Eco. Env. & Cons. 30 (1) : 2024; pp. (360-371)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i01.066

Environmental Impact Assessment: Case Study of an Expressway Project

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(Received 13 October, 2023; Accepted 17 December, 2023)

ABSTRACT

Environmental impact assessment (EIA) is widely used around the world as an instrument for sustainable development, helping to integrate environmental considerations into the decision-making process for various projects, including infrastructure development, industrial activities, and land-use planning. There are several important environmental regulations or policies in India, including the Constitutional Provisions, 'Environmental Protection Act, Water (Prevention & Control) Act, Air (Prevention and Control) Act, Forest (Conservation) Act, 'Manufacture, Storage and Import of Hazardous Chemicals Rules and National Resettlement and Rehabilitation Policy. The current study is a case study of Environmental Impact Assessment of an Expressway Project. It explains all the aspects of EIA, Environmental Management Plan, and the mitigative measures taken for the project.

Key words: *Construction, Highway project, Environmental aspect, Impact assessment, Environment management plan, environmental regulations, Mitigation measures*

Introduction

Economic growth, urbanization, industrialization, and population growth have all increasing rapidly around the world. As a result, changing life styles and the emergence of numerous infrastructures negatively affect the environment. These losses manifest themselves through pollution and degradation of the environment. The overall goal of an EIA is to ensure that development is environmentally sustainable and environmentally sound by examining, analyzing, and assessing planned activities (Glasson *et al.*, 1999). The practice of environmental assessment requires continuous interactions between stakeholder groups, as they respond to their own expectations as well as extrinsic ones from other practitioners and legislation (Emilia R. B, 2023). The current study is on Environmental Impact Assessment of an Expressway Project in India.

Environmental Impact Assessment (EIA)

The interactions between man and the environment (living and non-living) have been growing dynamically, globally, since the 18th century. Increased societal demands have led to environmental changes and risks, which in turn have shaped societal demands for measures to prevent, eliminate, minimize, or compensate the depletion of the environment. Environmental Impact Assessment (EIA) is a concept that was first introduced to the United States by the National Environmental Policy Act (NEPA) which was enacted in the 1970s (Morrison-Sauders and Arts, 2004). The EIA is a widely used around the world as a tool for sustainable develop-

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ment, helping to integrate environmental considerations into the decision-making process for various projects, including infrastructure development, industrial activities, and land-use planning. The process contributes to the overall goal of balancing economic development with environmental protection. Effective implementation of the EIA process is vital for reaching sustainable development by matching economic growth with environmental conservation and societal well-being. It safeguards that projects are designed and executed in a manner that minimizes adverse environmental impacts and maximizes the positive contributions to the society/community and ecosystem. Alternatives to the proposed project are often examined to determine the most environmentally friendly option.

Purpose of EIA

Since the start of the 21st century, the concept of EIA became popular in almost all the countries (Bond *et al.,* 2020). The EIA evaluates the potential environmental consequences of a proposed project, plan, program, or policy before it is implemented. The goal of an EIA is to identify and assess the potential environmental effects of a project and to ensure that these effects are considered during the decision-making process. Main purpose of EIA is to guarantee 'sustainable development that is in harmony with conservation of ecosystems, protection of human health, and with consideration of social aspects' (Wood, 2003; Wathern, 1994; Morrison S. *et al.,* 2001; Morrison-S. and Arts, 2004; Jay *et al.,* 2007; Toro *et al.,* 2010; Morgan, 2012; Toro *et al.,* 2013; Fadli, *et al.* (2014)). The EIA study assumes that consequences and future developments can be predicted and formally planned (Retief *et al.,* 2016). However, EIAs are always predictions, and real impacts may differ more or less from what they predict.

Implementation of EIA

The implementation of an EIA involves a systematic and structured process to ensure environmental considerations are integrated into the decision-making process for proposed projects. The EIA study involves project screening, scoping, baseline data collection, impact assessment, alternatives assessment, mitigation measures, EIA report preparation, public consultation, etc. The implementation of EIA has been discussed globally and has long been one of the important topics of expert studies (Loomis and Dziedzic, 2018). Its gradual development and improvement of EIA practices over time for achieving more accuracy of the predictions are crucial factor in preventing, reducing, or compensating of environmental risks associated with the development.

Post-project analysis

EIA post-project analysis EIA-PPA comprises evaluating the actual environmental outcomes and performance of a project after it has been implemented. It is crucial for assessing the accuracy of predictions made during the EIA process, identifying any unforeseen impacts, and ensuring that mitigation measures were effective. The EIA-PPA is a process of monitoring and evaluating the real environmental impact (Wood, 2003; Polonen *et al.,* 2010; Jalava *et al.,* 2015) of projects that were evaluated in the EIA and consequently its potential impacts were predicted.

When planning and designing a project, EIA-PPA permits for a formal and factual evaluation of the EIA process, the subsequent recommendations, and the acceptable conditions (Retief *et al.,* 2016; Loomis and Dziedzic, 2018; Morrison-Saunders *et al.,* 2015). By comparing predicted expectations with real impacts, it becomes a key test of EIA predictive power. Continuous feedback on implemented EIAs can be beneficial (Wood, 2003) to gain new knowledge, experience, lessons, and examples of good practice that will aid in improving future evaluations. It remains to be seen how the post-auditing should be legislatively designed in relation to the EIA process in both the temporal and material contexts.

Literature Review

As EIA procedures were developed around the world by major emerging economies such as those in China, India, and Brazil, as well as developing countries facing their own unique sustainable development challenges (Yang, 2018), all these countries developed governance systems (Yang, 2018; Johnson, 2020). Individually and collectively, EIA procedures have strengths and weaknesses (Morgan, 2012), this is why we explore EIA researchers' perspectives to highlight them.

Core characteristics and implementation of EIA procedures can be comparable across jurisdictions, but they vary from country to country, leading to different environmental outcomes, sometimes even between projects in the same jurisdiction (Nita, 2019). These differences come from several limits obstructing the proper implementation of the EIA process which are common worldwide: low quality

of assessment reports (Nita *et al.,* 2015; Anifowose *et al.,* 2016; Bond *et al.,* 2018), lack of public participation (Hasan *et al.,* 2018) or manipulation of the process (Enríquez-de-Salamanca, 2018), insufficient equipment and trained staff, inadequate institutional framework for decision making (Suwanteep *et al.,* 2016), and low cooperation between policymakers, researchers, and stakeholders (Dangi *et al.,* 2015; Bratman and Dias, 2018).

Sustainable development practice is increasingly being accepted worldwide because it supports economic development while considering the environmental protection necessary for our long-term survival (Esseghir and Haouaoui Khouni, 2014; Marques *et al.,* 2018). Sadler (1996) defined the EIA as "a process where EIA is working as intended and, secondly, whether it is meeting the purposes for which it was designed". It has been a recurring theme in EIA investigation since the 1970s (Khan *et al.,* 2020; Lyhne *et al.,* 2017), facilitating the development of good practices in conducting EIAs and strategies for strengthening them. Therefore, this concept has been used for publications (e.g., Hirji and Ortolano, 1991) that analyzed and analyzed EIA's procedural elements, their costs, and benefits, which continue to generate discussions on its effectiveness (Morrison-Saunders *et al.,* 2015. This has led to the publication of numerous papers on EIA effectiveness (Chanchitpricha and Bond, 2013; Geißler *et al.,* 2019; Loomis and Dziedzic, 2018; Pope *et al.,* 2018), considerations and analyses on different effectiveness dimensions (Baker and McLelland, 2003; Bond *et al.,* 2015; Loomis *et al.,* 2022; Pope *et al.,* 2018; Sadler, 1996), evaluation of effectiveness (Cashmore *et al.,* 2010; Morrison-Saunders and Arts, 2004) as well as case studies in several countries countries (Arts *et al.,* 2012; Caro-Gonzalez *et al.,* 2021; Kahangirwe and Vanclay, 2022; Nakwaya-Jacobus *et al.,* 2021).

The EIA is a systematized procedure to evaluate environmental impacts to promote sustainability and the decision-making process of a future project (Ferreira *et al.,* 2016). This is a method for analyzing a project's socioeconomic and environmental impacts and providing measures to mitigate them (Alamgir *et al.,* 2017; Fitzpatrick and Sinclair, 2009). Road projects must be environmentally sustainable in order to mitigate the negative environmental impacts of megaprojects (Makhdoom *et al.,* 2018; Saqib *et al.,* 2023). The construction of roads creates significant emissions of carbon dioxide, losses of biodiversity, pollution of water, loss of agricultural land, and soil contamination (Iarocci *et al.,* 2019; Saqib *et al.,* 2022; Zhang *et al.,* 2013). In addition to noise pollution and air pollution, natural resource depletion, deforestation, and increased waste production are other examples of adverse environmental effects (Hassaan *et al.,* 2016; Kanwal *et al.,* 2020; Saqib *et al.,* 2018). Natural environments may also be negatively affected by deforestation and glacier melting (Jaafari *et al.,* 2015; Lamorgese and Geneletti, 2013; Yang *et al.,* 2015). There may be an increase in CO_2 emissions and atmospheric pollution as a result of the gradual increase in transportation (Nabi *et al.,* 2017; Saqib *et al.,* 2023). There are several systematic and widespread methods available for assessing environmental performance, including multi-criteria modeling and metadata analysis (Pirrone *et al.,* 2005).

The limited scientific evidence in impact assessment studies along with the low involvement of scientists in policymaking and decision making are often mentioned as the weak points of the EIA process (Cashmore, 2004). Even though there are several studies that provided international surveys or reviews of discourses or studies that envisaged environmental assessments' performance, outcomes and challenges (Sadler, 1996; Cashmore, 2004; Wood *et al.,* 2006; Jay *et al.,* 2007). In addition, there is an urgent need to better understand the science – practice gap and overcome ubiquitous EIA procedural weaknesses environmental evaluation of projects, because we are now faced with the critical challenge of using these EIA procedures to effectively address the climate change crisis.

Environmental Regulatory Frameworks in India

There are several important environmental regulations or policies in India that might impact the project environment, including the Constitutional Provisions ('Article 48 which provides for the protection & preservation of the environment' and Article 51-A (g) on fundamental duties), 'Environment (Protection) Act, 1986' towards protection & improvement the overall environment, Water (Prevention & Control) Act, 1974 (on prevention and control of water pollution), Air (Prevention and Control) Act 1981 (or the prevention, control and abatement of air pollution), Forest (Conservation) Act 1980, 'Manufacture, Storage and Import of Hazardous Chemicals Rules 1989' and National Resettlement and Rehabilitation Policy.

According to existing regulations and rules, the contractor must take all necessary precautions and measures to ensure the work will comply with all statutory and regulatory environmental requirements, avoid nuisances or disturbances to the public, and restore the affected area to its original condition.

EIA Case Study

Basic studies on the Environmental impact assessment requires to make out the rationality of the environmental assessment, significance of the mitigation procedures suggested and the opportunities to improve of the quality of road - defined environment. Environmental impact due to the project activity on each of the environmental attributes has been summarized below.

About the Project

The length of six-lane project 58 miles connecting two cities. The expressway is designed to handle up to 1,000,000 PCUs. There is a provision for 7000 trees plantation on both sides of expressway. The actual completion cost of project was US$200 million. It has six ventilated tunnels totalling 5,724 metres. The expressway has provided faster connectivity between two cities and also connected nearby cities. This has led to reduction in travel time between these cities. The estimated cost to meet environmental obligation is as follows:

Total capital cost in Rs. Lakhs

Aforestation: 30
Minimisation of severance: 3874
Development of grazing lands: 80
Annual recurring costs: 9

Impact on Air Quality

During construction phase: Burning diesel produces air pollution throughout the construction phase. Under adversative meteorological circumstances like constant condition during winter subsequent to sunset, it is likely that the CO_2 standard may be dishonoured by working round the clock. There can be an increase in Suspended Particulate Matter (SPM) levels also because of the construction phase. Construction work being performed round-the-clock may violate the SPM standard. The construction phase will also increase SPM levels. Although the background levels of gaseous pollutants are low, no violation of SPM standards is expected due to low winds and stable conditions that increase gaseous pollution levels. Water should be used to stabilize areas prone to fugitive dust emissions (for example demolition, excavation and grading sites and route of delivery vehicles across areas of exposed earth), so stationary equipment should be located as far from receptor locations as possible. Construction activities should be restricted been 6.00 a.m. and 6.00 p.m. to avoid violation of the 24-hourly average standards.

Operations phase: Entrepreneurs use the California Department of Transportation air quality model CALINE3 or the years to predict future air quality scenarios and to determine the long-term value of a quality by comparing it to the prior period.

CO levels: On comparison with the hourly standard for CO of 4000 kg/m3 no violations of CO standards are expected due to the project. The CO levels, in fact, will remain below the standards.

Nox levels: Hourly simulations for Nox the prior period and current period are compared with the WHO standard of 400 kg/m3. Predicted values are expected to be well below the standard prevailing.

The usage of fuel-efficient engines, etc. and regular engine maintenance will aid to reduction in pollution because of vehicular emissions. In addition, plantation of suitable plants with properties to absorb HC like neem is recommended.

Noise Level Impacts

Construction phase: Construction is likely to produce noise levels ranging 80 to 95 dB (A). Workers generally are exposed to 80 to 90 dB(A) during one shift against the approved limit of 90 dB (A).

Use of equipment omitting noise of not greater than ninety dB (A) for the shift which is of 8-hour duration, citing of construction yards leaving at least 100 m distance from any residential areas, use of noise shields to construction machinery and provision of ear plugs to the heavy machine operators are some of the mitigating measures during construction activity

Operations phase: The before and after model results of traffic for both "without project and with project" scenarios, regarding the distance from the edge of the road, have been worked out. The projected day ambient noise-level of 55 dB (A) with the free-flow condition are likely to arise at 200 m after the road, and the night noise level of 45 dB (A) at more than 700 m. Greenbelt development along the

main road was found to be the solution for reduction in noise levels.

Impact on Water Quality

Spilling of construction materials, oils, grease, fuel, and paints etc may cause Contamination to water bodies. As there is no circumstance of dumping and thus leaching harmful substances into water table, impact on ground water quality was minimal. Appropriate drainage to carry out the surface run-off away from the water bodies were designed.

Terrestrial and aquatic ecology impacts

The preliminary project site construction work involves land clearance, cutting, filling and levelling, which may cause partial loss of potential fertile agricultural land and loss of vegetation. Unavoidably there will be temporary impact on existing of nesting sites for the birds. The elimination of herbaceous vegetation from the soil and disappearance of the topsoil largely cause soil erosion.

Instead of cutting tress, they should be excavated from their roots and anted in nearby alternate empty areas to minimize the impact of landscaping. Plant species suitable for the areas would be planted a 1 set of the monsoons. The plants should be provided acceptable protection form animals and appropriate monitoring be carried out to assure their growth.

Impact on creeks

During the construction of over bridge, the construction material may find its access to the water bodies altering the natural water flow, hereby disturbing the aquatic fauna. Temporary displacement of the aquatic fauna may take place during the construction of the over bridges. Considerable care should be taken not to spill construction materials, fuel oil, paints etc near water bodies.

Impact on Quarry Sites

The import of earth fill materials and stone aggregates is the main quarrying need for the project. As most of the area in the expressway is passing through barren hilly terrain, the construction material will be easily available. No major impact relating to quarry site areas is envisaged due to construction activity at least as far as the present expressway projects are concerned.

Environment Management Plan

The probable impact during the construction of the project and the mitigating measures including the post project monitoring programs undertaken by the concerned entity are briefly summarized below:

Mitigation Measures

The construction of expressway will result in overall improvement of quality of environment in the surrounding region. However, within the ROW itself some local environment impact is unavoidable. Mitigation measures to be undertaken address the following areas:

- Coastal Zone Management aspects.
- Quarrying operations.
- Disposal of construction waste.
- Soil quality management.
- Water quality management.
- Movement of people animals and wild life noise control.

Coastal Zone Management Aspects

All island (whether shown or not in CZ MP maps) in rivers, creeks, backwaters and sea will be classified and treated as CRZ -I if uninhabited and as CRZ-III if inhabited.

Plantation of mangrove trees equal to twice the mangrove area affected by the project should be ensured. In the zone of tidal movement, sufficient number of balancing bridges will be provided with adequate waterway opening.

Quarrying and Earth Materials

The construction / fill material should be from approved sites. When it is necessary to obtain materials from new quarries, approval for opening of quarries should be obtained from the competent authority.

- No new quarries are to be opened anywhere.
- No excavation or dumping of surplus material will be allowed on private property without previous written consent of the owner.
- No excavation or dumping will be carried out on wetlands, forest areas or other ecologically sensitive locations.
- Cutting form borrows areas will be done in a systematic manner to prevent scars on environment. Proper dressing of slopes, drainage measures, landscaping and disposal of surplus material will be ensured.
- Operations of crushers and earthmoving machinery should not create dust nuisance. Proper water sprinkles etc., should be used.

Disposal of Construction Waste

Construction wastes including bituminous material and the hazardous material will not be allowed to contaminate watercourses. The sites for disposal of such materials identified well in advance before construction and lined adequately so that such materials do not reach in the ground water.

As much material as possible form ROW cutting will be utilized for road construction. The disposal of excess material and unsuitable material for road construction will be in planned way in pre- determined locations (such as closed quarries, identified and approved lowlands etc.) The finished surfaces will have proper levels, side slopes required from the point of view of stability, drainage and will be treated so as not to create scars eyesores to general landscapes.

Soil Conservation Aspects

Excavation work will be carried out in consultation with soil conservation and watershed development agencies working in the area.

Slopes of cutting in soil for roadwork and in quarries will be gentle and stepped and will be covered with suitable turf, plantation / pitching for prevention for erosion.

Tree felling will be restricted to actual construction limits. The trees, which are necessary to be felled, will be identified beforehand and necessary specific prior approval from the competent authority will be obtained. Sufficient number of trees of suitable species will be planted in lieu of the trees felled.

Extensive-avenue plantation with suitably selected species will be undertaken on both sides of the read. At least three rows of trees on each side will be planted subject to availability of land.

It is possible to transplant some species to trees having certain age and size. Such trees should be identified and transplanted

Controls with Respect to Quality of Water

For minor watercourses adequate waterway will be provided in the hydraulic design of culverts. All culverts will be of suitable size for proper cleaning and culverts maintenance. A minimum pipe dia. of 1.6m (1.2m in exceptional cases) will be used with box-sections having minimum of 2.0m (absolute min. 1.75m) and width of 2.0m.). Where no identified watercourses exist, the water blocked by the embankment will be drained by toe drains, which will discharge cross into drainage work at approximately every 300-400 meters. Water pounding will be avoided. The C.D works will carry water across the expressway without affecting the drainage patterns of the area in any major way. Adequate waterway will be ensured at all river crossing to avoid undesirable obstruction to river flow and also nay adverse effects on the river regime.

Construction bridge superstructures, when perennial rivers are involved will be done in such a way as to eliminate the need of putting staging in the river water. Thus, technique like cantilever construction, launching of precast girders, staging supported on piers etc will be used. Adequate provision for infrastructure facilities in water supply, fuel, sanitation etc. will be ensured for construction workers during construction period to avoid adverse impact on environment by the presence of work force and discharge of domestic and construction waste.

Movement of Peoples, Animals, Wildlife and Noise Control

The expressway being fenced does not allow cross movement of people, animals and wild life. For them sufficient provision below the embankment by way of opening such as foot- bridge / crossing over cutting of long stretches should be made. The average spacing of such facilities is to be about 500 Apart from car-track under- passer, over-passes and pedestrian crossing, C. D. works of rectangular section of minimum height of 1.75m and 2m width (and above) can be taken as suitable provisions for this purpose.

In forest area width of constructed. When toe-drains and plantations restrict of discourage such cross movement, sufficient number of crossing as mentioned in (19) should be provided.

Near habitable areas (nearer than 500m from expressway) provision for noise control should be made. This consists of noise barriers in heavily populated areas. In lightly populated areas noise control by plantation of trees forming barrier of foliage for full height (such as Ashoka tree) will be used.

Other General Aspects

Workers colonies should be properly planned and supply of potable drinking water and LPG fuel should be ensured to them to prevent cutting of trees for fuel. Suitable sanitary arrangements for

them should be provided.

The Project affected people should be adequately rehabilitated. The rehabilitation and resettlement of tribal shall conform to the provision of panchayats (extensions to scheduled area) Act 1996.

Separate environment clearance will be needed for real estate development associated with such project following the applicable procedures.

A broad-based committee will be set up by the project proponents involving environmental experts, local people representatives of state government, representatives of state pollution Control Board and the project staff to ensure that the conditions stipulated and recommendations made of MoEF are strictly followed. This committee will be independent of the project construction / suspensions staff.

The project authorities will have to prepare a disaster management plan so that the victims of accident can be provided with immediate medical help. Essential equipment, buildings and facilities required for this purpose will be budgeted for in the project.

Safety Measures and Safety Barriers

Road marking: The purpose of road marketing is to inform and guide drivers about exact locations of traffic lanes, limits of roadway, location of merging or diverging lanes, zones where entry of vehicles should preferably be provided, directional arrows, restrictions on overtaking, etc.

International practice for expressway has to be considered since Indian practices for expressway have not yet been established. These signs have been more or less internationally standardized. In India these standards have been covered by the Indian road congress in Code IRC: 35-1970, (latest reprint 1992). The MOST detail in "type design for intersection on national highways", provides good guidelines. Some of these signs are independent of the design speed; the sizes of letter need be larger and spaced in such away as to suit the faster speed and reduced time for driver to see them.

Type of road markings: Since the expressway is an access control facility, the types of signs to be used on the carriageway proper are limited. For other roads joining the expressway standard signs as per IRS: 35 are to be used.

Carriageway marking

- Traffic lane lines, and no passing zone markings.
- Border or edge line.
- Carriageway width transition marking and obstructions approach signs.
- Direction arrows.

Object markings

1. Object adjacent to carriageway (e.g. Emergency Roadside Telephones)
2. Kerb marking for visibility.

Recommended Size and Dimensions and Colours

Traffic lane line and no passing zone marking

Traffic lane dividing lines are to be in white color paint. Generally, they are 100 wide broken line with 3m long segment and 4.5 m gaps. On all curves in palm and on two sides of length of summit curves equal to minimum passing sight distance, the line should be full continuous the line indicating no passing zone.

Border of edge line

A full line in yellow colour having width of 150mm at the edge of outer traffic separating traffic lane from paved should.

Carriageway width transition marking and obstruction approach read

These are expected only near approach / exit from toll plaza, interchanges and roadside amenities where lane merging take place.

Direction arrows

These are to be used in additional to overhead signs by marking at center of lanes showing direction of movement.

Object markings

Two types of object marking are required.

Environment Impact Assignment

The preliminary EIA report for project was submitted to the ministry and the least expensive route was selected.

Following surveys were conducted.

1. Surface water quality along proposed expressway alignment and the adjacent project.
2. Soil quality survey.
3. Air quality survey.
4. Noise level measurements along the adjacent

project.
5. Severance studies along proposed expressway alignment.

Surface Water Quality Survey: The survey was conducted for open wells, tube wells, rivers, lakes and creek falling on the expressway alignment and 100 m distance from both sides of the alignment.

Soil Quality: The Soil samples were collected on the proposed alignment and existing adjacent project. The soil samples were analyzed for Lead, magnesium, sulphates, chloride contents etc.

Air quality: The air quality was measured for 502, Nox, SPM, CO and HC on the expressway alignment.

Noise Measurements : The noise levels were measured at the existing adjacent project at a distance of 5 m from vehicular source.

Environmental Components of Concern

The various environmental parameters mentioned below would be adversely affected and need suitable mitigative and protective measures.
1. The water quality of rivers used for drinking and industrial purposes.
2. Drainage of the entire area along the alignment and, particular, the low-Iying area near Panvel.
3. Loss of forest area in general and loss of exclusive and rare floristic resources in particular.
4. Effect on the wild life in ghat area in genera and on endangered species (Giant squirrel and mouse deer in particular).
5. Landslides in the ghat section.
6. Servants which may be suffered by the inhabitants of villages located adjacent / close to the alignment.
7. Land use and grazing pattern.
8. Borrow areas and landscaping, particularly in the ghat section.

Adverse impacts on other environmental components like air quality, noise vibration. Fisheries, navigation, land use, public health and places archaeological and historical values etc. are not expected to be appreciable, through mitigative measures to minimize their adverse effects will be implemented.

Significant Positive Impacts

These can be summarized as follows:
1. Travel between the industrial centers of the two cities will be economical, safe and fast.
2. Traffic volume on adjacent National Highway is expected to decrease due to diversion to the proposed expressway hereby reducing traffic intensity on it resulting in decreased air and noise pollution.
3. Inconvenience and safety problems presently faced by the people at certain areas, due to intensive use on adjacent NH, will be reduced.
4. Industrial activity at the area connected would be enhanced.
5. Commercial activity is expected to grow at the point of access to the proposed expressway.
6. Employment opportunities will be created during construction phase.

Environmental Management Plan (EMP)

The objective of preparing an Environmental Management Plan (EMP) is to formulate measures to (a) mitigate adverse effects on environmental resources as identified in the EIA study; (b) safeguard environmental resources wherever possible; (c) improve the value of environmental components wherever possible, etc.

In addition, the EMP includes a plan for monitoring, in order to, facilitate evaluation of the achievement or failure of environmental management methods and re-orientation of the plan if found essential. Construction supervision consultant and the contractor will be responsible for ensuring that the environmental commitments.

It is emphasized that many of the protective and enhancement measures be implemented by adopting suitable planning and design criteria for construction of the expressway. The resources required for the mitigative / protective / enhancement measures and to ensure their implementation and for monitoring are provided in the cost estimates of project.

Mitigation Measures Taken

Along the rural uninhabited stretches, plantation should be done in two rows in a staggered manner at about 4 m spacing. Green strips of native species of highly tolerant to grazing, compaction and other physical disturbances should be regenerated in the land proposed to be acquired on either side of Project Road along rural stretches. Along the uninhabited urban stretches, plantation of suitable indigenous species is provided in single row on either side at about 4 m spacing. Shrubs of low height such as Bougainvillea and Kaner are planted on the central median. Along urban and rural densely populated stretches, special screens of double storied

plantation developed as air and noise barrier.
The mitigative measures to check the localized effect of project on land use are:

- Development of quatter/settlements in the proposed ROW of the road is prevented.
- Care is taken to confirm that the construction workers camp does not interrupt the surrounding land use.
- Impacts from Construction Workers Camp
- Solid waste and sewage generated from construction workers camp can pollute the surroundings and cause health problems.

Mitigation measures related to the construction workers

- Water supply and toilet facilities at construction camps are provided.
- Lavatories are located away from the water bodies.
- Proper disposal of domestic refuse was undertaken.
- Medical facilities for the construction workers are provided.

Conclusion

Environmental impact assessments are carried out on the construction projects to ensure minimisation of adverse effects of construction. The Environmental Management Plan was formulated to mitigate adverse effects on environmental resources as identified in the EIA study and improve the value of environmental components. Measures such as road hardening, boundary fencing, and bare ground covering are done to reduce dust emissions, and the spread of dust can be effectively inhibited by watering. Waste disposal was also taken care of. Appropriate mechanisms were adopted to protect soil, water and air quality. The positive social and economic impact of the project are considerable reduction in travel time, manufacturing and industrial activity of the connected area, generation of employment opportunities with the minimum environmental impact.

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