY OF LIFE	Farming, hunting and herding	X	X	
	Changes to social structures	X		
FEARS AND ASPIRATIONS	Community development expectations	X		X

Naturally, differences will exist in the impacts identified in the assessments because impacts are defined by the characteristics of the projects as well as the receiving environment [21]. Nevertheless, the difference between the report for the CBG mine covering 29 out of the 35

impacts, the BMH covering 21 and SML173, covering only 14 indicates differences that are probably defined by more than contextual factors. However, the most interesting part is the similarities between the three cases.

3.1 Handling of tangible impact factors in the three impact assessments

Despite contextual differences, several common impacts are assessed in all three cases, such as dust emissions, noise generation, potential traffic collisions, and accidents near mining areas. Additionally, the accessibility to adequate water and sanitation facilities and the resultant pressure on transport infrastructure have been recognized as crucial considerations. Another key aspect is the preservation of physical cultural heritage, encompassing the protection of sacred sites and rituals associated with the project areas. These are to a large extent well known 'traditional' impacts which has long been a part of environmental impact assessment practices [22], predominantly falling within the category of tangible impacts.

Other impacts which are traditionally also measured and handled as tangible impacts in relation to bauxite mining [23] are only included in one of the assessments; impacts related to access to land, loss of ecosystem services or social inequity.

3.2 Handling of intangible impact factors in the three impact assessments

Assessing intangible social impacts is a key aspect of SIA, as it allows for the analysis of non-quantifiable and qualitative effects on communities and individuals [24]. However, the intangible social impacts (intangible community, culture, political system, ways of life and fears and aspirations) are insufficiently assessed. Most are mentioned in the CBG report, fewer addressed in the BHM report and only a limited number in the SML173 report.

The intangible impact factors are often based on surveys, interviews with residents or hearings. None of the assessment reports use anthropological methods to assess the intangible impacts.

3.3 Perfunctory focus on gender

Furthermore, across the tangible and intangible impact aspects, there is a lack of emphasis on gendered impacts. The assessments from CBG and the BHM both consider specific needs of women regarding traditional employment and future opportunities in the mitigation sections, but the focus on gender considerations is generally limited and almost absent in the SML173 assessment. The CBG assessment to some extends consider gender effect in social-, and family structures. However, several typical gendered impacts related to mining projects are still not

fully assessed, such as the impact on women concerning public security and domestic violence related specifically to alcohol consumption [25].

The limited focus on gendered impacts and the gendered nature of impacts in all of the three assessments raise concerns about potential gender disparities and inequalities that might be overlooked or inadequately addressed.

4. Discussion

In regard to the tangible impacts most of the "traditional" social impact factors were addressed, though the SML 173 report in general addresses fewer factors. Only one of three reports addresses impacts related to access to land, loss of ecosystem services or social inequity. Although discussed as often central in relation to bauxite mining it might be more critical to address issues, related to more general societal aspects of property rights and equity.

The intangible social impact factors are only addressed to a lower degree. This may be due to the more complex and time-intensive methods to explore them. Assessing intangible impact factors often involves understanding individual and community perceptions, values, and beliefs, which are subjective and challenging to quantify objectively and might differ between stakeholders. Lack of direct measures complicates assessment of their magnitude and significance accurately. Data on intangible impacts may have complex and indirect cause-and-effect relationships, making it harder to establish clear linkages between project activities and resulting effects.

Including the gender impacts (and other intersectional factors) requires deeper analysis of what in many assessments are seen as "communities" as the unity. Looking at the different interests and fractions of the "community", complicates the analysis, but might be important to map the actual impacts (rather than average or impact for the dominant group).

This indicates that including thorough assessments of intangible impact factors as well as gender and other sub-groups of the community perspective requires more qualitative methods which will require more resources and time for the studies as well as different kinds of expertise. There seems to be a particular prospect in the emerging field of psychosocial impact assessment that are yet to be explored in a mining context [26].

5. Conclusion

This research provides insights into the challenges and opportunities surrounding SIAs for bauxite mining projects through analysis of SIAs from three prominent bauxite-producing countries: Australia, Guinea and Jamaica against a framework of social impacts factors of tangible and intangible character. The results cannot be generalized but contribute to a general discussion about the scope of social impact involvement in present practice of environmental assessments.

The analysis revealed that despite of difference between the assessments, in general the traditional tangible social impact factors were assessed. A few of the potentially more controversial; property right and equality related, were sparsely assessed. The intangible impact factors “way of life”, “fears and aspirations” proved more challenging to assess. This is probably because it requires more challenging and time-consuming methods and the intangible perspective tends to reveal the more complex picture of subjective individual perceptions, values, and beliefs, which might differ between stakeholders. The lack of direct measures complicates assessment of the magnitude and significance of the impacts addressed. Finally, the gender perspectives of social impacts - both tangible and intangible were almost absent in one of the assessments and limited in the others. To include the gender perspective (and other intersectionality aspects) new qualitative methods besides interviews are required as well as analysis that transcends treating the community as a homogenious unit such as e.g., psychosocial impact assessment.

A stronger focus on the intangible social impacts in the assessments, using novel qualitative, and probably more time-intensive methods would enable a more comprehensive understanding of the social implications of bauxite mining and alumina processing.

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