

# Assessing mining impacts on native vegetation

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## 1. INTRODUCTION

Mining is spatially dependent on the existence of mineral deposits and its effects interact cumulatively with those resulting from other land uses, such as urban and agricultural (Lechner et al. 2017). Mining can cumulatively impact water quality and availability, air quality, community well-being and local businesses, among others. In certain regions in particular, mining has potential of causing cumulative native vegetation loss and fragmentation (Malaviya et al. 2010; Siqueira-Gay et al. 2020) and consequently affects biodiversity and ecosystem services (Siqueira-Gay and Sánchez 2020).

Managing and mitigating cumulative impacts of mining on forests and biodiversity is an important goal for governments, conservation organizations and the mining industry (ICMM 2006, 2010; World Bank 2019). *Ex ante* assessment requirements include Environmental and Social Impact Assessment (ESIA), required by national legislation (Morgan, 2012) and international conventions (Sánchez and Croal 2012) as well as financial institutions' lending policies such as Equator Principles and the Performance Standards (PS) of the International Finance Corporation (IFC) (IFC, 2012). As required by PS1 (Assessment and Management of Environmental and Social Risks and Impacts), an ESIA should consider, as appropriate, direct, indirect and cumulative impacts. Not only should impacts under those categories be identified and assessed, but mitigation should be proposed for all significant impacts. Moreover, PS6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) requires special consideration of impacts on biodiversity and ecosystem services in order to integrate conservation needs into development proposals.

Although best practice guidance has been fundamental for advancing ESIA (Morgan 2012), little is known about their actual application and even less about actual outcomes, particularly about the potentially significant cumulative impacts on native vegetation in mining regions. In this context, this research aims at understanding how cumulative impacts on native vegetation are currently addressed by ESIA of mining projects.

## 2. MATERIALS AND METHODS

We reviewed ESIA's prepared to meet IFC's Performance Standards (IFC, 2012) and used the IFC web data base (<https://disclosures.ifc.org/#/landing>) to select cases. The methodology involved: (i) selection of mining projects with complete documentation available from 2013 until 2019; (ii) elaboration of a review checklist based on literature; (iii) document review to extract evidence about consideration of cumulative impacts.

The criteria applied for the selection of cases are: (i) projects in the mining sector; (ii) availability of documents on the IFC website; (iii) have PS6 in the list of applicable standards. Only projects classified as A (major risks) were considered in the search. The selection resulted in three cases (Table 1). One project from Mauritania was not selected because on first review it does not show relevant aspects related to cumulative impacts on native vegetation. The checklist (Figure 1) was adapted from the original review package made by Lee et al. (1999) enriched with specific criteria on biodiversity and cumulative impacts drawn from the literature (Cooper et al. 2004; IFC 2013; Dibo et al. 2018; Veronez and Montaña 2018), to investigate general aspects of mining studies and present specific questions about how these studies address the cumulative impacts on native vegetation. Lee et al. (1999) proposed seven main criteria for classifying information provided in EIA reports (Table 2).

**Table 1. Information of the selected projects**

Project name	Project type	Proponent	Location	Date of ESIA	PS (IFC)	ESIA report preparer
Aurora Gold	Exploration and development of gold deposits	Guyana Goldfields, Inc.	Guyana	July, 2013	1,2,3,4,6	ENVIRON International Corporation (Updated ESIA) ERM First ESIA
Guinea Alumina Corporation	Bauxite mine and associated rail, port and marine infrastructure	Guinea Alumina Corporation S.A.	Guinea	October, 2017	1,2,3,4,5,6,8	ERM

Figure 1. Review checklist

<p><b>1. Project description</b></p> <p>1.1. Are the objectives of the project clearly stated?*</p> <p>1.2. Are the size of the project and the area of influence described?*</p> <p>1.3. Are the operation described?*</p> <p>1.4. Is the environmental legislation clearly described?*</p>	<p><b>5. Cumulative impacts</b></p> <p><b>5.1. Other related projects, programs and plans</b></p> <p>5.1.1. Are other projects in the area described (by narrative description and/or map)?**</p> <p>5.1.2. Are other related programs described?***</p> <p>5.1.3. Are other related plans described?***</p> <p>5.1.4. Are the relation between other plans and programs and the project clearly described?*</p> <p><b>5.2. VECs selection</b></p> <p>5.2.1. Are the native vegetation and/or critical habitat selected as affected VEC?*****</p> <p>5.2.2. Is the scoping of VEC selection clearly stated?*****</p> <p>5.2.3. Is the VECs identified in consultation with affected communities and stakeholders? *****</p> <p>5.2.4. Is the temporal scale of analysis for each VEC justified? *****</p> <p>5.2.5. Is the spatial scale of analysis for each VEC justified? *****</p> <p>5.2.6. Are the spatial scale based on ecological boundaries ? *****</p> <p>5.2.7. Are the indicator species, endangerment or conservation status used in the VEC's selection?****</p> <p>5.2.8. Are natural and social stressors affecting VEC identified and described?*****</p> <p>5.2.9. Is the present condition of VEC described?*****</p> <p><b>5.3. Magnitude</b></p> <p>5.3.1. Is the impact magnitude predicted, either in quantitative or qualitative terms?</p> <p>5.3.2. Are the criteria clearly justified?*</p> <p><b>5.4. Significance</b></p> <p>5.4.1. Are the criteria for evaluation justified?*</p> <p>5.4.2. Are the pathways described?***</p> <p>5.4.3. Is the interaction between impact considered? ***</p> <p>5.4.4. Is fragmentation considered as significant cumulative impact?****</p> <p>5.4.5. Is habitat loss considered as significant cumulative impact?****</p> <p><b>5.5. Cumulative residual impacts</b></p> <p>5.5.1. Is the cumulative effects of residual impacts described and evaluated?*****</p>	<p><b>6. Mitigation and monitoring</b></p> <p><b>6.1. Mitigation measures</b></p> <p>6.1.1. Are the strategies, plans and procedures to manage all identified impacts clearly described and justified? *****</p> <p>6.1.2. Are monitoring indicators for all identified impacts described and justified? *****</p> <p>6.1.3. Are the strategies, plans and procedures to manage the cumulative impacts proposed? *****</p> <p>6.1.5. Are measured to avoid impacts proposed? *****</p> <p>6.1.6. Are measured to minimize impacts proposed? *****</p> <p>6.1.7. Are measures to restore impacts proposed? *****</p> <p>6.1.8. Are offsets for biodiversity and ecosystem services proposed?*****</p> <p><b>6.2. "No net loss"</b></p> <p>6.2.1. Is there any consideration of loss in terms of biodiversity and ecosystem services?****</p> <p>6.2.2. Is there any consideration of gains in terms of biodiversity and ecosystem services?****</p> <p><b>6.3. Monitoring</b></p> <p>6.3.1. Are indicators (ecological and others) proposed for the project follow up?*</p> <p>6.3.2. Are actions to minimize the impacts during all projects phases?*</p>
<p><b>2. Alternatives assessment</b></p> <p><b>2.1 Methods</b></p> <p>2.1.1. Is the method used clearly explained?*</p> <p>2.1.2. Are the effects of each alternative described?*</p> <p><b>2.2. Alternatives selection</b></p> <p>2.2.1. Are the reason aligned with location strategies and land use types?*</p> <p>2.2.2. Is the alternative of "no project" consider?***</p> <p>2.2.3. Are technological alternatives presented?*****</p> <p>2.2.4. Is the avoidance criteria used in the project design?****</p> <p>2.2.5. Is the avoidance criteria used through the site selection?****</p> <p>2.2.6. Is the innovative options used considering the avoidance?****</p> <p>2.2.7. Is the minimization component used in the alternatives selection?****</p>	<p><b>3. Affected Environment</b></p> <p><b>3.1. Description of affected environment</b></p> <p>3.1.1. Are the areas affected described (by narrative description and/or map)?*</p> <p>3.1.2. Are the types of habitats affected described?****</p> <p>3.1.3. Are the critical or sensible habitats described in detail? **** *****</p> <p>3.1.4. Are the trends and factors of historical degradation identified? ***</p> <p>3.1.5. There is ecosystem services assessment? *****</p> <p><b>3.2. Data and methods</b></p> <p>3.2.1. Are the sources of data used clearly stated? **</p> <p>3.2.2. Is the methodology for primary data collection described? **</p>	<p><b>7. Communication of results</b></p> <p><b>7.1. Layout</b></p> <p>7.1.1. Is the information logically arranged in section and chapters?*</p> <p>7.1.2. Are chapter and other sections of the report, unless very short, present summaries outlining their main findings and conclusions?*</p> <p>7.1.3. Are external sources cited?*</p> <p>7.1.4. Are maps and figure with good resolution?*</p> <p><b>7.2. Presentation</b></p> <p>7.2.1. Is the information presented comprehensible for all audiences?*</p> <p>7.2.2. Is obscure language avoided? Acronyms and initials should be defined*</p> <p><b>7.3. Uncertainties</b></p> <p>7.3.1. Are uncertainties and other limitations regarding information, data and methodologies acknowledged?*</p> <p>7.3.2. Uncertainties and limitations have been handled within the environmental appraisal are explained and justified?*</p> <p><b>7.4. Consultation</b></p> <p>7.4.1. Were audiences of public consultation developed for the project appraisal?</p> <p>7.4.2. Are the opinions they expressed summarised and taken into account in the Report?*</p>
<p><b>3. Affected Environment</b></p> <p><b>3.1. Description of affected environment</b></p> <p>3.1.1. Are the areas affected described (by narrative description and/or map)?*</p> <p>3.1.2. Are the types of habitats affected described?****</p> <p>3.1.3. Are the critical or sensible habitats described in detail? **** *****</p> <p>3.1.4. Are the trends and factors of historical degradation identified? ***</p> <p>3.1.5. There is ecosystem services assessment? *****</p> <p><b>3.2. Data and methods</b></p> <p>3.2.1. Are the sources of data used clearly stated? **</p> <p>3.2.2. Is the methodology for primary data collection described? **</p>	<p><b>4. Identification and evaluation of key impacts</b></p> <p><b>4.1. Description of impact</b></p> <p>4.1.1. Is the screening clearly described and justified? *</p> <p>4.1.2. Are the direct and indirect impacts described? *</p> <p>4.1.3. Are the residual impacts described? *</p> <p>4.1.4. Are the avoided impacts mentioned in any part of project assessment? *****</p> <p>4.1.5. Is the fragmentation identified as impact? *****</p> <p>4.1.6. Is the habitat loss identified as impact? *****</p> <p><b>4.2. Evaluation methods</b></p> <p>4.2.1. Is the general methodology clearly described? *</p> <p>4.2.2. Are participatory methods were used? *</p> <p><b>4.3. Magnitude</b></p> <p>4.3.1. Is the impact magnitude predicted, either in quantitative or qualitative terms? *</p> <p>4.3.2. Are the methods clearly described?*</p> <p>4.3.3. Are the criteria clearly justified?*</p> <p><b>4.4. Significance</b></p> <p>4.4.1. Are the criteria for evaluation justified?*</p> <p>4.4.2. Is the duration of the impact consider?*</p> <p>4.4.3. Is fragmentation considered as significant impact?*</p> <p>4.4.4. Is habitat loss considered as significant impact?*****</p> <p>4.4.5. Are the residual impacts evaluated?*****</p>	<p><b>References:</b> *(Lee et al., 1999), ** (Veronez and Montaño, 2018), *** (Cooper, 2004), **** (Treweek, 1999), ***** (Ekstrom et al., 2015), ***** (Dibo et al., 2018), ***** (IFC, 2013)</p>

**Table 2. List of criteria used in the document review. Adapted from Lee et al. (1999)**

Symbol	Explanation	Color code
A	Generally well performed, no important tasks left incomplete	
B	Generally satisfactory and complete, only minor omissions and inadequacies	
C	Can be considered just satisfactory, despite omissions and/or inadequacies	
D	Parts are well attempted but must, as a whole, can be considered just unsatisfactory because of omissions or inadequacies	
E	Not satisfactory, significant omissions or inadequacies	
F	Very unsatisfactory, important task(s) poorly done or not attempted	
NA	Not applicable. The review topic is not applicable, or it is irrelevant in the context of this environmental appraisal report	

### 3. CASE STUDIES REVIEW

#### 3.1. AURORA GOLD

The project is situated about 170 km west of Georgetown and is connected, by a 150 km access road, to the Buckhall Port on the Essequibo River (with a barge crossing of the Cuyuni River at Tapir). The main components of the Aurora Gold project include: (i) the open pit, mill and tailings storage facilities within the boundary of a 5,802 ha lease; (ii) the logistics support facility; (iii) the extension of existing Barama road; (iv) a new 33 km road constructed connecting the Barama road to Tapir Crossing (a vehicle barge landing on the Cuyuni River), and extending west to the Aurora site. The Aurora Gold project presented a first EISs elaborated by the consultancy ERM followed by an updated ESIA prepared by the consultancy Environ (Table 3).

**Table 3. Details about the report analyzed: Aurora Gold**

	Updated ESIA (Environ)	Original ESIA (ERM)
Number of pages	421	421
Number of chapters	15	12
Number of appendixes	13	0
Number of annexes	4	4

In general, the project description misses only information about the pertinent legislation applied to the project and clearly summarizes project information. The analysis of alternatives

considers: (i) technological alternatives for energy production; (ii) avoidance of clearing native vegetation in the road's projects and general infrastructure. There is no consideration of "no project" scenario and only the difference of cleared area between the design alternatives is presented, but without the clear description of the criteria used for overlaying the maps used as reference for comparing alternatives (Figure 2).

**Figure 2. Analysis of Aurora Gold case study**

Project description	1.1.	1.2.	1.3.	1.4.									
	A	B	A	B									
Alternatives assessment	Methods				Alternatives selection								
	2.1.1.	2.1.2.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.2.7.				
	D	D	B	F	C	B	A	A	B				
Affected environment	Description of affected environment					Data and methods							
	3.1.1.	3.1.2.	3.1.3.	3.1.4.	3.1.5.	3.2.1.	3.2.2.						
	B	A	A	A	D	A	A						
Identification and evaluation of key impacts	Description of impact					Evaluation methods							
	4.1.1.	4.1.2.	4.1.3.	4.1.4.	4.1.5.	4.1.6.	4.2.1.	4.2.2.					
	B	E	A	A	F	A	B	F					
	Magnitude				Significance								
	4.3.1.	4.3.2.	4.3.3.	4.4.1.	4.4.2.	4.4.3.	4.4.4.	4.4.5.					
	A	B	B	B	A	F	A	C					
Cumulative impacts	Other related projects, programs and plans					VECs selection							
	5.1.1.	5.1.2.	5.1.3.	5.1.4.	5.2.1.	5.2.2.	5.2.3.	5.2.4.	5.2.5.	5.2.6.	5.2.7.	5.2.8.	5.2.9.
	A	A	A	B	A	F	F	F	B	F	F	A	A
	Magnitude			Significance			Cumulative residual impacts						
	5.3.1.	5.3.2.	5.4.1.	5.4.2.	5.4.3.	5.4.4.	5.4.5.	5.5.1.					
A	B	C	F	F	F	A	F						
Mitigation and monitoring	Mitigation measures							No net loss				Monitoring	
	6.1.1.	6.1.2.	6.1.3.	6.1.5.	6.1.6.	6.1.7.	6.1.8.	6.2.1.	6.2.2.	6.3.1.	6.3.2.		
	A	F	A	C	B	B	C	D	D	F	A		
Results communication	Layout				Presentation		Uncertainties			Consultation			
	7.1.1.	7.1.2.	7.1.3.	7.1.4.	7.2.1.	7.2.2.	7.3.1.	7.3.2.	7.4.1.	7.4.2.			
	A	A	A	B	A	A	F	F	B	F			

The description of affected area was evaluated as satisfactory, containing biodiversity studies in the appendixes and the identification of endemic species and critical habitats. IFC asked for the updated ESIA to reconsider the potential impacts on ecosystem services, especially on water provision downstream. The updated ESIA presents the information that no communities live in the project vicinities that could be impacted by the project.

The Cumulative Effects Assessment (CEA) subsection ranked as the weakest part of the impact assessment (Figure 2). There are some pitfalls related to Valued Environmental and Social Components (VEC) selection: (i) the spatial scale of analysis is not clearly described and it is not based on ecological boundaries; (ii) the temporal scale is not defined; (iii) the methodology used for VECs selection is not clearly explained and no indicator of species or threshold is used for this purpose; (iv) there was no documented public participation in the VECs

selection; (ii) pathways and impacts interaction are not discussed. The cumulative impact of habitat loss was identified, but there is no mention to fragmentation impacts, despite important roads to be constructed as part of the project.

### 3.2. GUINEA ALUMINA CORPORATION

The main project comprises: (i) a bauxite mine, including access roads, explosive storage, bauxite crushing plant, ore stockpile and other facilities; (ii) port; (iii) marine infrastructure. The associated infrastructure includes a railway and a port terminal. In a second stage of the project, an alumina refinery will be constructed. The main ESIA report is focused on mine site and port area and comprises four volumes and the two other ESIA reports are focused on rail expansion and dam (Table 5).

**Table 4. Details about the report analyzed: Guinea Alumina Corporation**

	ESIA mine and port				ESIA Rail	ESIA Dam
	Volume 1	Volume 2	Volume 3	Volume 4	Volume 1	Volume 1
Number of pages	943	571	284	709	550	590
Number of chapters	9	7	2	1	14	12
Number of appendixes	0				0	0
Number of annexes	0			14	1	11

#### 3.2.1. MINE AND PORT AREA

The ESIA of the mine and port is presented in four volumes: (i) project description and alternatives, institutional and legal framework, environmental studies; (ii) social studies and cumulative impacts; (iii) social and environmental management plan and monitoring plan; (iv) annexes. The project was cleared described with some omissions on the size of total area to be cleared. The alternatives analyzed were: (i) mine infrastructures locations; (ii) mine planning and operations schemes; (iii) port infrastructures locations and ore loading technology. There is no consideration of avoidance criteria in the alternatives assessment and there is no mention of “no project” development (Figure 3). The environmental baseline is divided into mine and port area with a clear description of critical habitats to be impacted, including threatened species of chimpanzees.

**Figure 3. Analysis of Guinea Alumina Corporation case study – Mine and port report**

Project description	1.1.	1.2.	1.3.	1.4.									
	A	C	A	A									
Alternatives assessment	Methods			Alternatives selection									
	2.1.1.	2.1.2.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.2.7.				
	A	C	C	F	B	E	E	B	B				
Affected environment	Description of affected environment				Data and methods								
	3.1.1.	3.1.2.	3.1.3.	3.1.4.	3.1.5.	3.2.1.	3.2.2.						
	A	B	A	C	A	A	A						
Identification and evaluation of key impacts	Description of impact						Evaluation methods						
	4.1.1.	4.1.2.	4.1.3.	4.1.4.	4.1.5.	4.1.6.	4.2.1.	4.2.2.					
	C	A	A	C	A	A	C	B					
	Magnitude			Significance									
	4.3.1.	4.3.2.	4.3.3.	4.4.1.	4.4.2.	4.4.3.	4.4.4.	4.4.5.					
	A	B	B	B	B	A	A	A					
Cumulative impacts	Other related projects, programs and plans				VECs selection								
	5.1.1.	5.1.2.	5.1.3.	5.1.4.	5.2.1.	5.2.2.	5.2.3.	5.2.4.	5.2.5.	5.2.6.	5.2.7.	5.2.8.	5.2.9.
	A	B	B	C	C	E	E	C	E	C	B	B	B
	Magnitude			Significance			Cumulative residual impacts						
	5.3.1.	5.3.2.	5.4.1.	5.4.2.	5.4.3.	5.4.4.	5.4.5.	5.5.1.					
	F	F	F	F	F	B	A	F					
Mitigation and monitoring	Mitigation measures						No net loss		Monitoring				
	6.1.1.	6.1.2.	6.1.3.	6.1.5.	6.1.6.	6.1.7.	6.1.8.	6.2.1.	6.2.2.	6.3.1.	6.3.2.		
	A	A	B	B	A	A	B	A	A	B	C		
Results communication	Layout				Presentation		Uncertainties		Consultation				
	7.1.1.	7.1.2.	7.1.3.	7.1.4.	7.2.1.	7.2.2.	7.3.1.	7.3.2.	7.4.1.	7.4.2.			
	A	B	A	A	A	A	B	C	B	B			

Determination of impact significance is similar in the three ESIA: the criteria of sensitivity of receptors and magnitude of impacts are used to estimate the significance of each impact in a four-level qualitative scale (negligible, low, medium or major), then mitigation measures are proposed and the residual impact evaluated. Impacts of direct habitat loss and fragmentation are considered in the section of terrestrial fauna and evaluated as of major significance and after mitigation measures (avoidance and minimization of land clearing among others) they resulted in moderate residual impacts for some mammals group. In the CEA, the study boundaries (spatial and temporal) are not clearly defined. The study brings other projects (by third parts) in the region but did not mention the two associated facilities presented in the other ESIA's (railway and dam). The cumulative impacts are described in narrative way but their significance is not evaluated.

### 3.2.2. RAIL

The project alternatives considered were: (i) transport of bauxite by road rather than railway, (ii) optimization of changes to be made to the existing rail system. The road alternative is described in general, but there is no mention of alternative road design and no map is presented with the impacted vegetation. The preferred alternative of rail transport mentions avoidance in

Key Biodiversity Areas of Kamsar (port region). The baseline is divided into environmental and social, including critical habitats identification (Figure 4).

**Figure 4. Analysis of Guinea Alumina Corporation case study – Rail**

Project description	1.1.	1.2.	1.3.	1.4.									
	A	A	A	A									
Alternatives assessment	Methods			Alternatives selection									
	2.1.1.	2.1.2.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.2.7.				
	B	C	C	F	F	B	B	C	B				
Affected environment	Description of affected environment				Data and methods								
	3.1.1.	3.1.2.	3.1.3.	3.1.4.	3.1.5.	3.2.1.	3.2.2.						
	A	A	A	B	A	A	A						
Identification and evaluation of key impacts	Description of impact					Evaluation methods							
	4.1.1.	4.1.2.	4.1.3.	4.1.4.	4.1.5.	4.1.6.	4.2.1.	4.2.2.					
	C	B	A	B	A	A	B	B					
	Magnitude			Significance									
	4.3.1.	4.3.2.	4.3.3.	4.4.1.	4.4.2.	4.4.3.	4.4.4.	4.4.5.					
	B	C	B	B	B	F	F	A					
Cumulative impacts	Other related projects, programs and plans				VECs selection								
	5.1.1.	5.1.2.	5.1.3.	5.1.4.	5.2.1.	5.2.2.	5.2.3.	5.2.4.	5.2.5.	5.2.6.	5.2.7.	5.2.8.	5.2.9.
	C	B	B	C	A	B	E	E	E	E	F	B	B
	Magnitude			Significance			Cumulative residual impacts						
5.3.1.	5.3.2.	5.4.1.	5.4.2.	5.4.3.	5.4.4.	5.4.5.	5.5.1.						
	B	C	C	F	F	B	B	B					
Mitigation and monitoring	Mitigation measures						No net loss		Monitoring				
	6.1.1.	6.1.2.	6.1.3.	6.1.5.	6.1.6.	6.1.7.	6.1.8.	6.2.1.	6.2.2.	6.3.1.	6.3.2.		
	A	B	B	B	B	B	B	F	F	B	B		
Results communication	Layout				Presentation		Uncertainties		Consultation				
	7.1.1.	7.1.2.	7.1.3.	7.1.4.	7.2.1.	7.2.2.	7.3.1.	7.3.2.	7.4.1.	7.4.2.			
	A	C	A	A	A	A	E	E	B	F			

The impact assessment is divided into projects phases and presents a similar approach of the other ESIA of the project. For the magnitude, the report brings detailed information about duration, scope (local or regional), frequency and probability of occurrence but it is not standardized for all impacts. Habitat loss is not mentioned as an impact, only degradation of natural habitats and impacts on biodiversity in general. Fragmentation is mentioned as an impact resulted from habitats destruction but classified as negligible because the area is already fragmented by human occupation. The cumulative impact assessment is not VEC-centered and consequently there is no mention to spatial and temporal boundaries. Most mitigation measures are presented in impact evaluation and general programs and measures are presented with indicators at the end of report.

### 3.2.3. DAM

The ESIA of the dam is an update, including downsizing the water reservoir capacity and consideration of interferences with human settlements and villages in relation to an original project. The reservoir is for the project only and the use of water are for dust suppression, process

water, fire water and potable water demand. There were three project alternatives but no methods were applied to evaluate their impacts. Only the description of the avoided chimpanzee’s habitat is mentioned as a criterion (Figure 5). Habitat loss is considered moderate or minor depending on the type of habitat considered and their significance does not change after the mitigation measured proposed, thus, the residual impacts are considered as moderate and high as well. Habitat fragmentation is identified as impact but evaluated as negligible. The social cumulative impacts are described in the chapter of social impact assessment, where mining activities are presented as “cumulative impact”. No assessment of cumulative loss of habitats is presented.

**Figure 5. Analysis of Guinea Alumina Corporation case study – Dam**

Project description	1.1.	1.2.	1.3.	1.4.									
	A	B	A	A									
Alternatives assessment	Methods			Alternatives selection									
	2.1.1.	2.1.2.	2.2.1.	2.2.2.	2.2.3.	2.2.4.	2.2.5.	2.2.6.	2.2.7.				
	E	E	C	F	F	F	C	F	C				
Affected environment	Description of affected environment					Data and methods							
	3.1.1.	3.1.2.	3.1.3.	3.1.4.	3.1.5.	3.2.1.	3.2.2.						
	A	A	A	B	A	A	A						
Identification and evaluation of key impacts	Description of impact					Evaluation methods							
	4.1.1.	4.1.2.	4.1.3.	4.1.4.	4.1.5.	4.1.6.	4.2.1.	4.2.2.					
	B	A	A	B	A	A	B	F					
	Magnitude			Significance									
	4.3.1.	4.3.2.	4.3.3.	4.4.1.	4.4.2.	4.4.3.	4.4.4.	4.4.5.					
B	B	C	B	B	B	A	A						
Cumulative impacts	Other related projects, programs and plans				VECs selection								
	5.1.1.	5.1.2.	5.1.3.	5.1.4.	5.2.1.	5.2.2.	5.2.3.	5.2.4.	5.2.5.	5.2.6.	5.2.7.	5.2.8.	5.2.9.
	B	C	C	C	F	F	E	F	F	F	F	F	F
	Magnitude				Significance				Cumulative residual impacts				
5.3.1.	5.3.2.	5.4.1.	5.4.2.	5.4.3.	5.4.4.	5.4.5.	5.5.1.						
F	F	F	E	F	F	F	F						
Mitigation and monitoring	Mitigation measures						No net loss			Monitoring			
	6.1.1.	6.1.2.	6.1.3.	6.1.5.	6.1.6.	6.1.7.	6.1.8.	6.2.1.	6.2.2.	6.3.1.	6.3.2.		
	A	A	F	A	A	A	F	F	F	A	A		
Results communication	Layout				Presentation		Uncertainties		Consultation				
	7.1.1.	7.1.2.	7.1.3.	7.1.4.	7.2.1.	7.2.2.	7.3.1.	7.3.2.	7.4.1.	7.4.2.			
	A	B	A	C	A	A	B	E	A	B			

## 4. CONCLUSIONS

We found a lack of approaches to capture the cumulative impacts on native. Despite the importance of habitat loss and fragmentation to biodiversity conservation and no net loss policies, in the reviewed case studies regional landscape analysis, cumulative impacts of habitat loss and fragmentation are overlooked. The analysis showed that ESIA of mining projects that are expected to comply with international standards lack sufficient analysis of impacts on native vegetation. Environmental and social performance during project construction, operation and decommissioning will likely be impaired due to shortcomings in the assessment phase.

Some opportunities for improvement were identified: (i) integrative assessment between project components and other infrastructures considering the interaction of impacts and further effects in the landscape; (ii) explicit inform the criteria for VEC selection and justify the boundaries of assessment; (iii) proper consideration and evaluation of cumulative residual impacts; (iv) consideration of cumulative impacts in critical habitats, improving the consideration of critical habitat assessment into impact evaluation. Further investigations would be conducted to analyze in more detail cumulative impacts on biodiversity in mining regions.

## **5. ACKNOWLEDGMENTS**

This research is supported by the São Paulo Research Foundation (grant 2018/12475-7). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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