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Environmental Impact of Bauxite Mining: A Review

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Abstract: ***Since prehistoric times bauxite have been extracted from the earth which has been linked with the social, economical and industrial development. The various mining processes create negative impacts on environment both during the mining operations and for years after mine is closed. To quantify the impact of the mining on environment, it is necessary at first to evaluate the existing environmental quality of the area. As, all the environmental dimensions may not be significantly affected by a particular mining activity; it is necessary to identify the pertinent dimensions for studying in detail, in order to analyze the impact of the mining activity on them. Thus the recent changes in surrounding have increased the importance of assessment of mining impact on environment.***
Keywords: bauxite, environment, negative impact, mining, environmental dimensions, assessment.

I. INTRODUCTION

Mining and the processing of minerals have a profound impact on our environment. In addition, each mine requires an infrastructure of roads, power lines, rail links, water pipelines and a mineral processing plant. The effects of chemicals due to mining and mineral processing less than the disturbance of land but are often more dangerous and long-lasting. Mining operations have to keep to specified environmental standards and mining projects must include a so-called environmental impact statement that covers the proposed methods of ground reclamation and every possible effect on vegetation, climate, air and water.

To quantify the impact of the proposed mine on the ambient air quality, it is necessary at first to evaluate the existing ambient air quality of the area. The air borne particulate matter generated by mineral and overburden handling operations, and transportation of mineral is the main air pollutant. To quantify the impact of the proposed bauxite mine on the ambient air quality, it is necessary at first to evaluate the existing ambient air quality of the area. The existing ambient air quality, in terms of Particulate Matter- 10 (PM-10), Particulate Matter- 2.5 (PM-2.5), Sulphur-dioxide (SO2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO), has been measured through a planned field monitoring. Bauxite mining is carried out by opencast manual method. The air borne particulate matter generated by ore and handling operations, transportation and screening of ore is the main air pollutant. The emissions of Oxides of Nitrogen (NOx), Sulphur Dioxide (SO2) contributed by diesel operated excavation/loading equipment and vehicles plying on haul roads are marginal. Forecasting of impacts on air environment has been carried out taking into remuneration proposed production and net increase in emissions.

Noise is one of the most undesirable and unwanted by-products of our modern life style. It may not seem as insidious or harmful as air and water pollutants but it affects human health and wellbeing and can assist to decadence of human well-being in general and can cause neurological disturbances and physiological damage to the hearing mechanism in particular. It is therefore, necessary to compute both the quality as well as the quantity of noise in and around the proposed site. Noise generated at the mine is due to manual mining operations and truck transportation activities. The noise generated by the mining activity dissipates within the mine.

Water quality assessment is one of the essential components of Impact Assessment study. Such assessment assists in evaluating the existing health of water body and advising proper mitigation measures to minimize the potential impact from development projects. Direct retrogression can occur to ground water situation downhill from a surface mine by the flow of contaminated drainage from the mine. Indirect retrogression of groundwater could result from blasting which causes a temporary shaking of the rock and results in the new rock fracture near working area of the mine. Blasting can also cause the old pre-existing rock fracture to become more open or permeable, by loosening mineral debris or cement in this fracture; this could affect nearly vertical fractures located up to several hundred feet away from the surface mine causing vertical leakage of rainage from nearby abandoned deep mines to underlying aquifers.

The sustainable use and conservation of natural ecosystems and biodiversity is essential to support sustainable development with biological resources providing raw materials for livelihoods, sustenance, trade, medicine and industrial development. In any Environment Impact Assessment study, it is necessary to identify the baseline levels of relevant biological environmental parameters which are likely to be affected as a result of the construction and operation of the planned project. Similar approach has been adopted for conducting the Biological Environment study of the proposed Project. The biological study was undertaken to understand the present status of terrestrial and aquatic ecosystems of the study area.

Alteration in soil condition alters the normal mineral composition of plants. Land degradation is one of the major negative impacts of opencast mining in the form of excavated voids. Exploitation of mineral resources from the land surfaces through mining causes environmental and ecological instability. The impact of the mining activities can be quantified through Impact Assessment Studies within the impact zone. The findings of Impact Assessment studies help in preparation of the environmental management plan for preventing the adverse impacts.

II. RELEVANCE OF STUDY

Mining involves the production of large quantities of waste, in some cases contributing significantly to a nation's total waste output. The type of mineral extracted and size of mine governs the amount of waste produce. Disposal of such large quantities of waste is challenging for the mining industry and may significantly impact the environment. The impacts are more for open-pit mines than for underground mines, which tend to produce less waste. Deterioration of aquatic ecosystems and receiving water bodies, often involves reductions in water quality, can be among the most severe potential impacts of mining.

Mining and the processing of minerals have a profound impact on our environment. In addition, each mine requires an infrastructure of roads, power lines, rail links, water pipelines and a mineral processing plant. The chemical effects of mining and mineral processing might be less than the disturbance of land but are often more dangerous and long-lasting. Mining operations have to keep to specified environmental standards and mining projects must include a so-called environmental impact statement that covers the proposed methods of ground reclamation and every possible effect on vegetation, climate, air and water.

The Impact assessment study was carried out to have an idea about the existing environmental condition related to physical environment, biological environment and social environment. To assess the current environmental scenario of the area Environmental Management Plan has been prepared and then based on the activities of mining proposed, to carry out Impact Assessment. The plan will identify and address the impacts, where these are adverse in nature, and thereafter design preventive measures to manage such impacts in a manner as to conserve environment and ecology of the area.

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III. METHODOLOGIES FOR IMPACT ANALYSIS

A. Overlay Method

This method basically displays graphically the types of impacts; impacted areas and their relative geographic allocations by superimposing a map of base line conditions on another map depicting impacted environmental characteristics.

B. Checklist Method

This method combines a list of potential impact areas that need to be considered in the environmental impact assessment process with an assessment of individual impacts. However this method does not provide for the establishment of direct cause – effect links to various project activities and does not include an overall interpretation of collective environmental impacts.

C. Network Method

This method starts with a list of project activities or actions and then generates cause condition effect network i.e. chain of events. The method attempts to recognize primary, secondary and tertiary effects so that all impacts are identified. If all environment changes are described in details and all possible interrelationships included, the resulting impact network could be too extensive and complex to be really useful.

D. Matrix Method

This method basically incorporates a list of project activities or actions with checklist of environmental conditions or characteristics that might be affected. Combining these lists as horizontal and vertical axis for a matrix allows the identification of cause effect

relationship between specific activities and impacts. The entries of matrix may be qualitative or quantitative estimates of this cause effect relationship. In quantitative approach estimation is done by a relative weighing scheme for different attributes leading to a total impact score. This enables one to judge comparatively various alternatives from total environmental impact considerations. The evaluation is subjective as some impacts are more important than others. Nevertheless, it is the best method among the different alternatives available.

IV. WORK CARRIED OUT BY RESEARCHER

Lad R. J. and Samant J. S.[1] carried out the study comprising two bauxite mines adjoining village Udgiri, Kolhapur, Maharashtra. This study revealed that how the bauxite mining activities alters the basic physico-chemical properties of the local soils and this is causing a major adverse environmental impacts resulting in changes of land use pattern. The investigation included analysis of twelve physico-chemical parameters of soil collected from identified sites near the bauxite mine. The physic-chemical characteristics such as Organic Carbon, Nitrogen, Phosphorus, Potassium, Calcium and Magnesium, field capacity and water holding capacity were analyzed. The analysis of these characteristics gives information about nutrient deficiencies and deteriorated characteristics of soil. The study revealed that aluminium toxicity is found to be a main factor which limits plant growth, but the higher concentration of aluminium not only damages plants but also free living micro organisms are inhibited too. The nutrients released due to microbiological activities are lost soil reclamation is not done.

Rohan J. Lad and Jay S. Samant[2] investigated negative impacts of bauxite mining activities on local environment in the eco-sensitive region of the Western Ghats of Kolhapur district. The major threads of this activities are dust pollution, vegetation loss, forest fragmentation and biodiversity loss, negative impact on water resources, generation of wastelands and social impact. It is observed that blasting, drilling and transportation activities are major source causing entire area of bauxite mining and all roads leading to mines have become dusty. The opencast type of mining operation practiced in bauxite mining requires complete removal of vegetation in the mine area. The roads leading to bauxite mines often go through the dense forest become much wider as compared to earlier, adding to increased deforestation and forest fragmentation. It was observed that bauxite mining and associated activities like blasting, removal of ore, movement of heavy vehicles has adverse impact on small water bodies which supply water to main river built up of sediments that disturbing the flow rate of river.

Nurul Hidayah Hussain, Zailina Hashim, Jamal Hisham Hashim, Norazura Ismail and Junaidah Zakaria[3] studied the psychosocial, social and health impacts of bauxite activities on the Felda Bukit Goh and its neighboring communities. Communities who lived near the bauxite mining areas exposed to environmental factors from the mining activities such the nuisance of noise from lorries carrying bauxite, traffic congestions, accidents, road destruction, dusty road and homes, soil erosion and increase surface water turbidity, deforestation or habitat destruction, environment destruction with red bauxite mud, could result in social, psychosocial and health impact. The study were carried out by face to face interview using questionarries; this study sample consisted of those head of household who have resided in the area at least 1 year and volunteers to participate in the study. The highest complaint from the respondents was about air pollution increment and dusty houses because of the dust come from the bauxite mining activities and exaction processes near to their houses and the dust produced from bauxite lorries along the road; respondent complaint that the excavating machine used to extract the bauxite from the earth was noisy and disturbed their sleep. The environmental factors of psychosocial impacts were mostly due to bauxite trucks driving in and out of narrow routes, noisy sound produced and the houses and facilities turned to red because of dust emitted from their loads which caused stress among respondents. They need to close all the windows and doors to avoid the dust from entering their houses. There various types of pollutions, such as noise, air, soil and water pollution which with their combined effects have resulted in high prevalence of health complaints among the community within the mining area. Therefore, it is recommended that proper governance and standard procedures should be carried out in the mining activities to avoid environmental destruction and threat to public health.

Adukam Veedu SIJINKUMAR, Kizhur SANDEEP, Nazar SHINU, Vaniya MEGHA, Chandran SHYAMINI, Koottalakal Raghavan SREENI, Kadakam SUVARNA[4] investigated possible environmental impacts due to bauxite mining and laterite mining in the Karinadalam and Kinanur area of Kasargad district of Kerala. The mining activities would inevitably require removal of trees and vegetation situated in a mine area and deforestation to a lesser extent is also caused by infrastructure facilities changes the micro-climatic conditions which ultimately lead to degradation of flora and fauna. The process of the environmental degradation which starts with the extraction of minerals, resulting in land degradation and addition of pollutants to air and water, continuously give rise to environmental degradation. In the quarrying and open cast mining, excavation and filling works disturb the original topography of the area and can cause conspicuous effects on ground water level and quality. The study presents the comparison of

Google Earth satellite images within a period of 7 years from 2003 to 2010 which reveals the significant increase in mining activities in the area resulting in the land degradation.

Lee KY, Ho LY, Tan KH, Tham YY, Ling SP, Qureshi AM, Ponnudurai T, Nordin R[5] reviewed the environmental and occupational health impact of bauxite mining in Malaysia. In bauxite mining, activities such as site clearance and road building, open-pit drilling and blasting, loading and haulage, vehicular movement, ore and waste rock handling generate dust particles can react with the air in atmosphere, causing various chemical reactions, affecting soil, hence health of plants; dust can also dissolve in water from where it is ingested by humans or aquatic animals. Heavy mining activities which have been carried out aggressively contaminates water, especially drinking water sources, causes potential harm impacts due to components of heavy metals and harm the aquatic ecosystems. In open cast bauxite mining large volume of soil removed; this destabilizes the environmental balance by changing the geo-morphological processes. In addition, land clearing processes before mining, such as deforestation, forest fires, opening up new road networks for better access and waste disposal, lead to habitat destruction and soil erosion. Potential health effects include noise-induced hearing loss, loss of hearing sensitivity, and sleep disturbances and there are many cases of pulmonary fibrosis, cancer, tuberculosis, cardiovascular and respiratory diseases as well as premature deaths due to the exposure of bauxite dust.

George M. Ochieng, Ephrahim S. Seanego and Onyeka I. Nkwonta[6] focuses on the studies that have been undertaken in South Africa have shown that the water decanting from the mining areas of companies is highly acidic and as such cannot be released into the natural watercourse (streams and rivers). Some form of water treatment and prevention to nullify or neutralize the acid levels of the mine water is necessary. The aim of this paper is to raise awareness of the environmental risk associated with acid mine drainage in our environment. Mine water creates adverse impacts by increases level of suspended solids, leading to mobilization of iron, aluminium, cadmium, cobalt, manganese and zinc and decreasing pH of receiving water and deteriorate the water quality in many water sources that may impact on the domestic, industrial and agricultural users. The major acid mine drainage effects are depletion of aquatic life; contamination of food chain and drinking water supply; and deterioration of ecosystem which require treatment of mine water. Due to the mine water and mine tailing dumps with higher concentrations of heavy metals in South Africa, where water table is close to surface, the upper 20 cm of soil is severely contaminated by heavy metals due to capillary rise and evaporation of groundwater; these contaminated water discharged into streams causing an acidity in stream water. The author discusses two methods of acid mine drainage treatment viz., wetlands and Rhodes biosure process. The study conclude that water quality of the Blesbokspruit, klip and wonderfontein in the test area was below standard due to the presence of acid mine drainage.

Iosif Vorovencii[7] proposed an overview on the role of satellite remote sensing in environmental impact assessment and how modern technology specific to remote sensing can be used in impact caused of urban development, environmental impact assessment, mining and alterations that appeared due to the human factor or natural factors. Because of the absorption, emission and reflection of electromagnetic radiation at different wavelengths, it is possible to analyze spectral signature recorded with satellite sensors; identifying details of objects and materials on earth's surface; monitoring and modeling of earth surface processes and their interaction with atmosphere; computation and estimation of geographical, biological and physical variables. impacts of uncontrolled urban development over environment is degradation and the quality of water resources, alteration of natural hydrological conditions of river, changing water balance, increasing erosion of rivers and decrease in channel flow during dry season can be analyzed and quantified using remote sensing records. Mining operations causes notable impact on the environment, landscape, ecosystem; pose serious problems, reducing the area covered by forests, soil erosion and pollution and biodiversity loss, damages to flora and fauna analyzed by using remote sensing records. Satellite remote sensing technique is cheaper and can be efficiently used to collect large scale information records which are made as needed in different parts of the electromagnetic spectrum in various forms (analogue, digital, radar, lidar). Satellite data are useful for both developed countries and developing countriesand reliable data on spatial information are lacking. M. Jagannadha Rao, Ch. Hanuman Prasad, Mustefa Mohammad, Asif Iqbal Kakkassery[8] present the possible impacts of active mining initiatives in the region of Eastern Ghats of Andhra Pradesh; examines the people's apprehensions related to impacts on environment and tribal socioeconomic and cultural implications and suggest the possible remedial measures for environmentally friendly mining of these resources with minimum impact on the environment including the sensitive forest cover, land, water, tribal culture etc. mining can have negative impact on surrounding surface and ground water due to dumping of mine drainage into water streams. Open cast mining involves removing the top soil causing difficulty for vegetation which can be minimized by immediate replacement of removed soil after mining operation is finished. It further suggest there should be a technical committee that should investigate the environmental data on soil cover, surface water, ground water, flora and fauna during the progress of mining and processing to assess the impact of environment if any. Afforestation on the reclaimed land is another important measure to be followed for maintaining the biodiversity and ecosystem.

V. CONCLUSION

After reviewing all the prior findings we can conclude that the various mining activities impart negative impacts on the environment and the life and livelihood of the local communities. There is lack of strong and effective measures for the reclamation and restoration of mined land. It is therefore attention of all concerned particulars for proper management and conservation of the environment in order to halt further loss of forest cover and top soil and to prevent deterioration of water quality, soil degradation, air and noise pollution for the healthy environment and sustainable development of the region. The mining land should be properly reclaimed and also renewed vegetation and wildlife in previous mining lands and can even be used for farming.

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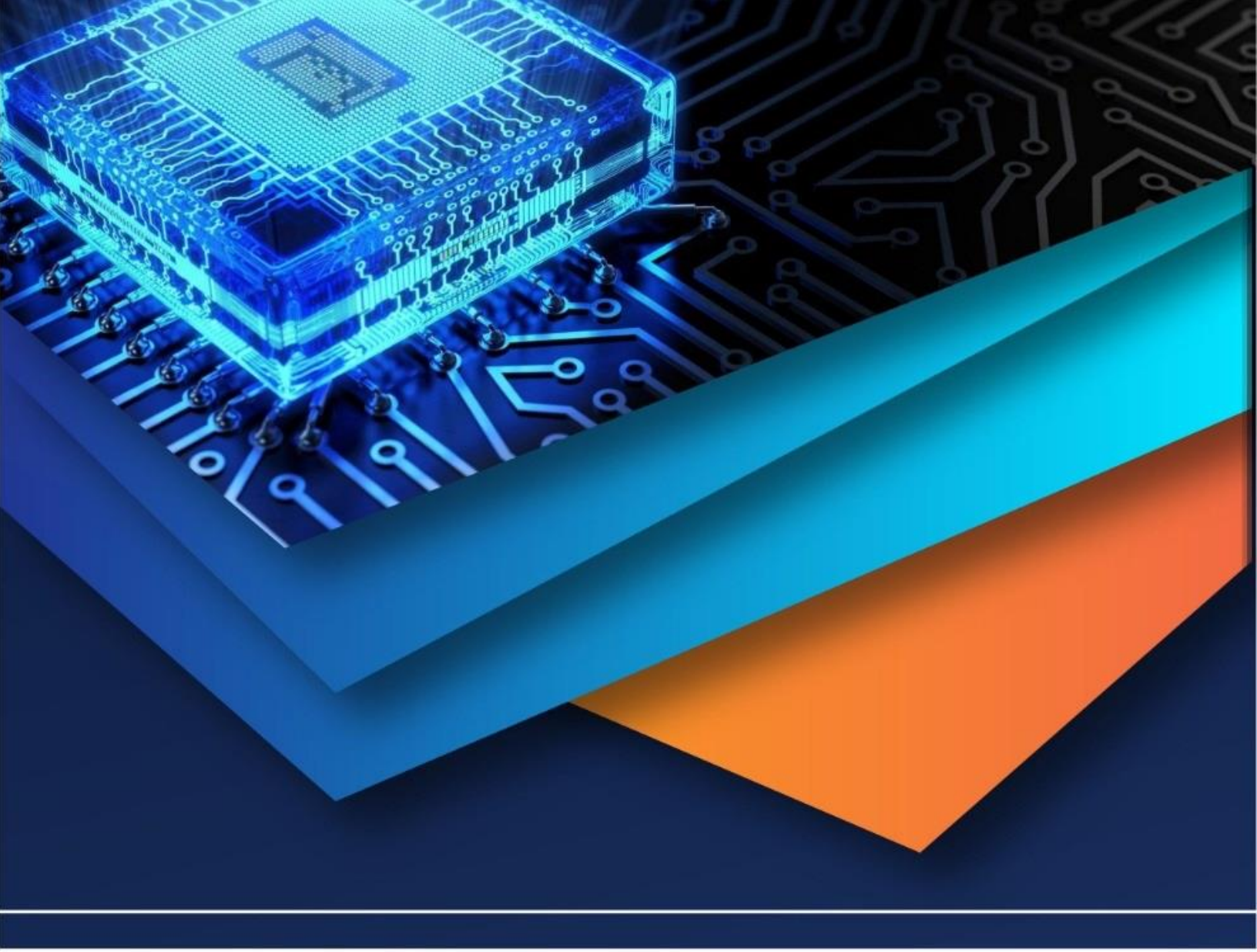

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