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THE IMPACT OF MINING ON THE ENVIRONMENT

Problems and Solutions



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for these industries to upgrade and modify their production methods towards minimizing the pricing charges for environmental damage. As a result, the pricing of the environment will marginally affect the price of the products of non-fuel mineral industries.

CONCLUSIONS

Throughout the paper it has been observed that pricing, the best found economic option for environment control, has also some severe limitations. First, price fixation for environment is a difficult task because it has to encompass all possible damages that may happen in contemporary and future times which are rarely discernible. Second, developers may develop a habit of paying the sum requested instead of making attempts to innovate abatement technologies themselves or to rethink the viability of existing damage practices as long as the pricing for environmental damage is low. Third, every polluter industry should have perfect information about environment control and related costs. Otherwise misconception of control costs and difficulties will be highlighted.

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TABLE 1: Summary of impacts of mining on agricultural land

Nature of impact	Opencast	Deep mine
Land loss (permanent) to site installations	**	*
Land loss (temporary) to excavation	**	
Land loss (temporary) to tips/soil stacks	*	**
Damage to soils during handling and storage	*/**	*/**
Subsidence - effects on land		**
Subsidence - effects on farm building		**
Settlement	*	
Water pollution and hydrological impacts	*/**	*/**
Noise	*/**	
Dust and air pollution	*/**	*
Severance	*	*
Socio-economic impacts	*	*/**

* Minor impact. ** Major impact.

[Adopted from "P.H. Selman" : 'Coal Mining and Agriculture: A study in Environment Impact Assessment', *Journal of Environment Management* (1986) Vol. 22, pp. 157-186].

RECLAMATION OF MINED LANDS IN BRAZIL



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ABSTRACT.

Protection of the environment is guaranteed by the Brazilian Constitution of 1988 and is implemented through numerous laws and regulations, which are described. Organised mines, run by companies, generally observe the legal requirements but the unorganised 'garimpos' not only exploit their workers but also cause serious environmental damage. The reclamation of mine sites and exploration scars, environmental protection during extraction, contouring, new land use, revegetation, monitoring, water reclamation and the aftercare of abandoned mines are discussed, and the reclamation of some areas affected by agriculture and industry in Brazil are described.

1. LEGISLATION.

Brazil is one of the few countries which include the protection of the environment in its Constitution (Brazil, 1988).

The property of mineral resources is defined in Art. 176: "The mineral deposits, mined or not ... are properties of the Union, the property of the product of mining being assured to the concessionaire"; Par. 1: "The exploration and mining of mineral resources...only can be made by authorization or concession of the Union, for the national interest, by the Brazilians or nationally owned Brazilian companies. "

The environmental licensing system for mining in Brazil is regulated by the constitutional Art. 225, Par. 1: "...is duty of the Public Power...III) To demand a previous Environmental Impact Assessment in every activity potentially damaging to the environment ..." This licensing system existed already before the 1988 Constitution, regulated by previous laws and resolutions, the most important being the Federal Law 6938 (8/31/1981), which established the National Policy for the Environment, and Resolution No. 1 (1/26/1986), of the National Council for the Environment, which established the format for Environmental Impact Studies (EIS). An EIS is required from all mining activities, regardless of size, location and disposal system. Resolutions 9 and 10 of the same Council (12/6/1990) established the activities and documents needed for Environmental Licences for mining (Previous, Installation and Operation), including the demand for a Reclamation Plan for the Installation License and a detailed Reclamation Project for the Operation license.

Reclamation of mining-affected areas is also considered by the Constitution. In Art. 225, Par.2: "All those who exploit mineral resources are required to reclaim the degraded environment..." This article was regulated by the Federal Decree No. 97632 (4/10/89), which established as the objective of reclamation "to

return the degraded site to use, according to a preestablished soil use plan, aiming at obtaining the stability of the environment”

Some differences in legislation between Brazil and some developed countries are evident in this short review

- a.) the ownership by the Union of all mineral property (allowing the miner the property of the production after it is mined);
- b.) an EIS is required for all mines;
- c.) Federal legislation defines very loosely the type of reclamation required;
- d.) no Federal provision is made for reclamation bonds (these are being established by States and Municipalities);
- e.) no provision is made for abandoned mined lands.
- f.) mining activities were “awarded” special treatment under Federal law, although the main responsibility for the land degradation in Brazil, considering the area involved, is the deforestation made for cattle ranching and farming in Amazonia.

The latter deforestation was made with Government incentives: tax cuts and land donation for the rich, loans and bad infrastructure for the poor and middle class in Rondonia, in projects undertaken in part with financial assistance from the World Bank. Ranching and farming made without research or use of local knowledge, by greedy companies or displaced farmers from the South, resulted in appalling land degradation in half a million square kilometers of former “green hell” forest, now becoming a “red desert”. New projects trying to catch more international money promise to use scientific techniques to reclaim this degraded land. For Brazilians versed in this kind of thing, it is easy to see that these projects will be another way to give money to the rich. They will use this money, as on other occasions, to invest in the financial market or to buy the smaller farms from people who have no access to easy governmental money.

2. MINING CONDITIONS IN BRAZIL

We need to separate Brazilian mining into two kinds: unorganized mining (garimpo) and organized mining

Garimpos: The conditions in garimpos can be summarized as: over exploitation of workers; no payment of taxes; destruction of mineral reserves; environmental degradation, with land, water and air pollution, crime.

Organized Mining: Organized metal and industrial minerals mine are run by companies, with growing environmental control. Pits and quarries, producing sand and gravel, generally near urban areas, also pay taxes, build an infrastructure that is used also for other development activities, pay wages and give social assistance to workers. Only for this organized mining is there some reclamation activity in Brazil. Even for the organized mining, only recently environmental control began. Only in the seventies did pollution control become mandatory, and only after 1986 was the requirement for environmental impact studies enforced. Beginning with the larger companies, reclamation activities are now a normal part of mining in Brazil. There has been a deep change in public attitudes to pollution and environmental degradation for all economic activities, with special emphasis on mining. Federal Law No. 7347 (7/24/1985), establishing the Public Civil Lawsuit, was only applied in a great number of cases after 1988, and is generally applied against mining pollution and need for reclamation. By this law, public attorneys are required to help associations dedicated

to environmental protection in opening litigation against polluters, without expenses for the associations if the cases are well grounded. These lawsuits and political pressures on local governments resulted in the closure of a number of mines and a change in environmental control and reclamation in all the more populated states in Brazil.

3. RECLAMATION ACTIVITIES IN BRAZIL.

3.1. Reclamation Of Mined Areas.

Griffith (1980) presented a compilation of techniques potentially applicable to Brazilian areas, in a pioneer effort at a time when only some companies were beginning reclamation plans in the country. The same author (Griffith, 1989) described the reclamation activities of the larger mining companies in Brazil. Fornazari et al. (1988) summarized the steps to be taken in sand producing areas in Sao Paulo for successful reclamation. These observations were applied in a series of reclamation plans (one) is described in Macedo et al., 1991). The Brazilian Association for Technical Norms (ABNT) is presently studying proposals of new norms for erosion control, with direct application in mining control and reclamation (Macedo, 1990a, 1990b). Macedo (1991a) critically analyzed EIS and reclamation plans in Sao Paulo, while Macedo (1991b) also summarized reclamation principals for students. IBAMA (1990) has produced a manual for reclamation of mined land, while IBRAM (1992) summarized some reclamation techniques and presented some Brazilian examples of sound environmental control and reclamation in mining.

Briefly, the main characteristics of the reclamation of mined areas in Brazil are as follows.

3.1.1. Exploration scars

Only now is the need to cover all exploration excavations being enforced. If there is some production during exploration, a previous permit is needed, including reclamation planning.

3.1.2. Extraction

In view of the fact that, in the humid tropical climate prevailing in almost the whole of Brazil, the effects of weathering and erosion are very large, the use of reclamation techniques simultaneously with mining was made mandatory. This is now being applied by all the larger mines.

3.1.3. Reclamation plans

All new mining plans and EIS should include reclamation activities. Older mines are demanded to make reclamation plans. An effort is being made to give some training in environmental control and reclamation to all mining engineers. The legal obligation to use external consultants to make EIS is an additional obstacle to involving mining personnel in environmental control and reclamation. In some cases, the EIS and reclamation plans are considered only bureaucratic obligations, not being used to guide mining operations

3.1.4. Contouring

There is no obligation to maintain approximate original contours. The land can be conformed to be prepared for new uses.

3.1.5. New land use

Usually the land is given an economic use agriculture and urban building are most common. Sanitary landfills are proposed for some mine scars, the success of this proposal depending on control of groundwater

pollution. There are some examples of recreational use, with old mine scars transformed into lakes and gardens. Some good examples are:

- (1) the Jundu Mine (industrial sand), used for offices, sports fields, gardens and a restaurant for employees on a carefully reclaimed area; and
- (2) the University of Sao Paulo, which used for a construction campaign in the 1960's alluvial sand from a pit designed to become a lake, used since then for boat races.

3.1.6. Revegetation

Emphasis is given by governmental regulations to quick contouring and revegetation to avoid erosion and silting. In small areas, gardening techniques are applied, using a great amount of human labour, very cheap in Brazil. In larger areas, agricultural machines and techniques are applied. There is no special machinery for reclamation activities, except some developed by mines, such as spiked iron balls to plough steep slopes. Hydroplanting and manual fixing of grass plates are used to revegetate these slopes. Only in a few cases nylon nets or other geotextiles are used.

Most areas are revegetated using non-native species. There is some progress since the evaluation by Barth (1989), as can be seen in IBRAM (1992) and by visiting the mines. Some effort is being made by governmental (Kageiama et al, 1986, 1988) and private organizations (MNR, promotional video and IBRAM, 1992, and personal communications of technical personnel of ALCOA, Serrana, Brumadinho) to develop techniques to quicken natural successions to use for revegetation with natural species. There are difficulties for this approach. Little research exists, and there are problems with continuity of work in research and experimental reclamation. One of these problems was experienced by the author of this paper in Rondonia. After making a preliminary plan and hiring some local technical staff (agronomist, biologist, geologist, mining engineer, sociologist) for an extensive EIS and reclamation plan using Amazonian native species, for 10,000 hectares of land disturbed by tin mining, the project was discontinued when the tin price fell to half the production cost, due to an invasion of garimpeiros to the largest tin deposit of the world. They destroyed the deposit, mining only the highest grade portions, and had a profit for not paying anything to the government and employees, and smuggling the production through Bolivia. All organized mining in Rondonia went out of business, and with them all environmental control and reclamation groups working for them. Recently, a consortium of companies took over the mine, and better environmental control will be done in the future.

We can be more optimistic examining basic research being done on native species propagation. Considering the number and quality of the new projects, described in the Second National Congress of Native Species (SMA, 1992), this research will certainly result in more and better use of native species for revegetation.

3.1.7. Control and monitoring

Only the larger mines have a control and monitoring program in effect. The small mines are controlled by state and federal employees, in small number, and in some cases lacking proper training for their duties. Few resources make difficult the regular visits that are needed for a successful monitoring programme.

3.1.8. Water reclamation

Surface and groundwater are reclaimed in the larger mines. The best examples of water reclamation is the niobium mine of CBBM and the phosphate mines in Araxa (Minas Gerais). A consortium was formed by companies and federal and state governments to reclaim hot water springs polluted by barium. Retaining walls, clean water injection, strict control of infiltration in mined areas, piles and ponds resulted in cleaning

the hot spring water.

3.1.9. Abandoned mines

Due to the nonexistence of reclamation bonds, several mined areas have been abandoned unreclaimed after exhaustion, the companies filing for bankruptcy after making some clever and unscrupulous people rich. Only in urban centres have some abandoned mined areas been reclaimed by government or private organizations to use the land for construction.

3.2. Reclamation Of Areas Disturbed By Other Activities.

Ab'Saber (1989) described an ambitious plan to reclaim areas disturbed by agriculture or ranching, reforesting millions of square kilometers: the "FLORAM PROJECT". Although undertaken by very experienced people, the project is still too general to be evaluated on a technical basis.

Marino (1990) (the only paper in English in this series) described efforts to revegetate the slopes of the coastal range in southern Brazil (Serra do Mar), affected by industrial pollution of the petrochemical and steel complex of Cubatao. A well coordinated effort between State and private organizations allowed research and application to reforest thousands of hectares, using native species. An interesting technique applied in this case was the scattering by helicopter of gelatin pellets containing germinating seed of native species in areas with difficult access.

4. CONCLUSIONS.

Despite a strong legislative framework and the availability of environmental protection and reclamation measures, environmental protection is not always applied at mine sites in Brazil and extensive environmental damage can result. Of particular concern are the uncontrolled 'garimpos' which operate outside the law and cause major environmental destruction. The successful implementation of environmental protection measures depends not only upon the presence of laws and regulations but also upon the political will to implement those laws effectively. Some good examples show that successful reclamation can be achieved, that mining need not leave permanent scars on the landscape, and that mine sites can be returned to productive use or a near-natural condition.

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Impact of Mining on The Environment, 1994

THE IMPACT OF MINING ON THE ENVIRONMENT: NECESSARY EVIL OR MERELY A CALAMITY?

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ABSTRACT.

Mankind has always used mineral assets and has become increasingly dependent upon them during his cultural, scientific and technological evolution. If it is true that mining is one of the ways in which man interferes with the environment by disfiguring, degrading and polluting it, it is no less true that mining is one of the ways to supply the needs indispensable to modern societies. For an unpredictable period of time to come, mankind will have to live with the consumption of metallic and non-metallic mineral and energy resources. It is impossible to sustain the unsustainable, to renew the non-renewable, but it is perfectly possible to make rationally executed mining compatible with the recovery and/or restoration of the environment. In developing countries like Brazil, politicians and business people, poorly-informed about environmental problems, usually try, without success, to solve the problems far away from metropolitan areas, for example in the Amazon region, forgetting about those problems closer to home which make life intolerable in the great urban centres like Rio de Janeiro, São Paulo and Belo Horizonte.

INTRODUCTION.

Marked by the Computer Age and the Age of New Materials, the 1980's and 90's may also be characterized as the age in which mankind began to awaken to the problems related to ecology, to the environment, and to air, water, soil and sub-soil pollution. Many technical and scientific publications have treated the environment and pollution with the intention of stimulating not only reflections but also actions upon these issues. Meetings, conferences, symposia, seminars, workshops and even popular demonstrations dealing with these issues have become increasingly frequent, making valid attempts to diminish or solve the problems that mankind must face in order to sustain a balance in the condition of his habitat.

Environmental problems as well as atmospheric and water pollution have been present ever since the earth came into being, as this planet has been continuously and actively subject to natural processes modifying its relief, climate, structure, drainage, soils and atmosphere, along with the form and disposition of its continental masses, islands and coastlines. As a consequence of these constant alterations, along with the evolutionary process that has acted upon living beings, the environment of the past was quite different from that of the present.