Journal of Engineering Excellence
ISSN: **3108-2793**| Volume 1 Issue 2 January 2026
www.jeejournal.com **JEE-01**

MANAGING THE ENVIRONMENTAL EFFECTS OF MINING: IMPACTS AND SOLUTIONS

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ABSTRACT: The economic development of China has been significantly influenced by the discovery of natural resources; however, mining will always have a substantial negative impact on the environment.The impacts of open pit mining on ecosystems, geological settings, and land resources are examined in this research using a methodical methodology. Environmental and ecological system impacts of open pit mining are the major foci of the research. This is predicated on research into the elements that amplify the environmental disasters brought about by mining operations.The research shows that mining technique, mining extent, and mining type are the three most influential factors on ecology and the environment.The research concludes with a variety of potential logical defenses, control mechanisms, and countermeasures based on the research findings. The goal of all of these is to control and protect the environment.

Key words: open-pit mining;environmental affect;inuence factors;countermeaflsures.

1. INTRODUCTION

Mineral resources are fundamental to human survival and progress because they allow for the expansion of human civilization. There are about 74,590 mines in China, both for metals and non-metals, as of 2010. The nation's economy reaped substantial benefits from the 8,032 underground mines and 67,862 open-pit mines that made up this. A harsh warning from China has been issued against Western countries participating in the "pollution first, treatment later" strategy for development. Actually, we're still on the same track, and the environment is in a terrible state. The ecological problems caused by mining, and more specifically by open-pit mining, are addressed in this article. The problems include damage to ecosystems and landscapes, air pollution, and the depletion of resources.

2. THE ENVIRONMENTAL IMPACT OF MINING

THE ENVIRONMENTAL IMPACT OF OPEN PIT MINING

The destruction of land resources

The practice of open-pit mining is harmful to the environment because it removes dirt and plants from the ground, reducing the available area for future use. Approximately 1.5–2.5 times the amount of land that has been mined is taken up by waste-dump material in China's open-pit mines, which is a result of the external dump method being used by most of these mines. As an example, in 2010, there was a dump that used 16,300 hm² of land for

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DOI : https://doi.org/10.5281/zenodo.18783629

every 1.0×10^4t of coal occupation, which used up a lot of land resources, with an average of 0.04 to 0.33 hm² each dump. With an annual rise of 2à10^4 Hm², direct mining engulfed and destroyed around 1.4×10^6 to 2.0×10^6 Hm² of land. A ton of copper requires 400 tons of waste rock and tailings, and 5 to 10 tons of overburden are needed to produce 1 ton of ore, according to the data. You can classify flames as either outcrop fires or ground fires. Construction sites are a breeding ground for outcrop fires due to the presence of heavy machinery, tools, and vehicles. Because of the outcrop's proximity to the soil's periphery, the soil's composition and structure can be changed by drying, hardening, and liquefying mineral particles due to the elevated temperatures. Surface temperatures and soil combustion extent are both decreased in a distance-induced ground fire. The fertility of charred soil is drastically reduced, and it is also quite crumbly.

The destruction of the ecosystem

Large areas of grassland and forest are destroyed during open pit operations as the topsoil is removed, leaving behind slag and subsoil. The compacting of soil by heavy machinery and equipment leads to a lack of organic nutrients and moisture. Animals will be forced to flee their homes or die as a direct consequence of the noise, vibration, and water damage that this causes. The mine is dwarfed by the impact zone, which is five to ten times larger.

The mining site reduces the diversity of biological activity, which compromises the stability and functionality of the ecosystem. Worldwide, the extinction of more than 20,000 vascular plant species is a real possibility. This includes 593 species of birds, 400 species of mammals, and 209 species of amphibians and reptiles. In most cases, this kind of biodiversity loss can never be undone. Restoring and rehabilitating the vegetation in the devastated area has not yielded very noticeable results. Some of the most prevalent rock types include granite, granulite, and chlorite schist. Their wind resistance is impressive, but they fall short when it comes to rehabilitating native ecosystems. In wealthy nations, half of those who undertake rehabilitation are successful, compared to 10% in China. Vegetation is more severely damaged at this slower rate. It is indisputable that burning coal has an effect on the environment. Soil organic matter and moisture levels are reduced as a result of physical and chemical changes brought about by rising soil temperatures. Because of this, soil quality declines, plant development is stunted, and biomass production is reduced. On the flip side, as surface temperatures rise, a number of plants die out instantly. This is harmful because it can spark wildfires in vast areas of meadows and woodlands. Coal fires have a devastating effect on natural habitats.

Geological disasters

Slope stability is a major concern for open pits when it comes to environmental geology. The increase in deep mining activities has caused the designed slope scale to expand in depth. The usual stress balance has been disturbed, leading to the slope's deformation, fracture, and sliding. One of the waterworks constructed by the Shougang Group in Qian'an, Hebei

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Province, has been subject to 109 landslides and unstable slope deformations since it was inaugurated.

The environment, including plants, waterways, terrain, and soil quality, will suffer as a result of mining. This will cause more interference and alteration from solid waste in the main mining zone, and it will also reduce the surface's capacity to retain water. Exacerbating the situation, the buildup of solid waste and loose soil on the ground leads to substantial soil erosion. Over time, this transforms into a conduit for debris flow, which causes landslides. Sand, gravel, and sparse vegetation characterize the area around the mine since development has a negative impact on the local flora and causes land productivity to diminish with time accelerated the process of desertification as time went on, both within and externally.

Charred rocks, incendiary cavities, combustion fissures, and ground subsidence are among the most noticeable geological effects of coalfields. Coal pillars, floating coal from below, and shallow coal seams are all burned to generate combustion chambers. Many surface fissures and cracks are a consequence of this upsetting the seam roof's equilibrium. The surrounding stones have taken on the look of varied degrees of combustion due to their charred surfaces.

3. THE IMPACT ON THE HUMAN LIVING ENVIRONMENT

Water Resource

Wastewater contamination by open-pit mining is obvious. Sewage containing suspended particles, acid, heavy metal ions, and a variety of compounds used in mineral processing are all produced in large quantities in the mining region. Emissions of wastewater are characterized by large amounts, complex compositions, long periods, and wide ranges. Reduced groundwater levels and blocked flow from the Quaternary aquifer are consequences of open-pit mining's extraction and depletion of groundwater. These processes have a major impact on how water is used. Second, oxidation, erosion, and leaching all contribute to the slow subsurface migration of hazardous and poisonous compounds in solid waste. Because of runoff and infiltration, the mining region and the surrounding areas are polluted by these toxins in the wastewater.

Air Pollution

The main air pollution generated by open-pit mining include:gas generated by large open-pit Emissions from heavy equipment, power tools, and transportation vehicles are the main causes of air pollution in open-pit mining. Other factors, such as coal extraction, spilling from the pit's sides, trash deposits, and coal displacement during transportation, also contribute to this problem. When left exposed to air for an extended period of time, it will spontaneously burn, producing a great deal of smoke and harmful fumes. It is common practice to use heavy motor vehicles, especially those with a weight rating of 100 tons or more, to transfer coal from large open-pit mines. A lot of pollution is created by this. Pollutants in the air can have a negative effect on many aspects of human health and well-being, including the ozone layer, acid rain,

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www.jeejournal.com **JEE-01**

greenhouse gas emissions, secondary pollution, and the quality of life for humans.

Transportation of garbage and wind erosion can cause dust storms to happen periodically, especially in the spring and winter. Even in the absence of constant precipitation, dust, both settled and airborne, can contaminate the environment and spread far and wide. In natural settings, dust has a potential to reach heights of 10–12 km and a specific density of about 300 t/(h•m²). There is a 10% drop in grain yield due to dust. Pneumoconiosis is one of the diseases that can develop from breathing in too much dust over an extended period of time.

Noise pollution

Big trucks and heavy machinery are the main culprits when it comes to the noise level in open-pit mining. There will be moments when the decibel level reaches 90 or 120 dB (A). In many cases, this level is higher than the noise thresholds. Environmental noise has negative effects on auditory systems, which in turn cause fatigue, insomnia, vertigo, and cognitive impairment; it also makes it harder to sleep and relax, which is bad for your mental and physical health.

The burning loss of coal resources and the destruction of the environment

The burning of underlying coal seams was made possible by the oxidation of oxygen along the fissure channel, which was caused by vertical fractures caused by the open pit mine perimeter and opencast coal mining (Figure 1). Ground subsidence and coal goaf combustion posed a threat to the safety of the residents of the area. People fell to their deaths after dropping empty containers into the coal fire that broke out at the Yining and Kerr base. Resources were depleted, land washed away, and air was polluted as a result of this, among other environmental disasters.

Figure 1 Xinjiang Hami basin three Lingopen-pitmines and surrounding landscape after coalcombustion

4. THE ENVIRONMENTAL IMPACT OF UNDERGROUND MINING

The environmental impact of ground collapse

The mechanical equilibrium in the surrounding area is disrupted post-mining. As the mined area expands, the surface subsides due to the underlying rock's inability to support the weight of the overlying rock mass.The foundational infrastructure, agricultural land, and irrigation systems will sustain damage following the occurrence of surface subsidence.Transmission lines, railroads, and bridges will all be impacted to varying degrees.

The roof strata experience deformation, rupture, displacement, and caving, resulting in surface subsidence due to altered sinking.In 2011, underground mining accounted for 92% of the 3.52 billion tons of coal extracted.As per

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incomplete data, by the end of 2011, countrywide underground coal mining subsidence has adversely affected one million hectares of land. This quantity continues to increase at a rate of 7,000 hectares annually.

The issues arising from the coal base in the eastern plain region, such as the devastation of human settlements, alterations to the rural landscape, and the significant number of village relocations, warrant greater attention than other environmental concerns associated with coal mining.

Preliminary estimates suggest that 2.7334 million individuals will be displaced from the five Lianghuai coal bases and the Great Plains in West Shandong, surpassing the over 1.3 million migrants from the Three Gorges. The subsidence resulted in severe consequences, affecting 509 villages and 9,780 hectares of land in the Jinxiang mining region.

Hydrogeological conditions

Underground mining influences Hydrogeological conditions, impacting both surface water and groundwater.Excessive mineral extraction from the earth causes subsidence, disrupting hydrological processes and resulting in decreased groundwater levels and increased surface runoff.The newly excavated subterranean area alters groundwater drainage patterns.Regulating runoff influences the groundwater system.

Mine drainage and the degradation of aquifer dynamic static reserves influence the dynamic principles of surface runoff in the basin, as well as groundwater storage and atmospheric precipitation.The aforementioned factors exacerbate the spatial and temporal inequity in the distribution of water resources.The situation is particularly concerning as mining wastewater discharge has not only negatively impacted the basin's surface water but may also have contaminated the groundwater via osmosis.

Groundwater must be depleted for mine groundwater to be utilized or for mine aquifer groundwater to be jeopardized. This alters the natural circumstances for groundwater flow and discharge. This depletes the groundwater in the mine and the superficial layer.

Artificial diversion or drainage depletes surface water.Excessive water waste adversely affects the ecosystem, impairs plant growth, degrades petrochemical soil, and diminishes the subsurface water levels in the region.Identifying the polluted site is challenging due to the slow movement of contaminated groundwater, which is difficult to detect.Improvement is challenging when relying solely on the aquifer's natural self-purification.

5.INFLUENCING FACTORS OF THE ENVIRONMENT IN MINE EXPLOITATION

Mining scale

Environmental damage is directly proportional to the scale of mining operations. More buildings, machinery, and space will be needed if the mine's production volume increases. They will take up a lot of room above and below ground and produce waste in the forms of solids, liquids, and gases. The required lifespan of production will be shortened, pollution will worsen, and the

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environmental constraints of self-regulation will be exceeded.

Mining methods

Underground mining may cause earthquakes, surface subsidence, and changes in hydrogeological conditions, although it has little effect on the ecosystem and surface landscape. On the other hand, open-pit mining degraded the surface landscape, extracted and degraded large amounts of land resources, caused geological disasters, and made life miserable for everyone involved. In order to make the most efficient use of available resources, open-pit mining has to be cheap and can easily extract lower-grade mineral deposits.

Mining types

The ecosystem is affected in different ways by the extraction of different natural resources. Construction material mining has a direct effect on mountain ranges, plant life, and other ecosystems. Solid garbage, waste rock dumps, and the release of toxic and hazardous substances (leading to acid rain or global warming) are all byproducts of combustible organic minerals.

Others factors

Mining's effects on the environment are linked to its surrounds.Impact levels on the human environment vary depending on the climate, topography, and mining area. Environmental harm near the population impacted, for instance. When it comes to the environmental issues brought on by mining, a city with an annual mine production of 50,000 tons will receive more complaints than a remote, abandoned island with an annual output of 5 million tons.The mining environment is greatly influenced by the local climate and terrain.The river moves more slowly and removes less silt from the water in the level area.On the other hand, dust and noise can go great distances at high altitudes.Rolling hills indicate that country matters.Geomorphological characteristics are crucial.High up on the dike, it is really noticeable. The air will be filled with dust and noise, and only a few people will be able to witness the equipment installation in the valley up close.

The nearby hills have created a strong barrier that prevents dust and noise from escaping.Because of its rapid flow velocity, the high-altitude river transports a lot of silt, which is deposited in a low-lying, comparatively flat area.Additionally, the diffusion of mine pollutants into the surrounding environment will be significantly impacted by wind, humidity, precipitation, air temperature, and other climatic conditions. Thus, the intensity of pollution is influenced by the climate. Precipitation has a significant impact on the diffusion of the waste liquid, and the atmosphere is primarily responsible for the release of waste gases, dust, noise, and air.

6.ENVIRONMENTAL PROTECTION MEASURES AND RECOMMENDATIONS

Sound environmental laws, regulations

Inadequate mine management and a lack of priority on environmental protection are consequences of our country's incomplete legal framework, which includes laws like the "Environmental Protection Law," the "Mineral Resources Law," and the "Geological Disaster Prevention and

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Control Law." Companies and the government put profit before environmental preservation, putting the environment at risk so that we can all live comfortably in the modern world. The first step in bettering our country's environmental protection laws is to compare them to those of developed nations. An important part of our efforts to conserve the environment is developing a system that works in tandem with our current conservation efforts.

Secondly, reach out to experts in environmental protection and regulation for help and step up your efforts to lobby for laws that protect the environment. People will have an easier time understanding the laws that govern the use of mineral resources after reading this. Laws governing mining and economic growth must avoid the blind support of exploitative behaviors by resting on basic principles. Third, to eradicate local protectionism, make environmental regulation violations more punishable.

Reclamation and utilization of open-pit mining

The open-pit mining technique ought to be used concurrently for both mining and reclamation. As reclamation is an essential part of mining, the dragline method, back haul, and back track freight should be used.A variety of subterranean basins, reservoirs, and ponds can be built to house man-made lakes and offer a platform for aquatic pursuits.Shallow water is ideal for growing aquatic goods like lotus root and wild rice stem. Once the soil has been modified through experimental studies, the right plants can be planted in reasonably level water pits.Time allowed for the development of an approach to agricultural integration that would maximize economic and environmental benefits.

One potential solution to the destruction of natural resources is biological reclamation.Revitalize degraded soil by reusing organic matter through the use of microbial fertilizer technology. Come up with a way to mix "the mud into the sand, the sand into the mud," so you can change the sand-to-mud ratio and make the soil more Filth-friendly.Protected areas and parks are essential for preventing habitat destruction caused by overexploitation of natural resources. We also need to make sure that developing different mineral resource projects won't hurt the biodiversity index. As a result, we must make it a top priority to safeguard the development zone around the biodiversity while we manufacture.

The stability and environmental impact of different stone revetment slopes must be investigated for the purpose of geological disaster prevention and management. The reason behind this is that mining produces a great deal of gradients.Separating a dangerous slope into an intercepting ditch and a drainage ditch can stop soil erosion from blocking solid debris. There will be more vegetation and better drainage as a result of this.

The most efficient use of water resources in an opencast mining location is an effluent and wastewater resource. It is reasonable to build a small sewage treatment plant that can handle the wastewater from nearby homes in addition to the sewage from the mining site.With the goal of minimizing water loss during mineral resource extraction and

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maximizing water efficiency in drainage and irrigation systems.

Renewable energy sources or liquefied petroleum gas should be used as fuel as much as possible on the construction site to reduce air pollution. Second, use a tarp to cover the transport truck and keep the loading and unloading height to a minimum. It is critical to remove the debris as soon as possible to avoid the buildup of wind-related debris. The work site has to have watering stations set up, and the vehicles used for transportation need to be cleaned up quickly. The outflow is the best place to mix concrete and execute other safety procedures.

Measures taken in underground mining

The underground processing facility does not receive a large quantity of debris directly from subsurface excavation in rock roads. As a result, less gangue will be left on the ground, pollution will decrease, and transportation expenses will go down. Utilizing gangue to stabilize surface movement and subsidence zones is one of the many technical methods employed by gangue well technology. Others include excavating roadways made of gangue rock, transporting them to an underground waste disposal site, and then bringing them to the surface for backfilling mined-out areas via pipeline and wind.

Raise the quality of the mining environment's monitoring system. Provision of thorough and accurate foundational data for scientific research and corporate development; consistent assessment of mining groundwater standards and elevated data; assistance and direction for the local environmental monitoring station; and the establishment of a groundwater environmental database. In addition to real-time monitoring of the water environment in the mainland region, the environmental departments also set up a compensation system and a regional groundwater monitoring network. The philosophy that guides their actions is "those who create protection, those who cause destruction, those who restore, and those who pollute govern." They are calling on the Mining Corporation to take responsibility for protecting and restoring groundwater ecosystems. After the groundwater environmental conditions are restored, the pit will be gradually closed using a variety of funding sources.

7. CONCLUSION

Deforestation, soil erosion, water contamination, air pollution, noise pollution, biodiversity loss, and long-term ecological imbalance are some of the negative environmental impacts of mining. Subsidence of the earth, loss of habitat, and pollution of surface and subsurface water sources with heavy metals and other harmful compounds are all possible outcomes of both open-pit and underground mining.

The local economy and population's health are hit hard by the worsening air and water pollution caused by dust, acid mine drainage, and greenhouse gas emissions. As a result, land productivity drops, ecosystems suffer, and sustainable development in mining regions is in jeopardy. Possible ways to lessen mining's negative effects include scientific mine planning, constant environmental monitoring, controlled mining operations, and strict enforcement of environmental

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laws. Mining projects are required to incorporate afforestation, land reclamation, and ecological restoration into their designs from the very beginning. Rehabilitating depleted areas, correctly managing trash, processing and recycling mining wastewater, and minimizing dust are all critical. To reduce pollution, it is necessary to use renewable energy sources and environmentally friendly technology. In order to save ecosystems that are in danger of extinction, it is crucial to establish protected areas and implement policies to preserve biodiversity. Adherence to regulations and accountability are fostered through community participation and corporate environmental stewardship. Using new forms of assessment and bolstering existing institutional capacities might help individuals make better judgments.

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