

Original Article

Environmental Impact Assessment: A Case Study of Construction of Metro Rail Nagpur, Maharashtra (India)

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Abstract - In recent years, the metro rail system implemented in major Indian cities has contributed to major changes in the country's transportation infrastructure and intra-city connectivity. Nagpur is Maharashtra's third-largest city and the state's winter capital. From March to April 2018, the environmental impact assessment of metro rail construction on five squares in Nagpur city was conducted. Portable Air Quality Detectors were used to research the PM 1, PM 2.5, PM 10, API Index, HCHO and TVOC variants. Other impacts are analyzed in a 100 m radius, such as vibration, traffic congestion, injuries, water use, vibration and noise pollution. In order to minimize these impacts during the implementation of the project, remedial steps are recommended.

Keywords - Metro rail, Transportation, Air pollution, Environmental impact assessment.

1. Introduction

Before the First World War, rapid industrialization and urbanization triggered a rapid depletion of natural resources in Western countries. This continued to raise questions about pollution, quality of life and environmental stress in the time after the Second World War. In the early 1960s, investors and people realized that the projects they were undertaking had an impact on the environment, resources, raw materials and people. As a result, pressure groups have been developed with the goal of acquiring a tool that can be used in any creation to protect the environment. The United States decided to respond to these issues and, in 1970, established a National Environmental Policy Act to consider its objective regarding environmental protection. The USA became the first country to adopt legislation on ENVIRONMENTAL IMPACT ASSESSMENT (EIA). This was the first time the EIA had become the official tool to protect the environment. The 1972 Stockholm Conference on the Environment of the United Nations and subsequent conventions formalized the EIA. All developed countries currently have environmental regulations, although most developing countries fail to implement them. (Lee, 1995; Modak & Biswas, 1999; Ogola, 2007).

The EIA is an evaluation of the potential environmental effects of a proposed project, taking into account the ecological, social and economic aspects. The evaluation aims to ensure that decision-makers consider the environmental impacts to determine whether to continue with the project (ANPS, 1997; Onishi and Fujita, 2006; Mondal et al., 2010; Zhuang et al., 2011). The EIA process

is a systematic approach used to define and analyze environmental and social problems relating to the project's research area. These involve possible threats and benefits to the community's well-being and the study area's physical, biological, and socio-economic environments. The evaluation ensures that any adverse environmental and social impacts/key areas of concern are properly addressed through mitigation strategies outlined in the management plan (Final Report, 2017).

The second capital of the state of Maharashtra is Nagpur. Due to urbanization, industrialization and becoming an educational hub, the population of Nagpur town is growing day by day. With an increased population, only a road-based system cannot fulfil the urban traffic needs of Nagpur. The reinforcement and enhancement of transport infrastructure have taken on the urgency with the expected rise in the region's population. In order to promote connectivity routes for the citizens of the city and to minimize pollution due to vehicle emissions, Maharashtra has decided to construct a metro rail within the city.

In this article, the report's main objective is the environmental impact assessment of the Nagpur Metro Rail Project in the city of Nagpur. In line with international best practices, this project has been planned. It assesses the applicable statutory framework; the social and environmental baseline; the options considered during the design phase of the project; the social and environmental impacts; and provides for the implementation of effective mitigation measures and a management plan.



2. Methodology

2.1. 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.

2.2. 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.

2.3. 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.

2.4. Equipments

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.



Fig. 1 Portable air quality detectors

3. Observations and Data Collection

3.1. 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:

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, 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.

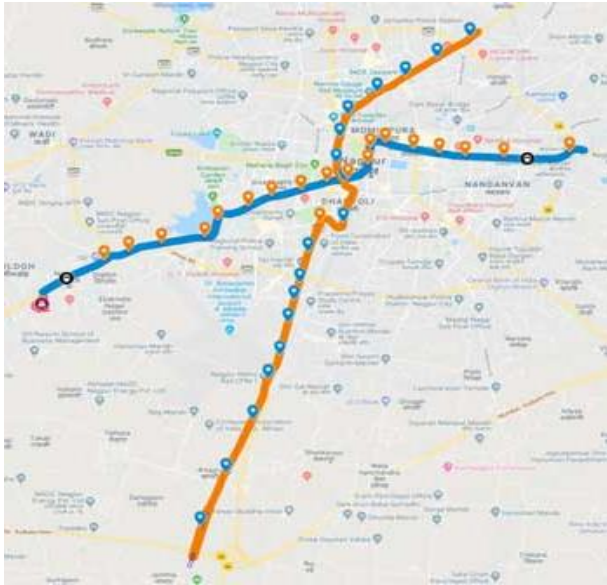
3.2. Air Quality Analysis

The data and information were collected at various squares (Chowks) in Nagpur city to identify different air pollution parameters due to metro project construction. The data collected in this regard is depicted in Fig 3 to Fig. 8.

Table 1. Nagpur metro corridor

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

(Source:dpr, 2013; NMRCL project report,2013)



Source: DPR, 2013; www.metrotrainnagpur.com

Fig. 2 Metro route at Nagpur

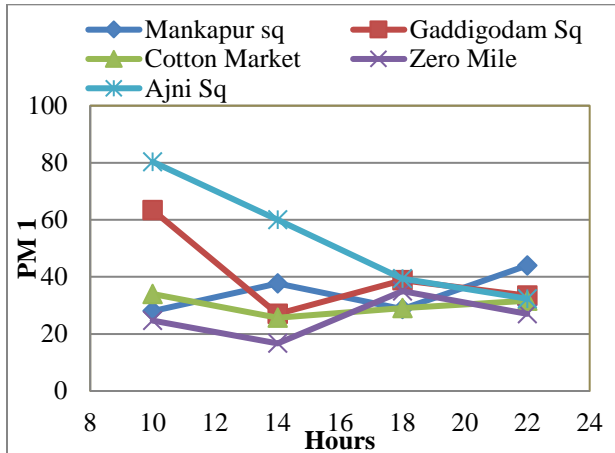


Fig. 3 PM 1 variation at 5 squares of Nagpur city during March- Apr 2018

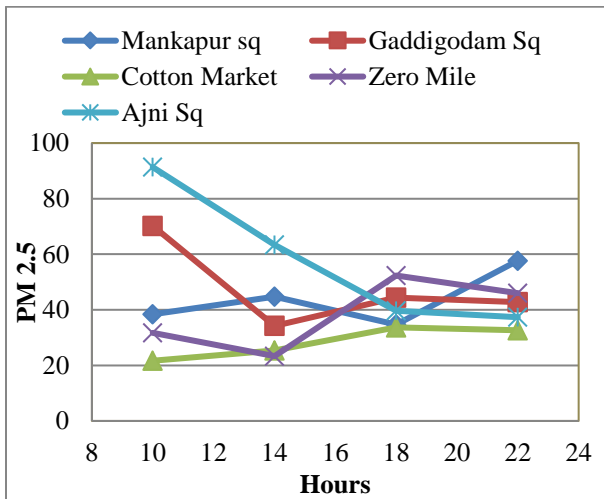


Fig. 4 PM 2.5 variation at 5 squares of Nagpur city during March- Apr 2018

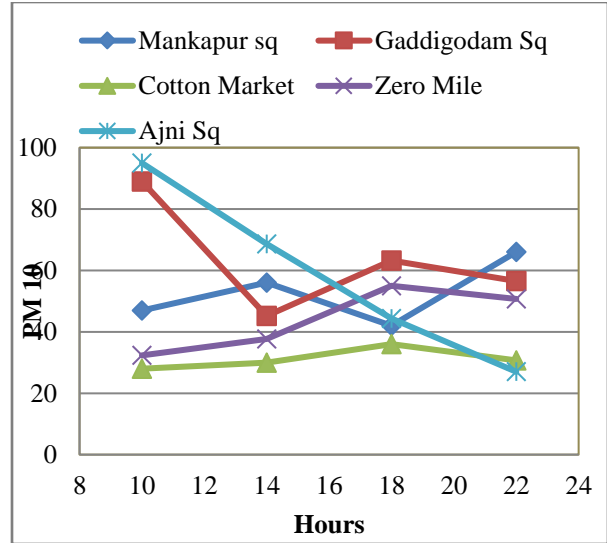


Fig. 5 PM 10 variation at 5 squares of Nagpur city during March- Apr 2018

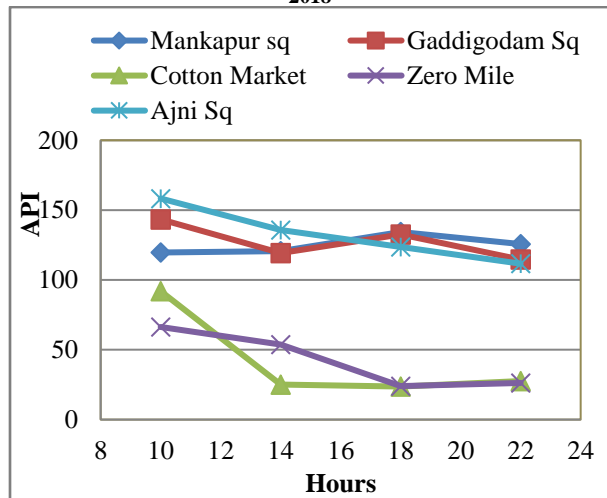


Fig. 6 API variation at 5 squares of Nagpur city during March- Apr 2018

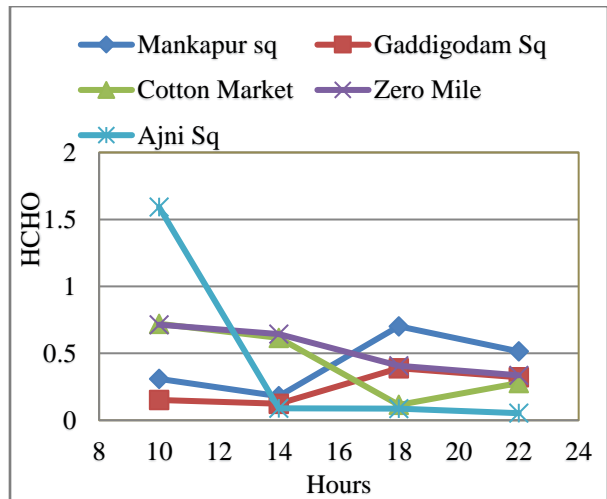


Fig. 7 HCHO variation at 5 squares of Nagpur city during March- Apr 2018

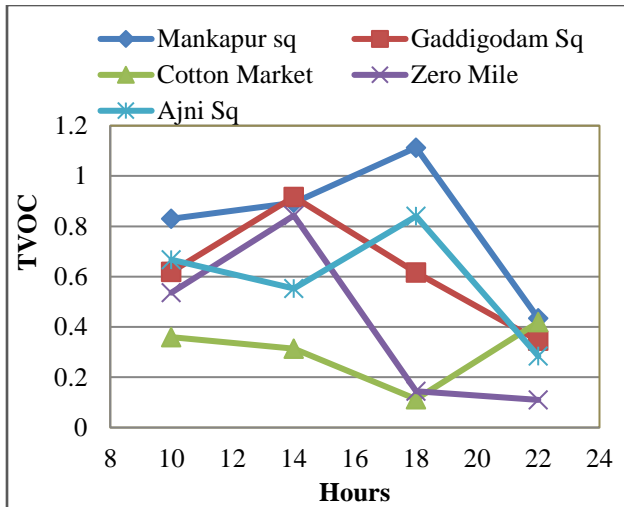


Fig. 8 TVOC variation at 5 squares of Nagpur city during March- Apr 2018

3.3. Traffic Congestion

Traffic congestion was observed throughout the city, where metro alignment work carried on. The area which is mostly affected and observed congested due to the construction of the metro project, Nagpur is on Wardha Road from Airport Square to Ajni Square; Pardi Square to Hindustan Builder’s buildings on Bhandara Road; the majority area of Hingna, Kamptee Road, Sadar area to Pagalkhana square. The traffic men were not able to monitor the scenario much of the time. The people who use these routes face the scenario of congestion regularly. Thus, to get the job/office, they have to leave their house early and vice versa.

3.4. Accidents

Two major accidents were recorded during the construction of the Nagpur Metro Rail Project. The first incident occurred at Itwara, and the second incident occurred in the city centre, but luckily there was no death.

3.5. Consumption of Water

As a result of construction activity and the movement of construction labor, the use of water supply rises. At the start of the summer season, the residents of Nagpur are faced with water shortages. Because of the construction of the Metro Rail Project, the water pipelines in most of the areas were damaged and not fixed within time, so people in that area were affected.

3.6. Vibration

Owing to the exaction of the Metro Rail piers, the vibrations were detected in the surrounding areas. No incident has been reported/recorded to date.

3.7. Noise Pollution

Noise pollution increased at peak hours because of traffic congestion and the construction of different components of the Metro Rail Network.

4. Results and Discussion

4.1. Impact of Air Quality Due to the Nagpur Metro Rail Project

The air quality parameters analyzed in the month of March – April 2018 at five squares of Nagpur city were depicted in Fig. 3 to 6. Fig. 3 indicates PM 1 variation. The PM 1 is more than 40 $\mu\text{g}/\text{m}^3$ at Ajni Square and Gaddigodam Square; the average is about 40 $\mu\text{g}/\text{m}^3$. Fig 4 indicates PM 2.5 variation ranges between 20 to 50 $\mu\text{g}/\text{m}^3$ and increases at Ajni Square and Gaddigodam Square. Fig. 5 indicates PM 10 variation ranges between 30 to 55 $\mu\text{g}/\text{m}^3$ increases at Ajni and Gaddigodam Square. Fig. 6 indicated Air Pollution Index (API) variation and increased at Ajni, Gaddigodam and Mankapur squares. Fig. 7 indicates HCHO variation and higher at Mankapur square. Fig. 8 indicates TVOC variation and found more than 1 at Mankapur square.

The permissible limit for 24 hours basis for PM 10 is 50 $\mu\text{g}/\text{m}^3$ (as per California ARB Standards), 150 $\mu\text{g}/\text{m}^3$ (as per Federal EPA Standards) and 100 $\mu\text{g}/\text{m}^3$ as per Indian National Air Quality Standards that of PM 2.5 is 35 $\mu\text{g}/\text{m}^3$ (as per Federal EPA Standards) and 60 $\mu\text{g}/\text{m}^3$ as per Indian National Air Quality Standards.

PM 2.5 is more than 35 $\mu\text{g}/\text{m}^3$ in almost all squares and more than 60 $\mu\text{g}/\text{m}^3$ at Gaddigodam and Ajni Squares in the Morning hours. This may be due to congestion in vehicle traffic and dust due to construction. This will affect human health and environmental impacts such as fog formation and low visibility during monsoon seasons and festivals.

4.2. Other Impacts

Sound pollution, vibration, water pollution. Traffic congestion, accidents and solid waste generation were observed during the construction of the Metro Rail Project in Nagpur.

5. Conclusion

After performing the study on the impacts of the Metro Rail Project at Nagpur from January 2018 to March 2018 following conclusions were drawn:

It is observed that PM 2.5 level at Mankapur, Gaddigodam, Cotton Market, Mankapur and Ajni square rises more than 35 $\mu\text{g}/\text{m}^3$, which is considerably more than the Federal EPA standards but permissible as per Indian National Air Quality Standards. Air Pollution Index (API) variation increased at Ajni, Gaddigodam and Mankapur squares at a moderate level from 10 AM to 10 PM.

This will adversely impact human health as well as the environment. Therefore, people should educate to wear a nose mask during the peak hours while moving by these routes.

This will create fog or low visibility during the monsoon/winter season and when crackers are used.

As the generation of solid waste increases due to the construction of the Nagpur Metro Rail Project, the excavated material and waste concrete should therefore be removed from the city to prevent traffic congestion and accidents.

The surface and subsurface water parameters should be regularly monitored to detect harmful contaminants, and steps should be taken to prevent their adverse impacts.

The traffic operators should be properly trained and educated also the proper system should be developed to handle the situation during congestion of traffic and to avoid the inconvenience to the people. It will help to reduce sound/noise pollution.

The Metro Rail Project is constructed using concrete structures, so the surrounding area's temperature may increase during the summer. The greenery should therefore be planted in order to balance the temperature increase in the future.

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