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Influence of Socio-environmental Factors on Future Closure Plans

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Summary

This work deals with the influences of the main socio-environmental factors that involve the definition of future scenarios of mine closure plans. It focuses on strategic specificities that could provide leverage to increment human development and environmental succession after closure, including guidelines that may influence initial or preventive planning, or the ongoing performance of the project operations.

1 Introduction

Mining activity is understood as a temporary use of land and a similarly temporary socio-environmental factor. It requires closure plans that envision one or more future scenarios that are capable of adding potential to the transforming effects to this human activity under the various social, economic and environmental aspects within its area of influence.

This document presents a methodology that is applied to various mines in Brazil, where the influence of the main socio-environmental factors is evaluated in light of strategic specificities; the goal is to add new values to those applied traditionally within mine-closure engineering practices. The objective is to turn the mine closure into an opportunity for the rectification of the region's long-term development, by providing leverage to increment human development and environmental succession after closure. The focus on human development in this case is not only directed to the maximization of possibilities within the economic sector, but also includes fostering social peace within the locality, to establish reliable possibilities for various groups and ethnic denominations, all within a climate of social and cultural inclusion. Ensuring stability of the basic ecological processes to maintain the region's natural potential is also sought.

The sooner such opportunities are identified and the methodological analytical work is begun, the more likely the directives arising thereof will influence mine planning in a preventive manner, by permitting ongoing adjustments to the enterprise's operations.

Real closure plan cases that were implemented in various parts of Brazil, with participation by the authors, will be analyzed as part of the development of this work. To preserve corporate secrecy, the cases will be presented without identifying the mining companies, which are mostly international listed companies. These cases are presented below, with indications of the socio-environmental factors that influenced the future scenarios adopted, as well as their impact on the closure strategies.

2 Methodology

Concept

The methodological precepts adopted by mine-closure engineering throughout the world are based on the fundamental pillars of environmental, social and physical stability of the structures and processes that are installed and developed during the operations phase. A number of analytical processes have been developed to meet these objectives. These processes are becoming consolidated throughout the world, and generally require mining companies to make radical changes in relation to their closure plans.

The operation of a mine is based on its physical development and associated engineering, which to some extent coincides with closure engineering. The need for mathematically predictable parameters, the handling of internal problems that are often temporary but that demand immediate solutions on a daily basis, very often creates a culture that's more oriented to the mine's internal problems than to the socio-environmental demands within the local areas surrounding the mine. Accordingly, conventional mine-closure methods, which appear to be the determining factor for a good decommissioning from the mining engineering point of view, may come to only play an eliminating role. In other words, they may focus on minimizing liabilities or obligatory reformation, and this can expose stakeholders to the likelihood of being classed as dubious or inconsistent in relation to the granting of corporate licensing in the future.

The socio-environmental demands that are outside the context of mine operations are becoming more and more important, in spite of their high degree of subjectivity and complexity. These demands involve factors related to the future social order, to human development on all levels, to sustained use of natural resources in the surrounding environment, as well as environmental preservation. After closure, mining operations could become constructive elements of change useful to the regions where they are located, instead of causing harm to these regions.

The methodological concept that includes non-traditional variables for mine closures, including locally influential environmental and socio-economical processes, requires re-analysis of the indicators used in Closure-Plan engineering. Paradoxically, all the engineering variables, i.e. those that are technically established or that can be resolved with foolproof solutions, are a fundamental part of the decision process for future uses, but are not determinant factors, nor are they the only ones involved in the definition thereof. Furthermore, even though other variables are considered in the majority of projects, they require special attention because they are outside the company's control. Such variables include governmental policies or suitability of the general environmental because of past use of local or regional systems.

In order to overcome these problems, and prepare a Closure Plan that is adequate within the local socio-environmental context, it is important to start with the basic liabilities that are already known from analysis, recognized by a variety of authors, and based on good local and regional diagnoses.

The second step, backed by well-based diagnoses, consists of the identification of a variety of closure possibilities. The purpose is to determine future uses that can establish the basis for a new post-mining socio-environmental development process throughout the region, and consolidate the concept of mining as being the agent behind such development. Emphasis here is on how issues are dealt with and future uses, and not just on one variable that can be absorbed socially and environmentally leading to rapid stabilization and achieving immediate social and environmental potential.

Accordingly, a closure plan seen from this point of view is envisioned as much more than just an instrument to decommission liabilities; rather, it is a means to consolidate the concept of mining as the fomenting agent behind socio-environmental development in the region.

During the third step, the alternatives are submitted to an analysis of costs that will fall upon the mining company and to seek public and private sector partnerships for their development.

The fourth step involves the social validation of the model to be applied. In this step, the alternatives are presented to the stakeholders, in a simple format that is full of illustrations and easy to read. These options were previously selected based on criteria that include: technical feasibility, compatibility with researched data, eliminatory and multidisciplinary discussions relating to tendencies, the checking of political and administrative circumstances related to each of the alternatives, as well as future local demands and vocations.

From this point onwards, the evolution of the model for future use enters a self-sustaining phase, in which proposals and their means of development may be altered to continuously improve the model until the time the actual mine closure. Long-term maturation is a fundamental feature of this process, permitting the accompaniment of regional and local socio-environmental changes. In this way, the closure plan is understood to be put together mutually by the local people, the public authorities and the entrepreneur.

The multi-objective analysis techniques used in environmental projects are not a recent invention and other authors report on the use of many useful techniques. Among them, we can mention Tucci & Mendes, 2006, who prepared training programs for the study course on Integrated Environmental Evaluation of River Basins. In this course, they mention multi-objective and multi-criteria terminology, thus giving the course a synthetic viewpoint that enables students to see the dynamism needed by environmental evaluation techniques to achieve more representative results. This methodology deals perfectly with the concepts examined in this study, and has been applied to mining for some years by the authors, especially in relation to mine closures and post mine closure scenarios. The multi-objective analysis is applied to closure plans in the following manner.

Stages for applying Methodology

The methodology, as indicated before, consists of five work-steps. Each of the steps should involve the employment of a differentiated analysis approach, which involves the training and integrated action of the analysts involved.

The first step consists of a good multi-disciplinary diagnosis. This method uses the mapping of biotopes as one of its main tools for diagnosis in order to visualize the main vocations and problems encountered in the area surrounding the mine.

The biotope mapping method, brought from Germany, is also known as “Comprehensive Biotope Mapping.” It was adapted for use in Brazil during studies by the Alexander Brandt Foundation (Fundação Alexander Brandt) that culminated in a publication by Bedê, et al., in 1997. The method consists of actual mapping, with the help of research data obtained by a specifically trained multi-disciplinary team, the use of latest-generation satellite images and sophisticated geo-processing software. The resulting maps, which are easy to read, are intended for territorial planning and are useful for both the establishment of a Closure Plan as well as for regional Ecological-Economic Zoning; they are strongly corroborated by the Brazilian Government for future territorial ordinance. The cartographic parameters, determined from the biotope mapping process that includes environmental function and occupation structures, are generally presented on a scale of 1:10,000, thereby generating homogeneous planning units. Such maps can be extended to cover the entire territory within a municipality where the mine undergoing closure is located, thus helping to attract financial stimuli or prepare territorial development master plans.

The second step consists of checking the collected research data and the analysis of tendencies from a future-planning viewpoint. This phase is essentially multidisciplinary and requires a great deal of discussion. The analysis of tendencies seeks to achieve a more in-depth understanding of the relationships between the various criteria and scales of analysis. Tools for compartmentalizing the data are used to permit their consideration from a local, regional and global viewpoint, on a short-term, medium-term and long-term basis. Discussions to integrate the data are then held. Such discussions are only effective when done by highly trained personnel and require much discipline and methodological fidelity. When improperly performed, a risk exists of falling back into the same tendencies that foster the socio-environmental liabilities caused by mining activities or by internal company culture that is limited by production interests.

However, the analysis of tendencies is not limited to the data collected during the first step, but goes beyond this, and reviews the concepts on local uses and the real cultural possibilities of putting them into practice in the work-region. This is a “mixed bag” method, as stated by Johnson, 1998 and by Tucci & Mendes, 2006, since it consists of an analysis of the objective data as well as the inclusion of subjective variables together with the complete explanation of ideas.

The result of this step consists of the preliminary identification of scenarios for closure as well as future uses. The scenarios in turn are compartmentalized into three evaluation scales, thus simplifying the data structure, namely: the objective scenario, the traditional scenario and the work-scenario.

The objective scenario considers the possibility of implementing sustainable economic activities after the mine is closed, taking into account current legislation. This scenario examines whether to maintain the current mine structures for future activities or to discard them. New ways to use old facilities depend upon regional vocations. Such vocations, which are subject to the region’s social and economical dynamics, are likely to undergo ongoing adjustments during the operations of mining activity; and the sooner the better. In the case of the objective scenario, involving uses that are likely to be predominantly for human purposes, the possibility of new environmental impacts cannot be ignored.

On the other hand, the conservative scenario envisions the complete dismantling of the structures and all infrastructure improvements to the area and the subsequent restoration of the areas that were interfered with; it does not include future human use. The costs of environmental restoration within this variable are generally extremely high for the entrepreneur. Furthermore, the conservative scenario also relies on the important variable of time, through the process of natural succession, to give rise to actual ecosystems in the places that are artificially restored. These new ecosystems will not necessarily be identical to the primitive ecosystems. The natural processes that occur by succession can lead to an increase in regional biodiversity, depending on the characteristics of the implanted and invading vegetation. On the other hand, the opportunity to use the existing infrastructure is lost; and this in turn may lead to the opening of new areas for use by man within natural areas. The possibility of the implanted ecosystems failing and causing a loss to the region’s biodiversity must also be considered.

The third scenario, i.e. the work-scenario, is directed toward a more refined and orderly usage. This scenario indicates numerous variables for alternative future use, using a holistic view of the structural elements of the region's socio-environmental landscape. In this case, consideration is given to environmental education, knowledge-based industries or eco-tourism, namely, furthering social inclusion and caring for the natural structural resources. According to UNESCO, such variables are discussed with the focus on Man within the biosphere, but do present adaptations to local conditions based on previously collected data. In many instances, this scenario inspires alternatives that are quite unusual for the locality or region. This process is valid, and may lead to discovering the scenario that will be taken to full maturity.

The scenarios aid in ordering the data in the manner necessary to generate definitive alternatives. Bringing these steps together with the knowledge obtained leads to the desired solutions in the end.

The third step in the methodology, as explained previously, consists of cost evaluation and the search for solutions to offset costs. The limits of mining companies' liabilities in Brazil are based on the Federal Constitution, which establishes the obligatory environmental restoration of all areas affected by the mining companies. The basic costs tables are prepared with assistance from the mining company's personnel, who have the most experience in the company's internal business and the regional economies. The data are organized in tables, which identify the cost control centers. They also identify issues that are normally subject to little study by the mining company, namely items that affect the environment, such as after-closure maintenance and bio-ecological monitoring. The costs determined in these processes will be subject to continuous updating to establish either local-based or corporate-based provisions for the development of the Closure Plan.

On the other hand, the cost for the implementation or investment for new use after closure must also be estimated. The cost of implementing the new use may be relatively far lower depending on the degree the old mining installations are made use of. Low costs should not be the only objective in this case, considering that the projects for future use are likely to involve a degree of complexity. The new plans for future use may be developed by a public and private sector partnership or by attracting investors with a new idea. Most plans for future new use require environmental licensing, which can often be time-consuming and complex. However, the diversity of alternatives geared toward local vocations and the demands made by the local population tend to open doors because of the attraction generated and confidence in the solution.

The implementation of actions for future new uses, in the majority of cases, should be started while the mine is still in operation or even before it is put into operation.

The fourth step consists of submitting the proposals to the stakeholders for evaluation. The method presented here requires internal participation by those responsible for the mine closure. The shareholders, in this case, should be informed in detail about the procedure adopted and the associated costs, and should approve the solutions before implementation. Next, the matter is taken to the stakeholders for discussion, together with representatives of associations, government and the interested public at large.

The fourth step involves another hurdle to be overcome, especially regarding the environment's capacity to absorb the solutions being adopted. Here again, at this stage, the biotope mapping tool can be very useful. The field-team personnel will at this juncture come together with those involved in the mine closure and the designers who are planning the future use. This constructive dialogue will focus on local-scale parameters, as well as more complex issues such as: the project's contribution to the water quality index (WQI), human development index (HDI), the gross internal product (GIP) and the gross national product (GNP), from a standpoint of longevity and the project's actual relevance, especially considering the benefits to be obtained for the nearby residents.

When the maturation stage induced by the foregoing steps has been reached, the fifth step is begun. This step requires training and subjective capacity on the part of the professional personnel involved. Multi-disciplinary analysis, like the techniques described by Tucci & Mendes, 2006, are important at this time. From this point, on, evolution of the model for future use enters a self-sustaining phase in which there will certainly be changes made to the proposals elaborated during the previous steps, and means will be developed to further the proposals for future use toward realization. Thus, long-term maturation represents a factor of ongoing improvement for the Plan and its adaptation to the region's socio-environmental evolution.

3 Results

Some concise information on examples of real cases is presented below. These are projects developed by Brandt Meio Ambiente with the participation of the authors, in various parts of Brazil, where the principles presented previously were considered, in addition to conventional mine-closure engineering. The mining companies have not been named in order to preserve their corporate confidentiality.

Iron mine in Minas Gerais - I

Large mine at the end of its useful life, located in a municipality neighboring the state capital (Belo Horizonte, with a population of around 3 million).

Tendencies observed: On the one side, the mine borders the largest nature park in the capital city. On the other side is a larger area maintained by the company as a conservation unit. The surrounding area is undergoing rapid growth of high-income residences, commerce and services. The mine represents an important factor for the generation of jobs and tax revenue for the municipality.

A simplistic analysis would recommend the rehabilitation of the mine with the integration of the existing preservation areas. On the one hand, this would mean there would no longer be an economic agent maintaining the conservation unit, and this burden would fall to the government or municipality. The area that had previously created jobs and tax revenue would now be economically inactive. The demand for land for urban development in the region is growing, and this would have an affect on areas that had been left in a natural state.

A multi-objective, multi-criteria analysis of environmental, legal, urbanist and geotechnical restrictive factors was developed, using geo-processing and super-positioning of layer techniques. This analysis resulted in a mapping of potential uses (figure 1). Taking into account local use tendencies, and seeking to maintain or improve the levels of employment and the tax revenue base in the area, a scenario was envisioned in which part of the area would be occupied by commercial and residential projects. Some of the existing mine buildings would be used in these projects, especially for uses like an open mall museum. The mine headquarters building would also be part of this set. Part of the preservation area would be used in projects for hotels and ecological tourism. The set of projects would make the Conservation Unit self-sustaining.

The closure plan made it possible to ensure that mining planning and disposal of mine waste complied with the areas defined for urban occupation, within the scenario developed.

The project was discussed with stakeholders, including hearings open to the public, and is presently in the final stage of environmental licensing for implementation

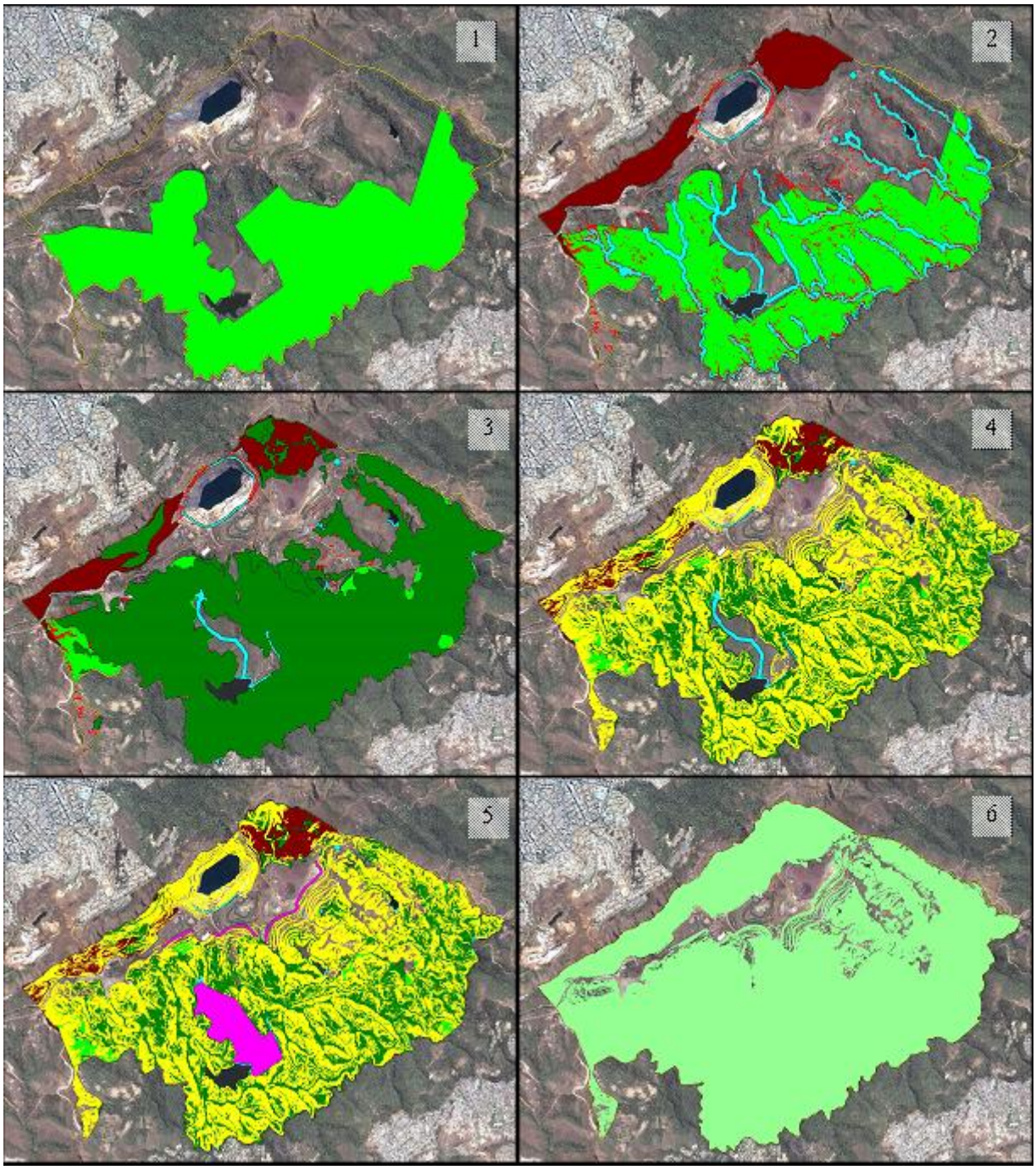

Figure 1 – Iron Mine in Minas Gerais: Multi-objective, multi-criteria analysis with use of geo-processing to define future uses : 1- Existing private Conservation Unit; 2 – Federal legal restrictions (permanent preservation areas), for watercourses and springs in blue, for mountaintops in brown and sharp slopes in red; 3 – Areas of high ecological importance (forests, *campos rupestres* and others); 4 – Municipal legal restrictions for urban occupation based on slope of land; 5 – Areas of geotechnical risk; 6 – Final zoning: Future use preservation and maintenance of physical stability in green, remaining area indicated for urban development.

Iron mine in Minas Gerais - II

This Mine is inactive because it is located in a preservation area of the state capital (Belo Horizonte), next to an urban park and close to an irregular shantytown.

Tendencies observed: inside area of preservation, the immediate tendency was to rehabilitate the mine for this use, and this was the initial requirement of the authorities. However, since this is private land, its transformation into a conservation unit could lead to the obligation to indemnify. In addition, the nearby urban park is used for shows and other activities, like ecotourism. Finally, the presence of the nearby shantytown means there is a potential for squatters to invade the area after its decommissioning.

The alternative adopted was to reactivate the mine to allow final conformation of the landscape for the development of an ecotourism project that would be integrated with the existing park, through a private developer, thus ensuring long-term sustainability of use and environmental preservation of the surrounding area.

Diamond mine in alluvial soil, in Minas Gerais

Mine located in the north of the state, at the end of its useful life, using dredging of alluvial soil that had been mined in the past by prospectors in a superficial manner. In spite of this past aggression, these alluvial soils are environmentally fragile areas that are protected by law. In this region, with a rural-based economy and low level of human development, another common activity is extensive cattle raising, also in alluvial soil areas. The original vegetation is *campo cerrado* in higher altitudes, and *mata ciliar* along river beds.

Tendencies observed: A closure plan was developed some 10 years ago that would replant the area for preservation purposes; however, the results achieved were not ideal, due to unauthorized premature use of replanted areas. This was the spontaneous use by the local population of the land for cattle raising and subsistence farming. Thus, it becomes clear that the scenario to be adopted must consider such use, which is deeply ingrained in the culture of the local population. Using bio-ecological monitoring over the years, an attempt was made to adapt rehabilitation methods to enable replanting to occur in way that would allow mixed use of the area. The final argument arising from the methodology presented here was indicated by the extreme social poverty in the region, and by the shifting cultivation, which includes the local population as a formative element of the landscape. Likewise, rehabilitation, or to be extract, replanting of the degraded areas, was guided by a mixed situation: in the areas farthest from the river, herbaceous surfaces were planted (grassy and leguminous plants), mixed with wooded areas or native trees, preferably in an inter-connected manner, and in the areas closer to the river, areas of wetland vegetation were planted, using native species. On the other hand, to avoid the risk of the imminent return of the prospectors to the entire area that was replanted by the mining company, holder of the mining license, copies of the mining plans were furnished to enable clear identification of areas with possible remaining minerals in the mined alluvial soil; in other words, areas that could possibly be used by prospectors. At first, the State environmental agency was against this proposal, but after the State Environmental Council and several other stakeholders and environmentally concerned regional and state NGOs became involved, the decision was made to approve the idea. At the present time, the mine is closed, and a large part of the replanted areas are already being used for this purpose, which is a tradition in the region.

Gravel Quarry in Rio de Janeiro

Quarry at the end of its useful life, located in an urban area of the city of Rio de Janeiro, bordered by a mixed-use area (commercial, industrial and residential), including a shantytown, close to a conservation unit with remnants of Atlantic forest.

Tendencies observed: Tension between shanty town growth, increase in demand for commercial land and preservation of the few remaining areas of Atlantic Forest still in existence in the city. Attempts to incorporate the area into the conservation unit were initially required by the authorities, who accepted a company proposal to create a lake in the area.

During an initial analysis, it was decided that the lake could become contaminated due to the lack of proper sewage treatment in the shantytown, and it could become a source of disease propagation. Without the lake, the replanted areas might be invaded by squatters from the shantytown. The quarry slopes could represent a risk to future inhabitants of the area.

The stakeholders in the surrounding commercial areas and shantytown dwellers were consulted, as were the municipal government and political leaders. The final scenario chosen was to adopt a stable central area, which would be transformed into a commercial center, and an area of protection between the center and the shantytown, where the quarry walls are located, preserving nature, which would be maintained by the surrounding commercial usage.

The mining plan was altered to ensure final conformation without the creation of a lake, in such a way as to enable the established future uses.

Limestone Quarry for cement production, Minas Gerais State

Quarry located in the metropolitan region of the capital city of the state of Minas Gerais, in an area that is partly urban, partly rural. The region has many caves, archeological sites and endemic native vegetation. For this reason, a conservation unit was created that includes the mine, but which allows its operation. Within this context, during an initial analysis, reclamation of the area within the context of environmental preservation would be the evident choice; that is, returning the area to nature.

The tendency analysis showed that the region has been undergoing urbanization, with a low-income population. Surveys taken of local stakeholders demonstrated the community's expectation to assume this space at the end of the mine's useful life, in the form of an urban/ecological park.

The closure plan prepared in accordance with these ideas established mining planning conditions that would create a "final pit" in which leisure and sport structures would be placed, with programs designed to foster social inclusion of the needy populations. Part of the area, which has caves with endemic troglobius species, was set aside for preservation and excluded from the mining plan. This area would be integrated into the park in the future, as an area for environmental education programs.

Limestone Quarry for cement production, São Paulo State

This quarry is located inside the Federal Conservation Unit created to protect the Atlantic Forest, decades after the mine was developed.

Although it was in existence before the Conservation Unit, the company was under pressure from the federal environmental agency, and from NGOs and Stakeholders to cease activities. At first, an unsuccessful attempt was made to reach an agreement that would allow operations to continue. The company decided to close the mine and the cement production unit, which led to the layoff of all employees. Attention was then turned to discussing the future use of the area, which at first, was to return the area to its original natural condition.

After an analysis of the tendencies, it became clear that there was potential for ecotourism activities, and a possibility to use part of the structures of the mine as special niches for animal life, thus reducing the cost of demolition.

Nickel mine in the state of Pará

This is a large mine that borders indigenous land in the Amazon region. The development area of the mine was totally deforested due to agricultural incursion into the forest by rural settlements that were later abandoned. A tendency towards use of the land for pasture has been observed, and towards a deterioration of the watershed, right upstream from the indigenous lands. This was a cause of great concern to the indigenous community, given the importance of rivers as a source of food and water.

In spite of these factors, a Closure Plan was developed that established the replanting of water sources and along riverbeds, with the participation of the indigenous community in the collection and supply of seed, available on their lands. This community was also invited to participate in activities of seedlings and replanting.. Species of special interest to this community were also considered for food and raw materials for traditional uses.

Copper mine in the state of Pará

This is a large mine with some 1,000 employees, close to a city with approximately 5,000 inhabitants, isolated from larger cities, in the Amazon region. The mine development area, neighboring a conservation unit, was totally deforested due to incursion for agriculture, by rural settlements that were later abandoned.

Considering the neighboring areas, with the conservation unit and the state of initial degradation of the area, the need for a Closure Plan that focused on replanting and post-closure integration of the mine area into the context of environmental preservation became clear. For this purpose, the development of a forest enrichment program was designed at that stage of project operation, with integration of the areas affected by the mine, as these became de-commissioned.

However, this solution alone would not meet the definition of socio-environmental sustainability. Analyzing the tendencies, at the start of mine planning, it became clear that the city would undergo strong initial growth, but that it would become very dependant on the mine, which was calculated to have a useful life of approximately 25 years.

Therefore, a program of economic diversification and sustainable development for that community was included in the Closure Plan. This program was to be implemented concomitantly with the start of mine operations. The program was widely discussed with stakeholders and at public meetings, and was implemented wit intense community participation.

Bauxite and Iron mines in the state of Pará

These are two large mines located in different areas of the state of Pará, in the Amazon region; both are located in federal conservation units called “National Forests”.

In both cases, due to their isolated location, residential complexes were built for personnel and their families. Considering the size of the projects, the municipalities and region developed a strong economic dependence on them

Since they are located in Conservation Units, the basic principle that had been guiding the rehabilitation was the return to a natural state of the forest; this was corroborated by the requirements of the federal environmental agency.

On the other hand, the communities involved expected sustainability after the mines were exhausted, even if it were over the long term.

After analyzing the situation, an attempt was made to find the means to maintain economic activity after the closure of these mines. A detailed analysis of Federal Law 9985/2000 showed that the objective of National Forests is the sustainable multiple use of forest resources and scientific research, with emphasis on methods for sustainable exploration of native forests.

Based on this objective, a review of the recovery criteria for mined areas was proposed, and Closure Plans were then developed taking into account the planting of native species with a high economic value, whether for wood, for nuts and fruits or for medicinal herbs. The idea is to favor mined areas for the development of forest resources so that the rest of the National Forest is less impacted by this development.

Based on this concept, other relevant aspects permeate the Closure Plan, like for example, the use of industrial mine areas (warehouses and shops) for the industrialization of the forest products, and also to use the residential areas for the future population involved in forest development.

Additionally, the presence of support structures like hotels and airports capable of handling commercial flights allows the introduction of future uses like ecological tourism and research centers.

As a result, the Closure Plan proposed meant a large reduction in demolition and industrial disassembly costs, an important modification in replanting methods, and principally, a new vision of sustainability of mining as a catalyst of a region's sustainable development process.

4 Conclusions

Mining is an activity that makes temporary use of the land and that has a strong potential of engendering negative or positive changes to the regions where it is carried out.

By using this potential in an adequate manner, mining can be an important factor in the raising of both social and environmental development standards within the region, even after the mine has been worked out.

Accordingly, Closure Plans must not be limited to mine closure-engineering concepts but should go much further, and include regional socio-environmental factors to aid the definition of future scenarios. Multi-criteria and multi-functional methodology, adopted in several mines, in a wide variety of biomes, in rural and urban areas of Brazil, have shown that the subjectivity of many of the questions raised by the social and environmental reality are not necessarily a factor leading to insecurity in the preparation of Closure Plans. Rather, if properly carried out, this can lead to better solutions than those produced by conventional methods.

When the enterprise guarantees the regional post-mine development, mining as an activity becomes a transitory leverage mechanism whereby the communities involved can be taken to a new, sustainable and long-term degree of development.

This is in fact one of the key elements for the establishment of sustainable development in the mining field: by considering it as an element of leverage to regional development, in a manner whereby an elevation of regional socio-economical standards will exist before and after the mine, providing that stability is guaranteed, or if possible, an improvement in environmental quality is guaranteed.

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