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EIAs and Environmental Protection: Evidence from the mining sector, Zimbabwe

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Abstract. The paper estimates contribution of Environmental Impact Assessment studies (EIAs) as conventionally practiced, towards environmental protection, given the questionable environmental image of the mining sector. Results reveal that impact prediction models used in EIAs underestimates the actual environmental impacts observed during mining both in terms of identification and their likely level of occurrence. The paper therefore argues that using static and linear EIAs to protect the environment may be necessary for procedural purposes but not sufficient enough for the substantive dimension of environmental protection since several environmental impacts exist unmonitored as a result of underestimation generic with EIAs models. The paper therefore argues that, for EIAs to be substantive, an evaluation suffix in the name of "follow-up quarterly reports" should be added to the EIA process to capture missed and possibly overstated environmental impacts for purposes of building continuity into the project approval, implementation and operational stages.

Keywords: EIAs; environmental protection

1. Introduction

The environmental image of mining is controversial worldwide [1], a situation that gives considerable public suspicion with regards to the attitude and commitment of the mining industry towards environmental protection [2], [3]. Mining and environmental protection seem to be mutually exclusive and incompatible as currently practiced [3]-[4]. This is supported by earlier sediments which acknowledge that, there are probably more examples in history of poor environmental control than there are "flagship" projects where resource development has proceeded in harmony with maintenance of high environmental standards [2]. Against this backdrop, several pieces of legislations were enacted, repealed and amended in Zimbabwe hoping to harmonize mining activities and environmental protection.

Before enactment of the Zimbabwean Environmental Management Act (EMA) Chapter 20:27 in 2002, the Zimbabwean Mines and Mineral Act (MMA) Chapter 21:15 revised in 1996 was the supreme law governing mining activities in Zimbabwe together with a series of other sectorial policies with relevance to mining. With that background previous studies described the environmental legislation by then, as being fragmented, incomplete, uncoordinated and based on a sectorial approach which was silent in as far as environmental protection was concerned [2]. Also, several studies attributes the industry's environmental challenges as emanating from the "overriding power" of the MMA over other land users [2]-[3]. Resultantly, many mining companies implemented mining projects without paying special attention to their environmental impacts leading to environmental pollution [5], a picture that characterize the present image of the mining sector [6].

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Enactment of the Environmental Management Act in 2002 based on its objectives, was therefore expected to synchronize developmental projects and environmental protection since under this new environmental legal framework, Environmental Impact Assessment studies, (EIAs) are mandatory to all mining and other prescribed activities. It was since then that several EIA studies were conducted by mining companies to comply with prevailing legal requirements. Unfortunately given the present image of the mining sector and the historical behaviour of miners, it remains appropriate to question the extent to which miners have managed to incorporate environmental mitigation strategies in their mining activities. The main issue is whether the provisions of the Act (EIAs) are substantive or procedural?

1.1. Problem Statement

Several authors argue that, the environmental image of the mining sector as currently practiced is highly questionable [1]-[2]-[3]-[4]-[7]. With that background, available legal framework to protect the environment (EIAs) has been criticized in its ability to protect the environment [3]. Fourteen years post implementation of EIAs in Zimbabwe under a process/project authorization system, mining and environmental protection seem to remain mutually exclusive with few flagship examples where mining has occurred with minimum environmental degradation. Need therefore arises to query the contribution of EIAs towards environmental protection focusing on scoping and impact assessment models that form the basis of mitigation strategies [8] and budget allocation to support their (mitigation strategies) implementation. This is against a background where previous efforts to evaluate EIAs have focused mainly on the procedural effectiveness [9]-[10] at the expense of the substantive dimension of EIAs normally considered an ultimately more difficult task [11].

1.2. Objectives

a) To assess the potential of scoping models to predict environmental impacts likely to occur during mining.

b) To assess the potential of impact assessment models to predict the likely impact levels of environmental parameters during mining.

2. Related Literature

Effectiveness of EIAs in addressing environmental problems is a highly debated environmental policy issue globally. Earlier studies that tried to evaluate EIAs argue that EIAs have many assumptions implying that their capacity to address environmental problems may be weak and questionable [12], [13]. Recently, [3, p. 28] argue that, “carrying out an EIA itself does not automatically translate into environmental protection and fulfilment of community expectations as many companies have been ignoring their EIA commitments”. Contrary, some studies however acknowledge a significant contribution of EIAs towards addressing environmental problems in project development [14], [15]. Several authors also argue that, the focus on evaluating EIAs is currently on procedural effectiveness at the expense of its substantive dimension [9]-[10]-[11]. With that conflicting background, this paper evaluates the substantive dimension of EIAs as practiced in Zimbabwe with the sole objective of assessing its substantive dimension towards environmental protection.

3. Methodology

The study was conducted in Uzumba and Mutoko communal areas of Zimbabwe. Using a case study of 5 black granite quarry mines purposely selected to accommodate EIA approval status, the study investigated the substantive dimension of EIAs under black granite quarry mines. Environmental monitoring schemes were used to capture environmental pollution observed during the mining era on the following parameters; noise, dust, soil contamination, deforestation and soil compaction. These were then compared to predicted levels postulated by EIA studies conducted before mining activities using the Related-Samples Wilcoxon Signed Rank Test as summarized in equation 1 and 2 [16].

Firstly, obtain each of the signed differences as illustrated in equation 1. $D_i = Y_i - X_i$ (Equation 1). Rank the absolute values of these differences from smallest to largest as illustrated in equation 2. $D_i = Y_i - X_i$ (Equation 2). Assign to each of the resulting ranks the sign of the difference whose absolute value yielded that rank and compute: **T+** = the sum of the ranks with positive signs and **T-** = the sum of the ranks with negative signs. **T+** or **T-** is the test statistic, depending on the alternative hypothesis [16].

4. Results

This section presents results of the estimated predictive power of scoping and impact assessment models. The predictive power of the scoping models/methods used was investigated against the null hypothesis that scoping models used were capable of capturing all impacts likely to occur during mining. Table I presents total number of predicted environmental impacts against actual impacts observed during mining at the five mines.

Table I: Predicted impacts against actual impacts observed during mining

Environmental Parameter	**Mine 1**		**Mine 2**		**Mine 3**		**Mine 4**		**Mine 5**	
	Predicted	Observed	Predicted	Observed	Predicted	Observed	Predicted	Observed	Predicted	Observed
Deforestation	√	x	√	x	√	x	√	x	√	x
Erosion	√	x	√	x	√	x	√	x	**	x
Soil Compaction	√	x	√	x	√	x	√	x	√	x
Soil Contamination	√	x	√	x	√	x	√	x	√	x
Surface Water Pollution	**	x	**	x	√	x	√	x	**	x
Dust Pollution	√	x	√	x	√	x	√	x	√	x
Noise Pollution	√	x	√	x	√	x	√	x	√	x
Siltation	**	x	**	x	√	x	√	x	√	*
Loss of Wildlife	**	x	**	x	**	x	**	x	**	*
Total	**6**	**9**	**6**	**9**	**8**	**9**	**8**	**9**	**6**	**7**
Overall	Observed (predictive power) = **79%**: Unobserved (predictive error) = **21%**									

Notes: √ = Impacts predicted before mining; x = impacts observed during mining; ** = Impacts not predicted before mining; * = Impacts not observed during mining

Results across all the five mines reveal an under prediction of impacts as observed during mining compared to EIA predicted impacts before mining. On average these findings suggest that the used scoping models had a prediction percentage of 79 with an underestimation error of 21%. Thus far, the paper tests the significance of the median differences of the two groups [(a) EIA predicted impacts and (b) Impacts observed during mining] as shown in Table II.

Table II: Hypothesis test summary

Null Hypothesis	Test	Sig.	Decision
The median of differences between EIA-Predicted Impacts and Impacts Observed During Mining equals 0	Related-Samples Wilcoxon Signed Rank Test	0.038*	Reject the null hypothesis

Significance level = 0.05

Results indicate that, the median difference between the two groups is statistically significant (*p-value*: 0.038). These findings therefore suggest that on average scoping models used under estimated the actual environmental impacts observed during mining. The predictive power of impact assessment models used was also investigated against the null hypothesis that the impact assessment models used were effective in capturing the level of impacts likely to occur during mining. From a list of predicted impacts observed from the five mines, only five environmental parameters (deforestation, soil compaction, dust pollution, noise pollution and soil pH) were common across all the mines. With that background, the paper tests the significance of the median differences between (a) EIA predicted impact levels and (b) impact levels observed during mining for each of the five shared environmental parameters as summarized in Table III.

Table III: Hypothesis test summary

Test	Null Hypothesis	Parameter	Sig.	Decision
Related-Samples Wilcoxon Signed Rank Test	The median of differences between EIA-Predicted Impact levels and Impact levels Observed During Mining equals 0	Deforestation	0.033*	Reject the null hypothesis
		Soil compaction	0.043*	Reject the null hypothesis
		Dust	0.500	Retain the null hypothesis
		Noise	0.012*	Reject the null hypothesis
		pH	0.045*	Reject the null hypothesis

Significance level = 0.05

In the case of deforestation, soil compaction, noise pollution and pH results reveals that, there is sufficient evidence to reject Ho since the median difference between the two groups is statistically significant (p-values: 0.033, 0.043, 0.012, 0.045). The implied message suggests that impact assessment models used during EIA preparation to estimate the likely impact level of the above four parameters failed to predict correctly the level observed during mining. With reference to dust pollution, results indicate that, there is significant evidence to accept Ho (p-value: 0.500), for the median difference between the two groups is statistically insignificant. These findings suggest that EIA impact assessment models used to estimate level of dust pollution were able to predict the level of dust pollution observed during mining.

5. Discussion

Two messages emerge from this paper as follows: Firstly, under estimation revealed for the scoping models suggest that predicted EIA impacts may be totally different from the actual impacts that will occur during project development. Secondly, under estimation of impact levels noted with impact assessment models further suggest possibilities of low engagement of mitigation strategies as well as under financing of these mitigation strategies. Thus far, using static and linear EIAs as currently practiced to protect the environment may be a false promise.

These findings reinforce the importance of quarterly reports post project implementation [11]-[18] reflecting results from monitoring schemes per every environmental parameter predicted to occur and new impacts observed during project development rather than relying entirely on initial EIAs. This approach is likely to identify missed impacts or over estimated impacts and correct level of impacts during project development stages. Quarterly reports will therefore be used to adjust initial EIA predicted targets in line with observed impacts, thus converting static linear EIAs into a dynamic iterative version with a better promise on environmental protection. Otherwise the current status quo promotes EIAs for procedural purposes with a minor substantive value towards environmental protection.

The merits are likely to be mutually shared between project proponents (miners) and society (environmental protection) as follows; Firstly, in the case of under estimation of impacts, low engagement levels of mitigation strategies will affect society and the environment who are likely to benefit once the missed impacts are identified and adjusted. Secondly, in the case of over estimation of impacts (although not tested in this paper but likely to occur) high engagement levels of mitigation strategies will create a heavy cost burden on proponents who are likely to benefit through proper alignment of mitigation strategies and their budget to correct impact levels.

6. Conclusion

The paper concludes that scoping models used under estimated several environmental impacts that were later on observed during mining. This was also true for the impact assessment models, where in most incidences level of impact predicted under EIA studies was far much lower than the level observed during mining. The paper therefore suggest that since mitigation strategies (and their financial commitments) are based on predicted impacts and their likely level of occurrence, under estimation by the scoping and impact assessment models mean that, several environmental impacts exist unmonitored and for those monitored their mitigation strategies are likely to be under financed.

7. Policy Recommendations

Errors generic with predictive models provides evidence on the weakness of static and linear EIAs to protect the environment. Need therefore arises to;

- Introduce an evaluation suffix to the EIA process so as to build continuity into both the project approval and development cycles
- Capture implementation challenges in the EIA process culminating into feedback effects in the whole system
- Also learn from and utilize results of case experience

Thus far, the EIA policy framework should focus more on quarterly reports, guided by variance between baseline data and data from scientific monitoring schemes, not on initial EIA reports from proponents.

8. Acknowledgement

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