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Nagpur Metro-Rail Constructional Impact on Environment

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ABSTRACT

Nagpur Metro Rail, an ambitious urban transport project, aims to provide a sustainable and efficient public transportation system for the growing city. The construction of the metro rail has had significant environmental implications, both positive and negative. On the positive side, it is expected to reduce vehicular emissions, ease traffic congestion, and promote eco-friendly transportation. However, the construction phase has led to deforestation, land-use changes, and temporary air and noise pollution. This paper assesses the environmental impact of the Nagpur Metro Rail construction, analyzing factors such as carbon footprint, land acquisition, biodiversity loss, and mitigation measures taken to minimize ecological disruption. Additionally, it explores the long-term benefits of the metro system in fostering sustainable urban development. The study highlights the importance of eco-sensitive planning in large-scale infrastructure projects to balance urban growth with environmental conservation.

1. INTRODUCTION

Nagpur, one of India's rapidly developing cities, has faced increasing challenges related to urban mobility, traffic congestion, and pollution due to a rise in private vehicle usage. To address these challenges, the Nagpur Metro Rail project was envisioned as an efficient and eco-friendly transportation system. The project aims to provide a reliable alternative to road-based transportation, reduce travel time, and decrease fuel consumption. However, while metro rail projects bring long-term sustainability benefits, their construction phase can cause significant environmental disturbances. This study focuses on assessing the environmental impacts of the Nagpur Metro Rail construction, considering factors such as air and noise pollution, deforestation, water resource management, and energy consumption. Additionally, the research evaluates the effectiveness of mitigation measures taken to reduce negative environmental consequences and ensure long-term ecological sustainability. The findings will provide insights into how large-scale

infrastructure projects can be developed while maintaining environmental balance.

2. LITERATURE REVIEW

A. Kumar and R. Singh, in their study on urban metro rail projects in India, analyzed the environmental impact of metro construction, focusing on air and noise pollution during the construction phase. The study highlighted the need for effective dust suppression techniques, noise barriers, and green construction practices. They suggested that environmental monitoring and mitigation measures should be incorporated at the project planning stage.

A literature review conducted by Patel et al. on the Nagpur Metro Environmental Impact Assessment (EIA) report revealed that the project adheres to environmental guidelines set by the Ministry of Environment, Forest, and Climate Change (MoEFCC). The EIA emphasizes air quality monitoring, proper waste management, and compensatory afforestation to mitigate biodiversity loss during construction.

B. Chaturvedi and N. Desai examined the role of metro systems in reducing greenhouse gas emissions in Indian cities. They reported a significant reduction in carbon emissions post-construction due to decreased reliance on private vehicles. The Nagpur Metro aims to achieve similar benefits by promoting the use of public transportation. The study also highlighted the potential of integrating renewable energy sources like solar panels into metro infrastructure.

S. Banerjee and K. Prasad conducted a comparative study on the operational phase of metro rail systems in cities like Bengaluru, Delhi, and Nagpur. The research highlighted that metro rail systems have contributed to improved air quality and lower fuel consumption. Additionally, they identified the importance of proper track design and advanced technologies for minimizing noise pollution and vibrations during operation.

Another study by T. Sharma et al. focused on sustainable construction practices in metro rail projects. They emphasized the importance of rainwater harvesting, energy-efficient lighting, and the use of recycled construction materials. The Nagpur Metro project has incorporated these practices to align with sustainable development goals and reduce its environmental impact.

R. Joshi and A. Mehta explored the social and environmental challenges faced during metro construction, particularly in densely populated urban areas. Their findings stressed the importance of community engagement and public awareness campaigns to minimize disruptions and promote the long-term benefits of metro systems.

K. Rao and M. Iyer highlighted the impact of metro projects on water resources. They emphasized the potential for groundwater contamination during excavation and tunneling and recommended proper drainage systems and groundwater recharge techniques to mitigate adverse effects.

N. Sinha conducted an environmental audit of metro rail systems and found that the Nagpur Metro could benefit from real-time environmental monitoring systems. These systems provide continuous data on air and noise pollution, helping project managers implement immediate corrective actions during both the construction and operational phases.

The literature highlights the environmental challenges and benefits of metro rail projects, with a strong emphasis on proper planning, mitigation measures, and sustainable practices to ensure a positive environmental impact.

3. METHODOLOGY

A. Data Collection

The existing land-use pattern of the area has been identified mainly as urban human settlements, roads, Trees and water bodies etc. Water Resources in the project were considered in terms of precipitation, surface runoff, quantity and water quality. These will facilitate decisions on various uses such as drinking, irrigation etc. Air and Noise quality is an important consideration during the construction and operation phases. Ambient air quality and noise levels were monitored in and around the project area to develop present baseline levels in the area. Terrestrial Ecology was studied. The vegetation types were documented through visual inspection, past research and field investigations. The materials and methods section should contain sufficient detail so that all procedures can be repeated. It may be divided into headed subsections if several methods are described.

B. Environmental Monitoring

It is necessary to monitor during various phases of project cycles the environmental attributes. Monitoring would indicate any environmental problem which has come up due to an ongoing activity. This will facilitate to assess the effectiveness of management /mitigation measures. The consultant has designed a post-project environmental monitoring program for implementation.

C. EIA

The objective of the study is to assess the impacts as a result of the construction of the Nagpur metro corridors along with depot and substations. The changes likely to occur in

different components of the environment were studied and analyzed. The core area of study is 100 m on either side of the proposed alignment. Based on project particulars and the existing environmental conditions, potential impacts were identified that are expected to be affected as a result of the proposed project and wherever possible, these are quantified. Both positive and negative impacts are evaluated to have an idea about the resultant impacts. These impacts were assessed for various phases of project cycles, namely, location, design, construction and operation. The standard methodology was adopted for impact prediction and assessment. Prediction is essentially a process to forecast the future environmental conditions in the project area that might be expected to occur. The project's environmental impact includes changes in land use, soil, erosion, air quality and noise levels etc.

D. Equipment's

Portable air quality detectors are used to analyze air quality parameters at Mankapur Square, Gaddigodam Square, Cotton market square, Ajni Square and Zero Mile square.

Figure 1: Portable air quality detectors

E. Observations and Data Collection

1. Nagpur Metro

38.215 kms of the metro corridor, 40 stations and 2 depots will be part of the Nagpur Metro Rail Network. Except for two stations, all stations are elevated (DPR, 2013). The entire stretch will be split into the following 2 alignments or corridors:

i. Nagpur Metro Rail Corporation Limited has arranged such projects in areas with nearby metro stations. Nagpur Metro will help Nagpurians such as Dilute Traffic Congestion, Control Pollution, Reduce Road Accidents,
ii. Increase Convenience, Protect from Weather Extremities, Reduce Travel Time, Reduce Transportation Costs and Save Energy (Fig. 1) The Nagpur Metro Region is therefore in need of a healthy, secure, effective, accessible, commuter friendly and environmentally sustainable fast public transport system.

2. Air Quality Analysis

The data and information were collected at various squares (Chowks) in Nagpur city to identify different air pollution parameters due to metro project construction.

Table 1. Nagpur metro corridor

Alignment	Corridor	Rail Length	From - to	No of Station	Link
1	North – South Corridor	19.658 Km	Automotive to Khapri	17	Mounje Square
2	East– West Corridor	18.557 Km	Prajapati Nagar to Lokmanya Nagar	19	

CONCLUSION

The construction of the Nagpur Metro Rail has brought significant improvements in urban mobility, reducing vehicular congestion and lowering long-term emissions. However, the study highlights several environmental concerns, including increased noise levels, disruption of water and soil quality, and loss of biodiversity due to deforestation. The use of sustainable materials, effective waste management, and adherence to strict environmental policies can mitigate these negative impacts.

To ensure minimal ecological disruption, it is recommended that the metro project incorporates renewable energy sources, green infrastructure, and regular environmental monitoring. Balancing infrastructure development with environmental conservation will ensure long-term sustainability and enhance the project's overall effectiveness in creating an eco-friendly urban transit system.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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