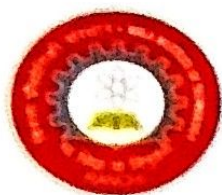


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**Assessing the Abiotic and Biotic Factors in Pit Lakes for Sustainable
Management of Water and Environment**

Submitted to
Ministry of Coal, India

Submitted by



cmpdi
A Min. Rates Company



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Executive summary

- As part of the S&T project, two pit lakes in CCL (Bhurkhunda) and one pit lake in MCL (Basundhara area, east) were studied. CCL pit lake 1, which is more than 50 years old and has a maximum depth of ~40 m, and CCL pit lake 2, which is nearly 15 years old and has a maximum depth of 15 m, were chosen. MCL pit lake is around 20 years old and has a maximum depth of 15 m. Along with these pit lakes, the study also included two control sites, one at Patratu Dam and the other at Hirakud Dam.
- The pit lake environment was studied by using a combination of in situ and ex situ analytical suites. Results showed that CCL pit lakes mix only during the winter months, starting in December, and full mixing occurs in January. DO in CCL pit lake 1 drops to very low concentrations throughout the year, whereas in CCL pit lake 2, the decline in DO was mainly during the monsoon season.
- The MCL pit lake also showed a similar decline in DO during the monsoon season only. Underwater light-penetration data showed that in all the pit lakes studied, light penetration was restricted to the top few metres.
- The study pit lakes were compared with two artificial reservoirs, and no significant differences in water quality parameters were observed. The major difference was in the catchment's influence on water quality, particularly during the monsoon period.
- Microbiological assessment of both pit lakes showed the presence of faecal coliforms during the monsoon period, which was mainly due to catchment drainage.
- The present metagenomic investigation of the CCL and MCL pit lakes reveals a diverse and functionally significant microbial community structured across various phyla, genera, and species.
- The overall findings of the pit lake microbial study showed the existence of functionally active microbial groups involved in biogeochemical cycles, such as carbon, nitrogen, sulfur, iron, and manganese cycling, demonstrating that the microbial community of CCL and MCL pit lakes plays a pivotal role in natural attenuation, ecosystem stability, and intrinsic bioremediation potential.
- Assessment of biotic factors showed that, other than occasional algal bloom, the pit lakes exhibited the progression towards a highly biodiverse environment. When compared, the biodiversity of pit lakes has been found to be greater than acidic pit lakes (as reported in scientific literature) but lesser than natural lakes, mainly due to unique hydro-chemical and environmental factors.

- The formation and maintenance of the pit lakes not only provide a valuable water resource but also provide immeasurable ecological services. The beneficial services provided by pit lakes extend far beyond the region initially impacted by mining activities.
- The study found that ecosystem services associated with pit lakes constitute invisible infrastructure for local communities. Developing, maintaining, and protecting them requires conservation planning and implementation, sustainable management, and integration into local policies and economies.
- For the pit lake as part of mine closure, the following are the key aspects: catchment engineering, land sloping, and pit lake bank stabilisation, which must include vegetation to stabilise surface materials and provide shelter from wind- and water-erosive forces. This will also help improve vegetation diversity and establish a self-sustainable ecosystem, ultimately maintaining the site's aesthetics.
- The results showed that pit lake water does not contain any specific pollutants that require new treatment methods, and existing water treatment methods are sufficient to produce potable water.
- Regular monitoring and maintenance efforts are needed both at the administration and local levels to make sure the lakes remain healthy to support a functional ecosystem.
- From the study, it can be inferred that though the biodiversity of the study pit lake is very high compared to that found in the scientific literature across the globe, these three pit lakes studied have not reached the level to be classified as Ramsar wetlands; however, with time, these pit lakes may fulfil that criteria.