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MEASUREMENT OF ENVIRONMENTAL IMPACTS IN THE PLANNING AND IMPLEMENTATION OF PERMISSION FOR MINING GOLD ORE AND CASSITERITE MINING IN TUCUMÃ - PA

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Abstract: Environmental impacts are easily identified when economic activity involves the use of natural resources. These exist from the planning stage, increasing in implementation and continually maximized in operation. For gold miner, which can be of different sizes, these impacts involve assumptions ranging from understanding the physical, biotic and socioeconomic environments, in accordance with current environmental and mining legislation. The objective of this work is to identify the environmental impacts observed in a mining permission located in Tucumã - PA, in which the means, the transforming activity, the environmental impact and the control measure adopted by the enterprise were mapped in attention to the size and polluting potential for the activity, associated with the projected mining and mineral processing methodology, now approved, by the Secretariat of the Environment, Tourism and Industry of Tucumã and the National Mining Agency.
Keywords: mining, environmental impact, mitigation measures, environmental pollution.

INTRODUCTION

The mining project that is the object of this study is the mining permit owned by prospector Jeann Souza Ribeiro, in which the environmental impacts resulting from the installation of structures to be used in the mine were measured.

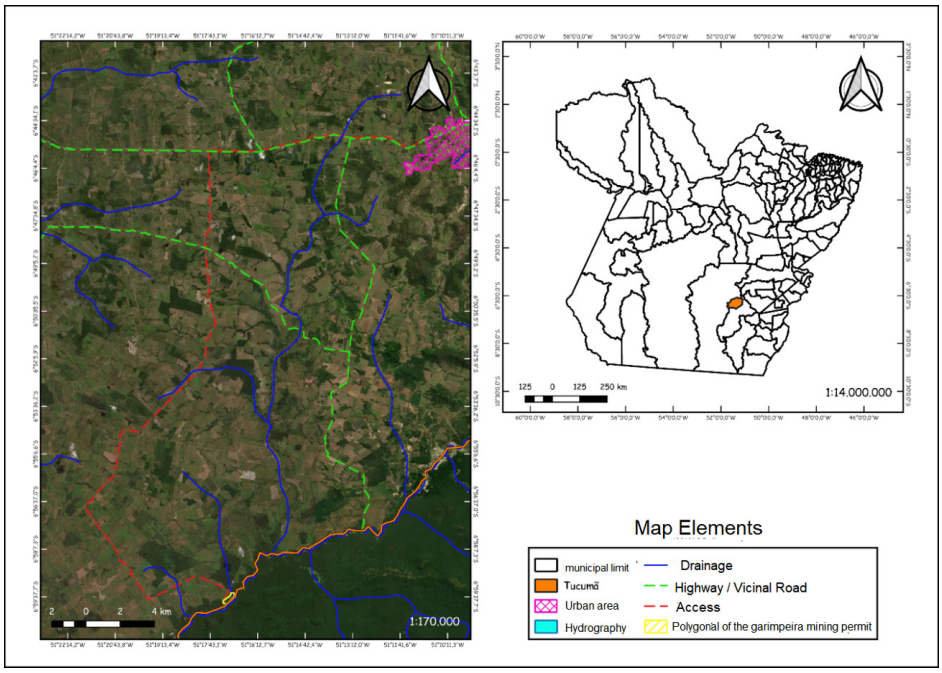
The prospecting mine, in its planning, requires attention from the parts that make up the object of interest, be it the miner, community, landowners and technicians of the project as a whole. This need is due to the fact that there are numerous points considered sensitive for the enterprise and that, since it has a smaller financial capacity than higher-level mines, doing the basics for operation becomes the great challenge.

The undertaking in its history was started on 12/18/2019 in which the holder of the mining permit requested from the National Mining Agency in the State of Pará, the right to carry out the mining activity for the extraction of gold ore and cassiterite, thus generating mining process number: 48059.851005/2019-72.

On 06/15/2020, a license request was requested, according to environmental process Number: 044/2020 with the Secretary of Environment, Tourism and Industry - SEMATI. On 10/08/2021, in compliance with a commitment signed with the entrepreneur, a request was submitted to reduce the area originally required, from 21.00 hectares to a total of 18.41 hectares. The reduction was necessary in view of the exclusion of the degraded area, whose use of residues and mining waste would be unfeasible. On 08/30/2021, operating license Number: 0041/2021 was issued. On 03/02/2022, mining permit number 76/2022 was published. After mining and environmental licensing, which lasted for about 805 days, from the application to the publication of the mining permit, in May 2022 the entrepreneur began the activities of installing the structure necessary for the operation of the enterprise, naming it Mine Taperebá. The development can be visualized on map 01.

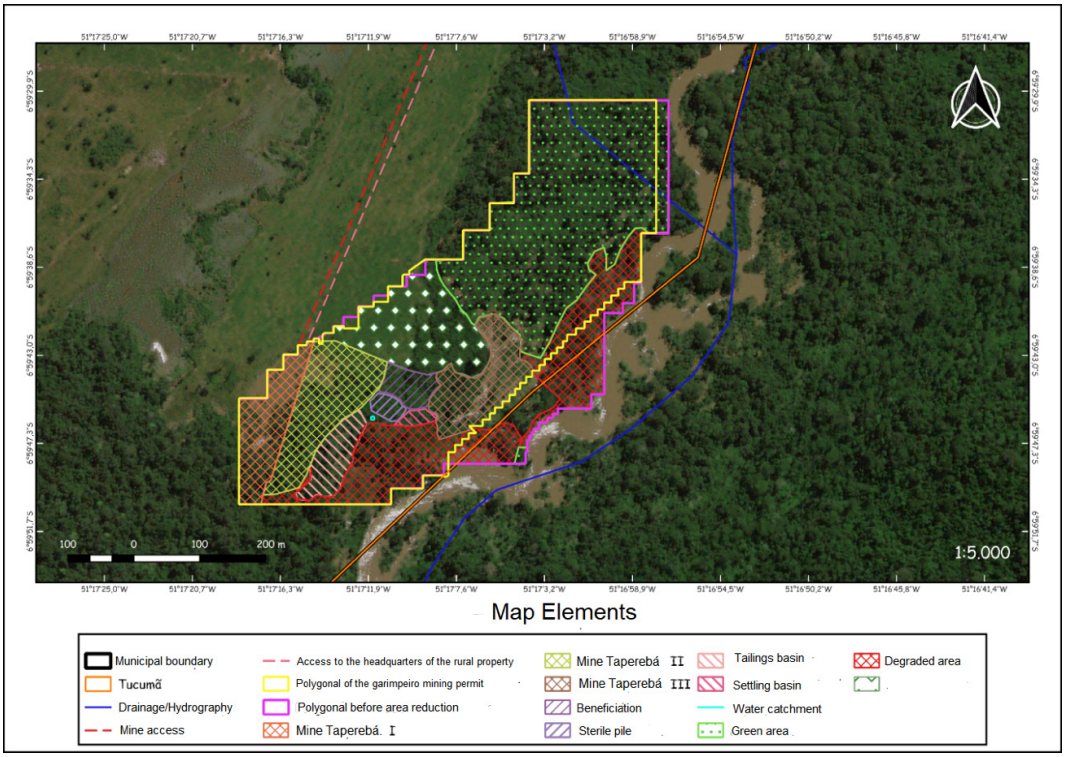
The undertaking has projected mineral extraction to occur on three mining fronts, to be operated subsequent to the exhaustion of the previous pit, in addition to a processing plant, decantation tank and other basic facilities for individual and collective use, such as accommodation, cafeteria and locker rooms; duly authorized by the competent environmental agency.

It must be noted that all the structures to be installed in the project, are included in the Mine Closure Plan presented by the entrepreneur to the National Mining Agency,



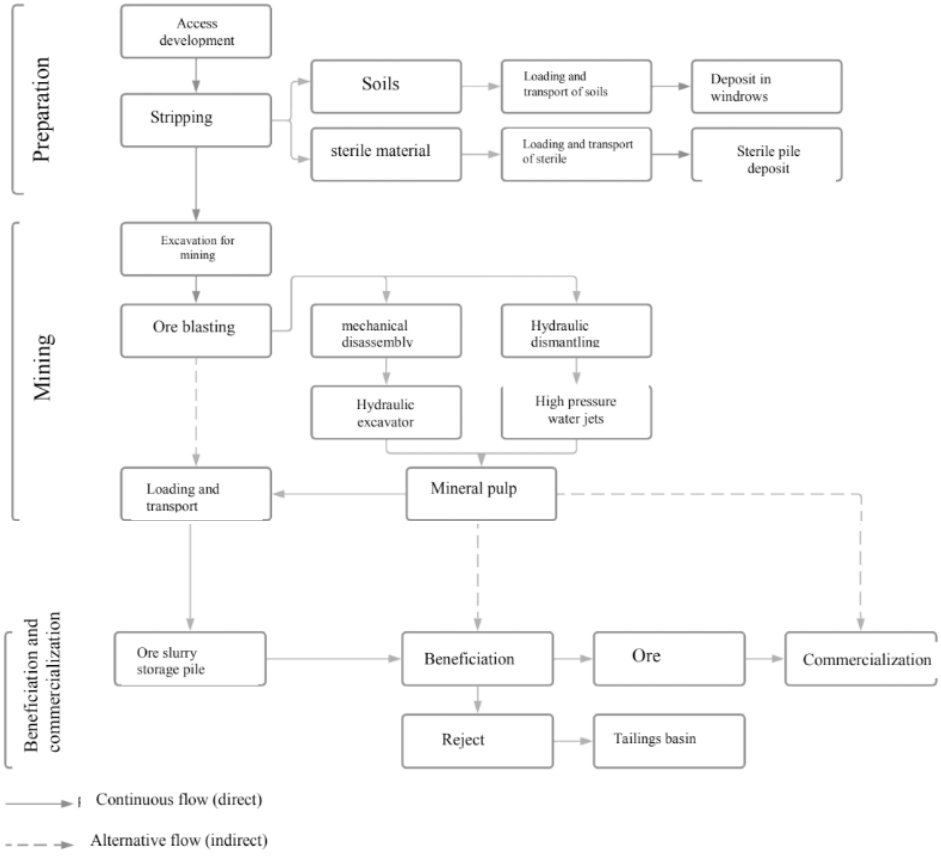
Map 01: Access to mining permission

Source: The author (2022)



Map 01: Identification of the mining permit on the rural property

Source: The author (2022)



Flowchart: Flow of gold miner operations

Source: The author (2022)

Phase	Kind affected	Transforming activity	Environmental impact	Measure of control
Planning	Anthropic	Team movement related to environmental licensing and the project	Generation of expectations related to the enterprise	Development of educational awareness campaigns, information and socio-environmental actions
			Risk of various frictions	Social communication program development
Implantation	Biotic	Vegetation suppression	Possibility of reducing the genetic variety of the terrestrial flora	Cultivation of specimen's native to the surroundings of the project's area of influence for reforestation purposes
			Fauna displacement	Rescue and salvage of specimens found in suppression areas
			Wildlife habitat loss	Recovery and plant regeneration of the area after the end of the mineral operation
	Anthropic	Hiring services	Generation of direct and indirect jobs	Hiring local labor
			Occurrences of accidents at work	Training, use of PPE, development signage
		Construction of support unit	Movement of the local economy	Prioritize local trade when purchasing products and services
			Occurrences of accidents at work	Training, use of PPE, development signage
	Physicist	Access improvement	Triggering of erosion processes and mass movement	Periodic maintenance of access and circulation routes
				Wetting the access roads to the enterprise
		Removal of vegetation and topsoil	Change in soil permeability	Increased vegetation in places without mineral structures
				Construction of drains
				Maintenance of access roads and circulation with aggregates such as pebbles and gravel.
			Possibility of reducing the number of specimens in populations of terrestrial fauna	Environmental monitoring by a qualified professional for the occurrence of wild animals in the gold mines
	Anthropic	People circulation	Risk of accidents	Training, use of PPE, development signage
	Physicist	Circulation of machines and vehicles	Change in air quality and noise levels	Periodic maintenance of mining machinery and equipment
				Monitoring of air quality and noise levels through the use of capture equipment
	Anthropic		Occurrences of accidents at work	Training, use of PPE, development signage
	Biotic	Determination of the mining front	Fauna displacement	Rescue and salvage of specimens found in suppression areas
		Preparation of mining fronts	Loss of fauna and flora habitat	Recovery and plant regeneration of the area after the end of the mineral operation

Table 01: Identification of environmental impacts according to activity

Source: The author (2022)

in compliance with ANM Resolution Number: 68/2021. It contains the necessary elements for the recovery of the areas affected by the extraction and the way in which the built or mobile structures will be decommissioned.

Thus, buildings and other mining structures, when applying this procedure, will be guided according to the projection proposed by the entrepreneur, which may still be changed in view of current legislation. In map 01, the listed structures are available.

The total area to be affected by the undertaking, involving all extraction operations, processing, civil installations, circulation, shipping, among others, are specified in the layout of map 01. now granted through ASV nº 001/2021, granted by the Secretary of Environment, Tourism and Industry of the Municipality of Tucumã. It is considered, therefore, as affected areas for the installation of the necessary structures, which required modification. At Taperebá Mine, the changes will take place in the context of vegetation removal and the mobilization of material from the stripping of organic and/or clayey soil, now necessary for the mineral body to be reached.

Therefore, in flowchart 01 it is possible to visualize the operational stages, as well as denote the places with the greatest generation of environmental impacts, according to the methodology and thus be applied, eventually, in the mineral operation, the best technique that will reduce this.

ENVIRONMENTAL IMPACTS

According to CONAMA Resolution nº 001/89, environmental impact is defined as "any change in the physical, chemical and biological properties of the environment, caused by any form of matter or energy resulting from human activities that, directly or indirectly, affect the health, safety and well-being of the population; social and economic activities; the biota; the aesthetic and sanitary conditions of the environment; the quality of environmental resources". In addition, Decree Number: 88.351/83, revoked by Decree Number: 99.274/90, which regulates Law Number: 6.938/81, is assigned to state licensing bodies and systems, where they must control and regulate activities. polluting by means of norms and procedures, which, when executed, have the minimizing character of the economic practice in question.

Mechi and Sanchez (2010) elucidate that virtually all mining activity implies suppression of vegetation or impediment of its regeneration. In many situations, the most fertile surface soil is also removed, and the remaining soils are exposed to erosion processes that can lead to siltation of the surrounding water bodies. The water quality of the rivers and reservoirs of the same basin, downstream of the project, can be impaired due to the turbidity caused by the fine sediments in suspension, as well as by the pollution caused by substances leached and carried or contained in the effluents of the mining areas, such as oils, grease, heavy metals. The latter can also reach groundwater. The hydrological regime of watercourses and aquifers can be altered when these resources are used in mining (hydraulic dismantling) and processing, in addition to causing the lowering of the water table.

In the meantime, Mechi and Sanches (2010) address that "often, the places of occurrence are environmentally sensitive and important for the preservation of biodiversity, water resources, landscape or other natural resources with an environmental function of great importance."

Gold miner, as well as other mining activities, generate impacts that require bold measures to minimize them, as well as constant monitoring activities carried out by professionals with knowledge and skills so

that propositions can be made in addition to those approved in the environmental project, given the movement of renewal and/or improvement of actions. Thus, for the assessment of impacts, the following defining criteria for changes were considered: in terms of nature, they can be positive when beneficial and negative when adverse; in terms of magnitude, defined by a scale of three categories low, medium and high density; the scope (extension), punctual or local, if related to the area of direct influence of the enterprise, or regional, if related to the area of indirect influence of the enterprise (within a radius of 2.00 km), possibly exceeding these limits; as for reversibility, reversible and irreversible; in terms of duration, with four categories, short, medium, long term and permanent.

Therefore, the regulation for mining to occur in a legal way for the miner culturally adapted to this practice, will start from the transcript in item I of article 70 of Decree Law nº 227/1967, in which it defines that "mining, the individual work of those who use rudimentary instruments, manual devices or simple and portable machines, in the extraction of precious and semi-precious stones and valuable metallic or non-metallic minerals, in eluvium or alluvium deposits, in the watercourses or on reserved banks, as well as in secondary deposits or plateaus (grupiaras), slopes and hilltops; these deposits generically called mining."

For Leite et al (2017) *apud* Silva (2001) describes that the impacts generated by mining cover several areas, causing geomorphological, biological, water and atmospheric changes, such as: removal of vegetation cover, pollution and contamination of soil and water resources by the substances used, increased erosion, sedimentation and silting of rivers, air pollution, waste generation, animal mortality, migration of animals in the area and noise pollution.

Thus, in view of the impacts observed in the qualifying literature and what was observed in the field, the impacts that can be described that are those existing in the enterprise in question, in view of the areas affected by the future operation, we have that the following transforming activities were identified and exposed in frame 01.

In this scenario, in view of the various needs of a globalized society, eager for development and new technologies, mineral commodities are widely used and essential for this. However, it is necessary to emphasize that each action generates an impact, which deserves to be highlighted. Thus, Mechi and Sanchez (2010), bring the following approach, conceptually well-defined on the impacts of mining and its implications:

> "Practically, all mining activity involves suppressing vegetation or preventing its regeneration. In many situations, the most fertile surface soil is also removed, and the remaining soils are exposed to erosion processes that can lead to siltation of the surrounding water bodies. The water quality of the rivers and reservoirs of the same basin, downstream of the project, can be impaired due to the turbidity caused by the fine sediments in suspension, as well as by the pollution caused by substances leached and carried or contained in the effluents of the mining areas, such as oils, grease, heavy metals. The latter can also reach groundwater. The hydrological regime of watercourses and aquifers can be altered when these resources are used in mining (hydraulic dismantling) and processing, in addition to causing the lowering of the water table. The lowering of river channels with the mining of their beds can cause the instability of their banks, causing the suppression of riparian forests, in addition to enabling the removal of bridges with eventual ruptures. Often, mining causes air pollution by particulates suspended by mining, processing and transport activities, or by gases emitted from burning fuel. Other impacts on the environment are

> associated with noise, acoustic overpressure and ground vibrations associated with the operation of equipment and explosions."

It is easily observed how much is the relationship of environmental impacts that can be caused by mining and when it occurs in a disorderly way, we have damage that can be irreversible.

However, planning is a crucial tool for the correct development of mining activity, so that it is compatible with the environmental practices widespread in the mining sector.

METHODOLOGY

As a methodology, the use of bibliographies available in physical and virtual means, use of Q.GIS 3.24.3 software for map development, as well as premises of the environmental project approved by the competent environmental agency and field observations, in compatibility with widely disseminated environmental and mining legislation.

FINAL CONSIDERATIONS

Pointing out the environmental impacts for the mining activity of gold miner, in view of the existing risks to the physical, biotic and socioeconomic environments, the surveillance of the operation itself, however much it has simplified and/or reduced operational processes, these must be observed, punctuated and punished, if by chance they represent a risk of different magnitude. For the gold mining object of this work, it can be observed that the impacts generated are mostly punctual and/or local, of low to medium magnitude, a good part of them are reversible, being distributed over periods considered as short and medium term.

This way, mining ventures must adopt procedures with broad support for the well-being of the affected environments, now degraded and to be recovered, adapting the regeneration of the habitat for future generations.

During the planning phase of the mining project, initially use is made of a mapping and diagnosis methodology widely disseminated in the technical field, as well as the compilation of data collected in the field, for the construction of the final form of the methods to be used. In the installation, there are impacts that are still considered small and/or medium-sized, since the generating factor is carried out by temporary and local procedures.

In fact, attention must be given to the operation of the gold mining, considering the mining method used, the size of the equipment, among other assumptions, the factors that can corroborate with severe and long-term environmental impacts, are basically identified in this stage of the enterprise.

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