Jr. of Industrial Pollution Control 20(1) (2004) pp. 17-24

COST BENEFIT ANALYSIS AND ITS ENVIRONMENTAL IMPACT IN MINING

RAJESH RAI AND T.N.SINGH

Department of Mining Engineering, Institute of Technology
B.H.U., VARANASI- 221 005 (India)

Key words : Mining, costs and benefits, pollution control.

ABSTRACT

The importance of environment in our daily life is well known. It adversely affects not only human lives but also to the coming generation. The environment has mainly two important components. First is physical and second is socio-economic component. Mining is the most hazardous activity to the environment which affects the human beings, land, air, water regime, climatic condition, ecology, aesthetic etc. On the other hand, one can't stop mining because there is numerous benefits to our society. Hence, this activity if properly designed by applying various environmental techniques and following the legislation can reduce this danger up to a great extent. However, this involves time as well as money. The cost benefit analysis is a basic tool to understand the mining and environment phenomenon, it provide suitable development and stability in term of economy in . The cost benefit analysis is widely used in many technological fields. The present paper mainly deals with the methodology of cost benefit analysis which is dependent on the types of project.

INTRODUCTION

Mining is one of the primary and oldest industries & contributes to significantly towards growth rate of any country. However, mining project require huge resource, both financial & technical. There is globalization, privatization and any company venture into the area only if it is clear about the cost and benefit of the project.

had to compulsorily bear the cost of various degradation and pollution, directly or indirectly (Dasgupta & Perace 1978). Direct costs are those which the society bears on its own account and the indirect costs are those which the society pays through various taxes, etc. The cost of the mine environment is ultimately borne by consumers through increase prices or taxes. Yet failure to prevent mine environmental contamination could cost people even more

Although most of the industrial and developmental activities are supposed to have built in pollution control and mitigative measures, the society had to compulsorily bear the cost of various degradation and pollution, directly or indirectly (Dasgupta & Perace 1978). Direct costs are those which the society bears on its own account and the indirect costs are those which the society pays through various taxes, etc. The cost of the mine environment is ultimately borne by consumers through increase prices or taxes. Yet failure to prevent mine environmental contamination could cost people even more in health, physical, and mine environmental damage.

In recent years, there has been a remarkable growth of interest in environmental issues in sustainability and the management of development in harmony with the environment. Associated with this growth of interest has been the introduction of National and International Lagislations . All the above consideration require a comprehensive and rigorous, cost benefit analysis of decision of whether to under taken an actively or not.

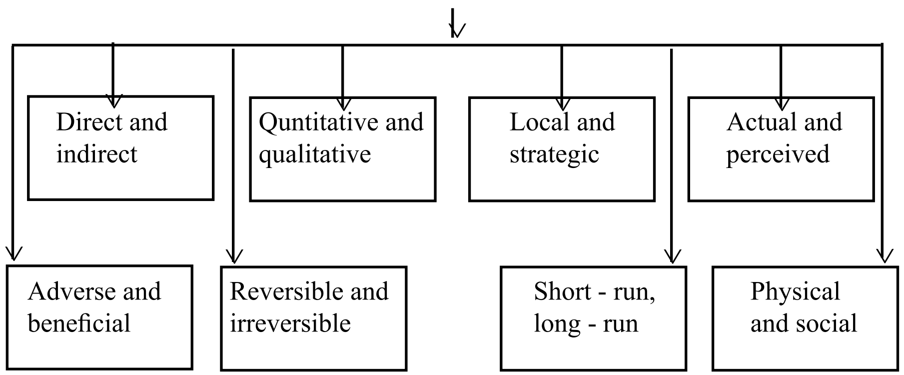
Mine environmental acitivity

The mine environment can be structured in several ways- include components, scale, space and time. A narrow definition of mine environmental component would focus primarily on all media susceptible to mine pollution, including air, water, soil; flora and fauna, and human being; landscape, urban and rural conservation and the built heritage (DOE 1991).

The nature of impact

The mine environmental impact of a project area are changes in environmental parameters, in space and time, compared with its status prior to mining (John 1988). All the relevant parameter like: air quality, noise levels, local unemployment, crime, degradation etc has to be assessed prior to mining in feasibility report .

Types of impacts



Mine environmental component

Physical mine environment

Air and atmosphere	Air Quality
Water resource & water bodies	Water quality and quantity
Soil and Geology	Classification, risk, evolution
Flora and fauna	Birds, mammals, fish, etc, Aquatic and terrestrial Vegetation, bio-diversity
Human being	Physical and mental health status & well being
Landscape	Characteristics and quality of Morphological Changes
Cultural heritage	Conservation, rain fall, wind, heat flow etc.
Climate	Temperature, rain fall, wind, heat flow etc.
Energy	Light, noise, vibration etc.

Social- economic environment

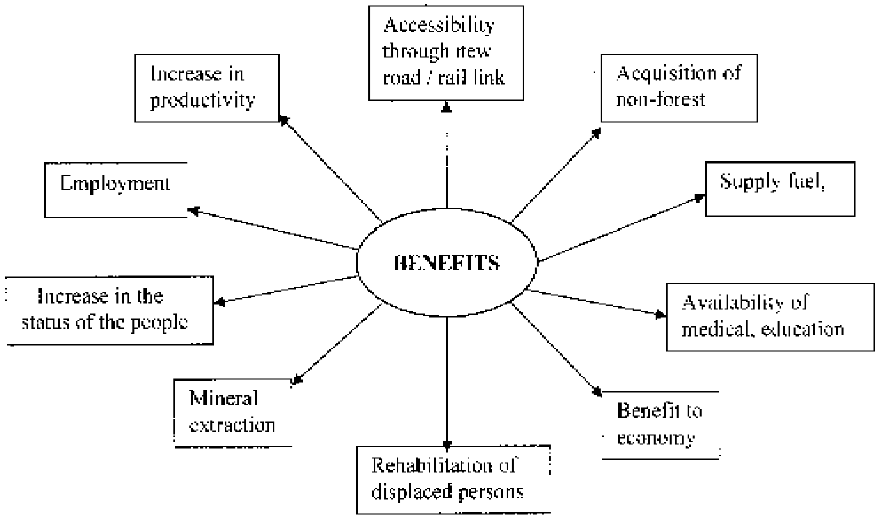
Economic base-direct	Direct employment; labor market charcter; local/ Non local trends
Economic base-indirect	Non-basic/services employment; labor supply and Demand.
Demography	Population and structure trends
Housing	Supply and demand
Local services	Supply and demand of services; health, education, Police etc.
Socio-cultural	Lifestyles/ quality of life; social problem, Community stress and conflict, etc.

Cost benefit analysis (CBA)

It is essential to have a cost benefit impact analysis of a project. It lies in a range of project and plan appraisal methods that seek to apply monetary value to cost and benefits. It is more compressive in scope. It takes long view of the project (further as well as nearer future) and a wide view (in the sense of allowing for side effect). It is the comparison of any positive or negative changes in the value of mine environment amenities with costs (or benefits) of implementing the proposed change.

It is based in welfare, economics and seeks to include all the relevant cost and benefits to evaluate the net social benefits of a project. In proposal for de-reservation or diversion of forest use, it is essential that ecological and environmental losses and sufferance cause to the people, who are displaced are weighted against the economic and social gain. It contains simply the work necessary to present a decision taken with the information, which require in order to make a decision.

In other sense, it goes further and includes the task of the decision. In some case the costs-benefits analysis may regard some alternative even though he or she is not the decision taker, because his/her ability to predict



that the decision taker himself would cause rejection. Cost benefit analysis can be done in two stages. First prior to mining, the project would be analyse based on through cost and benefit and later post mining, to analyse the cost of environmental control.

Benefits of CBA

General Application of Costs-Benefits Analysis

Benefits of CBA

In disease control program.

General Application of Costs-Benefits Analysis

1. In disease control program,
2. In a larger health care system,
3. In evaluating alternative planning policy,
4. In optimum allocation of resource to R & D project,
5. In water resource planning,
6. In transportation,
7. In airport location,
8. In calculation of environmental impact of a proposed mining activity.

Methodology

There are various methodology to calculate the CBA

- Project definition
- Identification
- Enumeration of cost and benefits
- Evaluation of cost and benefits
- Discounting and presentation of result

Cost - benefit analysis typically involves reducing an innumerable of complex physical and social-economic variable to simple, quantifiable categories of costs and benefits. Calculate the value in current monetary term of future cost and benefits. Benefits are commonly defined by a person's willingness to

pay for profit outouts. Costs are often defined, as the monetary expenditure required for using resource in one manner rather than another.

Future annual flows of cost and benefits are usually discounted to a net present value in a range of interest rate may be used to show the sensitivity of the analysis to change. If the net social benefit minus cost is positive than there may be presumption in favour of a project (Freeman, 1973).

The presentation of result should distinguish between tangible and intangible cost and benefits, as relevant, allowing the decision-maker to consider the trade - off involve in the choice of one option or the other.

Presentation of Result

Tangible

Category	Alternative 1 in Rs.	Alternative 2 in Rs.
Annual benefits	B1	b1
	B2	b2
	B3	b3
Total annual benefit	(B1+B2+B3)	(b1+b2+b3)
Annual cost	C1	c1
	C2	c2
	C3	c3
Total annual cost	(C1+C2+C3)	(c1+c2+c3)

Net discounted present value of benefits & cost over 'n' year of alternative 1 at X %* Rs. D

Intangible

Intangible, include costs	Alternative 1 in Rs.	Alternative 2 in Rs.
	I1	i1
	I2	i2
	I3	i3
Intangible summation Undiscounted	I1+I2+I3	i1+i2+i3+i4

* Net disounted present value of benefits and cost over 'n' year at X%D =

$$\sum\left[\frac{B_1}{(1+X)^1}+\frac{B_1}{(1+X)^2}+\dots+\frac{B_1}{(1+X)^n}+\frac{B_2}{(1+X)^1}+\dots+\frac{B_2}{(1+X)^n}+\frac{B_3}{(1+X)^1}+\dots+\frac{B_3}{(1+X)^n}\right]$$

$$\sum\left[\frac{C_1}{(1+X)^1}+\frac{C_1}{(1+X)^2}+\dots+\frac{C_1}{(1+X)^n}+\frac{C_2}{(1+X)^1}+\dots+\frac{C_2}{(1+X)^n}+\frac{C_3}{(1+X)^1}+\dots+\frac{C_3}{(1+X)^n}\right]$$

ANALYSIS OF MINE POLLUTION CONTROL

The mine environmental pollution control is tool to manage to minimize the cost of mineral. It involves appropriate time and space to dispose of waste. There are various techniques used to increase the ability of the natural mine environment and to accept wastes and mine pollution without significant damage to social or ecological systems. Finally, residuals can be treated biological, chemically, and physically to concentrate, contain, isolate, detoxify or recycle them with minimum exposure to social, and mine environmental and ecological systems.

The optimum level of mine pollution control

One of the most important concepts in residual management is costs and benefits involvement in term of mine environmental pollution and waste minimization. Proper decision making involves a comparison of total project cost and benefit in order to choose an alternative that returns the appropriate benefit for the least cost, thereby allocating resources in the most efficient way (Royston 1979). The ultimate goal of residual management is to provide the level of protection necessary for the prevention of significant damage to ecological and social system at a minimum cost.

The relationship between cost and benefit of investments in residuals control is showed in Fig 1(the model of optimum levels of mine pollution control). The model indicates that as the levels of mine pollution increases, damage to the mine environment also increases. That is, the mine environment with little or on ecological socio-economic damage can tolerate a small amount of mine pollution because development cannot took place free of cost. However, as sharply after the system's capacity to assimilate mine pollution has been exceeded.

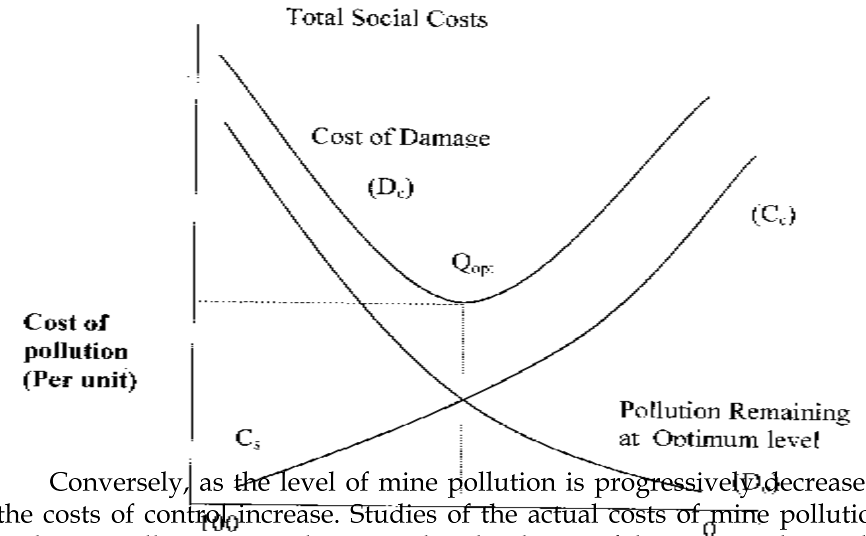


Fig. 1 Percent of pollution remaining

Conversely, as the level of mine pollution is progressively decreased, the costs of control increase. Studies of the actual costs of mine pollution and mine pollution control suggest that the shapes of the curve in the model accurately represent the real world situation (Page and Berejohn, 1974). The

model indicates that, initially, considerable mine pollution can be eliminate at very low costs. However, in the push to achieve a progressive cleaner mine environment, costs rise disproportionately fast and benefits begins to levels off. Eventually, by adding the costs of mine pollution damage and control for each levels of mine pollution, the total costs of mine pollution to society are obtained. At extremely high and low level of contamination, the total social cost area high. However, at the point of optimum level of mine pollution (Q_{opt}), total social costs are minimized. The benefits of further reduction in the level of mine pollution are far weighted by the costs of control. Also levels of damages that area considerably greater than the optimum result in damages that area considerably greater than the costs of cleaning up.

The optimum levels of mine pollution control are useful indicator that effects the inefficient mine pollution control strategies and inaccurate estimate of mine pollution damages. Inefficient mine pollution controls would increase the control costs from line Cs (cost of starting) to line Cc (cost of control). The real damage curve would move from line Dc (cost of damage) to line Do (pollution remaining optimum level) which indicates further mine pollution. Investments are warranted to incorporate all damage costs results in an under investment in mine pollution controls and on overly mine polluted mine environment. The model assumes perfect knowledge of the costs of damages and controls and that damage and cost of controls are proportionate to the level of mine pollution. The weight of cost and benefit is a regular, although implicit or hidden, occurrence in agency decision- making processes. For instance, decisions to relax automatic emission standards involve a balancing of control costs with human health impact and costs.

CONCLUSION

The cost benefit analysis is a useful tool to predict the damage caused by the mining in term of its impact of cost which can help management to take precautionary measure to minimize the damage and reduce the cost.

It will heavily reduce the costs of health service, improved productivity, minimize the losses of crops and forests, improve the life system etc. It reduce s protection cost of buildings attested by pollutant, minimize expenditure on imports of energy and raw materials.

Mine environmental quality controls can offer more suitable benefits. Mine Environmental controls reduce the need for defensive products, such as medical care health and life insurance burglar alarms and soon by improving the health and living condition of the general populate.

The economic, health, physical, and social benefits of mine environmental quality controls clearly outweigh the costs. In true economics sense, mine environmental controls provide a valuable service to citizens by promoting health, safety, welfare, peace, and permanence.

REFERENCE

DOE, 1991. *Policy appraisal and the environment*. London: *HMSO.*
Dasgupta, A.K. and D.W. Pearce, 1978. *Cost benefit analysis : theory and practices.* London: Macmillian.
Freeman, A.M., III, R.H. Haveman and A.V. Kmeese., 1973. The economics of environmental policy. John Wiley and sons, New York.
John, H. Baldwin, 1988. *Environmental planning and management.*
John, G., R. Therival, A. Chadwick., 1994. *Introduction to environmental impact assessment. Wiley*
Page, R., and J. Freejohn., 1974. Externalities as commodities: comment. *American economics review* 64:3: 453-459.
Royston, M.G., 1979. Pollution prevention pays Oxford: Pergramon.