# ENVIRONMENTAL IMPACT ASSESSMENT FOR NH-73 (NEW NH-344) FROM BARWALA TO PANCHKULA (KM 157.190 TO KM 176.430)

*A Thesis Submitted in Fulfilment of the Requirement for the Award of the Degree of*

**MASTERS OF ENGINEERING**

**IN**

**INFRASTRUCTURE ENGINEERING**

*Submitted By*

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# DECLARATION

I, Puranjay Mathur, hereby declare that the work prepared in thesis entitled "Environmental Impact Assessment for NH-73 (new NH-344) from Barwala to Panchkula (km 157.190 to km 176.430)" in fulfilment of the requirement for the award of degree of Master of Engineering in Infrastructure Engineering in the Civil Engineering Department, Thapar Institute of Engineering and Technology (Deemed to be University), Patiala is an authentic work carried out under supervision of Dr. Bholu Ram Yadav, Assistant Professor, School of Energy and Environment and Dr Dwarika Nath Ratha, Associate Professor, Department of Civil Engineering, Thapar Institute of Engineering and Technology, Patiala during July 2016 to July 2018. The matter presented in this has not been submitted either in part or full to any other university or institute for the award of any degree.

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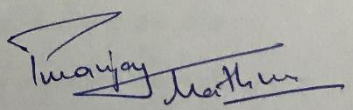

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# ABSTARCT

The Environmental Impact Assessment (EIA) is a systematic investigation of both positive and negative impacts on the physical, biological and socio-economic environment, which would be caused or induced due to a proposed developmental project. EIA provides a plan to reduce the negative environmental effects of proposed development project through alternative approaches, design modifications and remedial measures. Highway construction is a major activity of economic development especially in developing countries. Road development is major source of damage to the environment, including ecological destabilization, habitat disturbance and damage to flora and fauna. In this study analyses of the environmental impacts likely to occur due to the proposed widening of a 19.2 km stretch of NH-73 (new NH-344) from Panchkula to Barwala. The report highlights the importance of EIA in the sustainable development of highway project. The study concentrates on the EIA of the project in the light of the existing situation at the site. The parameters covered in study are Socio-Economic, Ecological, Soil & Noise. Samples of soil were taken to analyse their present conditions and were compared to the other set of samples collected from the nearest agricultural area. Minimal soil contamination was observed. Noise levels were found exceeded permissible limits during night time. Qualitative measure of the socio-economic factor was calculated by comparing the results of two surveys done for experts and local public.

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# LIST OF ABBREVIATIONS

| ABBREVIATION | FULL FORM |
|---|---|
| CPCB | Central Pollution Control Board |
| EA | Environmental Assessment |
| EIA | Environmental Impact Assessment |
| EMP | Environmental Management Plan |
| EPC | Engineering, Procurement & Construction |
| GIS | Geographical Information System |
| GOI | Government of India |
| MoEFCC | Ministry of Environment, Forest & Climate Change |
| NGOs | Non-Governmental Organizations |
| NHAI | National Highway Authority of India |
| PQC | Pavement Quality Concrete |
| RIAM | Rapid Impact Assessment Methodology |
| SIAM | Spatial Impact Assessment Methodology |
| SWOT | Strength, Weakness, Opportunity and Threat |

# CHAPTER 1
# INTRODUCTION

Environmental Impact Assessment (EIA) is defined as a tool used for decision making for projects, developments and programmes like airport runways, incinerators, peat extraction and pig rearing. EIA is used to identify the Environmental, Social and Economic impacts of a project development prior to decision-making. That means, it is easy to identify:

1. Most suitable option at an early stage
2. Best practicable environmental option
3. Alternative processes, if any

The project managers address these problems in order to restrict or minimize environmental impacts in conjunction with their project planning. This helps in the likelihood of the planning stages to run smoother. The Environmental Assessment (EA) is done by the Developer although the work is often performed by Environmental Consultants. EA is done to produce an Environmental Statement. The Environmental Statement should include:

- The project description: location, size, area etc
- Description of any significant effects
- Important Mitigating Measures
- And a Non-Technical summary

## 1.1 ORIGIN OF STUDY

The Government of India (GOI) passed the Environment (Protection) Act on 23rd May 1986. To attain the objectives of the Act, one of the decisions taken was to make EIA mandatory. After succeeding the legal procedure, a notification was issued on 27th January 1994, later amended on 4th May 1994, 10th April 1997, 27th January 2000 and 14$^{th}$ September, 2006 making EIA mandatory for 30 different activities. Beside this, the GOI under Environment (Protection) Act 1986 issued a number of notifications, which are related to EIA.

Highway development has many environmental impacts as compared to any other development projects. That is, because highways extend to a long distance and, by improving fast communication, they can influence dramatic changes in land-use patterns not just in the closest

locality but also in the nearby localities. Highway development is highly crucial for the socio-economic development of the area. Development of any industry, mining forestry, agriculture, trade and tourism etc. depends largely on the existence of proper transport network. In order to improve the efficiency of transportation system, new roads are constructed and previously present or existing roads are improved.

## 1.2 NEED OF STUDY

Panchkula-Barwala highway (NH-73, new NH-344) project, for the most part, was proposed to enhance the economic and social prosperity of individuals. Expanded road capacity and enhanced pavements can decrease travel time and lower the expenses of vehicle utilization, while expanding access to business sectors, employments, and health sectors and lessening transport cost for both cargo and passengers. For all the positive roles and uses of roads, they may likewise have huge negative impacts on close-by networks and natural environment. Hence, environmental study and also the study of socioeconomical changes due to the construction were important.

## 1.3 OBJECTIVE OF STUDY

The objective of the EIA process lies in its capability to direct project studies and address environmental impacts before they could occur.

The major objectives of carrying out the environmental and socioeconomic study on the Panchkula-Barwala highway (NH-73, new NH-344) widening project were as follows:

- Analysis of the socio-economic impacts on the project affected population and calculating the qualitative measure of the socio-economic factor.
- Determination of the environmental impacts due to noise during constructional phase.
- Impacts on the agricultural quality of the soil due to the widening of the existing highway.
- Identification of areas and characteristics, which are environmentally or socioeconomically important.
- Representation of public view on various environmental and socio-economic aspects.

## 1.4 SCOPE OF STUDY

Out of all the major problems that can occur in any highway project, the present study focuses mainly on the socio-economic impacts of the widening of the highway on the local people. Public consultation was done for various problems and benefits such as high noise levels, changing land values, new job opportunities and various other impacts. A survey for collecting the weightages from few experts was done regarding the socio-economic growth of an area. After analysing the data, qualitative measure of the socio-economic factor was calculated. Soil samples taken from the site were analysed and compared to the nearest agricultural lands to check any major change in the agricultural qualities of the soil. Noise levels were checked in different areas to check if the levels were exceeding the prescribed limits.

## 1.5 OUTLINE OF THESIS

Present study can be divided into 6 chapters in total

- Chapter 1 consists of the introduction of the present study.
- Chapter 2 contains the previous studies and other important knowledge about the work.
- Chapter 3 consists of the description of the study area over which the work has been done.
- Chapter 4 contains the methodology of the various tests done.
- Chapter 5 contains the results and the discussions over the results so obtained.
- Chapter 6 consists of the conclusions of the study and the future scope of the study.

# CHAPTER 2

# REVIEW OF LITERATURE

EIA is an important tool for decision making regarding projects, developments and programmes. By analysing the baseline information and predicting the impacts, alternative processes are suggested so that the most environmentally suitable options are adopted. The literature review addresses various studies made to review the EIA process & aims to analyse its effectiveness and suggesting measures to overcome the shortcomings. The review also aims to study new methodologies that can be incorporated to make the process more effective and less time consuming.

## 2.1 PREVIOUS STUDIES

The use of an Integrated Landscape Ecological Approach on the evaluation of the impact of a proposed highway over a high sensitive habitat of the highly endangered was described by **Fernandes (2000).** Study on landscape ecology, conservation management was conducted, and further evaluation of the alternatives in a highway EIA process was done. The method described prevents the occurrence of common errors in the decision-making process by allowing an increased knowledge of the ecological constraints of the project. The conflict of arguments on the consistency of the conclusions of the method was also described. The example given and the methodology proposed showed that Landscape Ecology is a powerful and useful tool for landscape management. It allows the evaluation of the cost of maintenance of given habitats or structures in certain sites and the identification of cumulative ecological impacts, thus avoiding biased conclusions or statements derived from an insufficient knowledge of the ecology of the target species or habitats. It was thus concluded that there is the urgent need for an integrated ecological evaluation of plans and policies at the regional and national levels, where the landscape will not be considered as a ―white sheet (considering only the economic and social infrastructures and uses), but as a complex structural and functional system where economy, culture, and environment are irreversibly bounded. With methodology proposed it is possible to develop a consistent habitat analysis based on scarce ecological data on a target species population which contributes to the reduction of errors.

Problems with the development of alternatives, based on a study of EIAs in the US was investigated and ways to improve environmental decision-making was proposed by **Steinemann (2001)**. Inadequate alternatives can undermine the goals of EIA. Public participation often occurs too late. In addition, the EIA process often occurs too late in agency decision-making to consider a full range of alternatives. Results of the study emphasized the importance of alternatives, and the need to improve alternatives development and the EIA process. Important recommendations were given like: incorporating environmental considerations earlier in the agency planning process, moving up EIA in the agency planning process, not easily eliminating the more environmentally sound alternatives & in developing alternatives, agencies should more fully consider the irreversibility of an action before making an irreversible commitment of environmental resources.

A new methodology for impact assessment-SIAM (Spatial Impact Assessment Methodology) was presented by **Antunes et al. (2001)** which was based on the assumption that the importance of environmental impacts is dependent, among other things, on the spatial distribution of the effects and of the affected environment. SIAM was demonstrated as a toll to improve the effectiveness of EIA. The information generated by the use of Geographical Information Systems (GIS) in impact identification and prediction stages of EIA were used in the assessment of impact significance by the computation of a set of impact indices. For each environmental component (e.g., air pollution, water resources, biological resources), impact indices were calculated based on the spatial distribution of impacts. A case study of impact evaluation of a proposed highway in Central Portugal illustrated the application of the methodology and showed its capabilities that can be adapted to the particular characteristics of a given EIA problem. It was thus concluded that SIAM could be applied to the EIA of any proposed project where the spatial distribution of the impacts is relevant & the application of this methodology can contribute to a more effective use of the information generated in all EIA stages for impact evaluation.

**Paliwal (2006)** evaluated the EIA process in India through Strength, Weakness, Opportunity and Threat (SWOT) analysis & she suggested that in India EIA relied on the institutional framework that has a strong supporting legislative, administrative and procedural set-up. Both central and state authorities together are sharing the responsibility of its development and management. The SWOT analysis taken up of the EIA suggested that there are several issues

that need to be readdressed. Several constraints, ranging from improper screening and scoping guidelines to ineffective monitoring and post project evaluation were highlighted. The opportunities addressed for improving EIA were increasing public awareness, initiatives of environmental groups, business community, and forward thinking to integrate environmental consideration into plans and policies. Poor governance, rapid economic reforms, and favours to small-scale units were identified some of the foreseen threats to the system. It was mentioned that improved effectiveness would also depend on strength of government agency coordination, integrated decision-making adequate training to various stake holders and supporting infrastructure for purposeful monitoring and enforcement. It was suggested that the EIA system should be regularly revisited for progressive refinement that should not only remove existing constraints but also take care of future challenges. It was further recommended that project level EIA needs immediate attention but efforts should also be targeted to include environmental conservation concerns at policy and planning level. Such initiatives would help in filling up the gaps in coordination between various government authorities involved in planning and execution.

A report on Environmental Impact Assessment (EIA) for the proposed improvements to the Project Road from Chengapalli (Km 100+000) to Walayar (Km 182+250) was presented by **Wilber Smith Associates (2008)** to National Highways Authority of India (NHAI). The report was prepared according to the structure of the EIA Report presented in the EIA Notification, 2006 by Ministry of Environment and Forests, Government of India. The EIA was based on detailed field reconnaissance surveys, inventories and available secondary information. No significant adverse impacts were anticipated on the environment due to the proposed improvements. However, temporary impacts are anticipated on air quality, noise levels, water quality, soil quality, flora & fauna and socio-economic environment of the project area. Further, an increase in ambient noise level is expected along the project road during the operation stage. Proper mitigation measures were proposed in the EMP for mitigating the negative impacts. The environmental monitoring plan and reporting mechanism proposed as part of the EMP will ensure the proper implementation of the EMP.

The applicability of the RIAM method (rapid impact assessment matrix) is in the context of impact significance assessment was evaluated by **Markku et al. (2010)**. The methodological

issues considered in the study were: to test the possibilities of enlarging the scoring system used in the method, and to compare the significance classifications of RIAM and unaided decision making to estimate the consistency between these methods. Cases were evaluated with respect to their environmental, social and economic impacts using an assessment panel. The study exemplified that how the RIAM method can be modified with respect to the assessment situation at hand and thus be made more responsive to the demands of the evaluation process itself. It was demonstrated that with a more flexible scoring framework and evaluation criteria, it is possible for an evaluator to more closely define the aspects he wants to bring to the analysis while taking advantage of the transparent basic structure of the method. The comparison of the RIAM method and unaided judgment showed that the essential conceptual characteristics of impact significance can be captured and assessed with RIAM, although some differences were also observed in the results.

An environmental impact assessment report on proposed 6/8 lane highway connecting Noida to Agra was presented by **Jaiprakash Associates Ltd (2010)** and described the situation existing currently and effectively predicted the degree of the effects the impacts related to project can cause. Socio-Economic impacts were carefully observed and it was made sure that public consultation must be taken regarding the project. It was concluded that both negative and positive impacts are associated with the project. It was also made sure that ecological sensitive areas were avoided. Since in the project environmental considerations have been taken care of from the project design stage itself barring a few unavoidable negative impacts no major impact is anticipated. On the other hand, a number of positive long-term environmental benefits can be derived from the project. With all the environmental considerations in mind, plantation in terms of number of trees per km and type of trees to be planted was suggested for each of the two rows. The two sides of the road are to be planted as per the same plan. Suggestions were also made regarding the technologies used during the construction so that there is minimal effect on the current prevailing environmental conditions.

An environmental impact assessment report for four laning of NH-95 from Chandigarh to Ludhiana was presented by **Consulting Engineering services (2010)**. It described the current existing situation and effectively predicted the degree of the effects the impacts related to project can cause. The EIA study was prepared in accordance to the terms of reference. The EIA fulfils the requirements of Government of Punjab & Chandigarh and conforms in content

with Ministry of Environment & Forests (Govt. of India). The report covered major finding on present environmental scenario, legal & administrative framework, and evaluation of potential environmental impacts due to construction of four to six lane and construction of new proposed bypass on the corridor. It was concluded that both negative and positive impacts are associated with the project and thus mitigation measures were also suggested. Different environmental issues were discussed in detail & the protection and preventive measures to be taken by contractor were also mentioned. To make sure that the construction work was carried out in sound environmental standards Environmental Management Plan (EMP) was also included. The EMP envisages the plans for effective implementation of mitigation measures to minimize adverse impacts due to project activity. Environmental Monitoring Programme during construction and operation was also advised.

Strategic issues of EIA for highway projects with a case study of Indian national highway NH-21 (Mohali to Ropar district connecting Kharar & Kurali) was analysed by **Chopra et al. (2011)**. The analysis highlighted the importance of EIA in the sustainable development of highway project with a case study of vital link of about 20 Kilometres. The study concentrated on the environment impact assessment of the above project in the light of the existing situation at the site. The parameters covered in the work were Socio-Economic, Biological, Air (Dust), Water, Noise, Ecological, Soil and Cultural/Historical. Based on existing data and the assessment/ evaluation and analysis of the potential impacts, total impact was calculated by the matrix method. Based on nature and type of impacts, an appropriate mitigation / enhancement measures were suggested that will be implemented during construction and operation phase. It was thus concluded that though there are some major impacts associated with the road construction the overall project was environmentally beneficial.

EIA was first introduced in India based on the Environmental Protection Act, 1986. But formally it came into effect, when Ministry of Environment, Forest & Climate Change (MOEF&CC) has the main purpose of EIA is to provide information to decision makers and public about the environmental implications of the proposed project activity before decisions are made. Besides providing information, **Panigarhi et al. (2012)** also suggests measures for preventing or reducing those impacts and mitigation plans paper evaluates the EIA system of India.

It was based on:

(1) Review of relevant literature on evaluation of EIA practice

(2) Analysis to various legal provisions, guidelines and procedures by Government of India.

(3) Secondary data on various projects and approval process of EIA reports in the country.

(4) Opinions of Government officials, Present and Ex- members of EIA Approval committee, Environmental Consultants, Research Laboratories, Project proponents, Non-Governmental Organizations (NGOs), Expert professionals from various backgrounds.

In the past, a number of methodologies have been developed to evaluate the effectiveness of EIA processes. India is one of the developing countries that has sound legal framework for EIA. Furthermore, a comprehensive package of EIA guidelines exists. It appears that EIA in India is evolving steadily; an overall evaluation of the EIA system reveals several weaknesses, not only in the institutional framework, but also in implementation and actual practice.

Various methods to estimate the soil permeability also known as hydraulic conductivity were discussed by **Elhakim (2016)** including constant and falling head laboratory tests on undisturbed samples. The values from the falling head method using different heights was compared to the values of the cone penetration test performed on the same site. The results from both the tests showed that the permeability decreases with depth showing the effects of increase in soil compaction with increase in the depth. The values obtained from the cone penetration test were similar with the values measured in the field. The cone penetration test was done to evaluate the permeability of the top layer of the soil.

EIA on NH-73 was performed by **Kamboj and Kumari (2017)** in which the parameters like socio-economic, biological, air, dust, water, noise, accidental, ecological and soil were considered. Ground water near Jagadhari showed the high amount of total dissolved solids, greater than the prescribed limit for the water to be used for drinking. Noise levels were not in the limits of the Central Pollution Control Board (CPCB) guidelines. Drainage system was failing in some locations resulting in vulnerable conditions of the pavement. Soil pollution was under the limits but the chances of occurrence during the constructional phase was predicted. Highway capacity was analysed and need of immediate widening was proposed. Suggestions were made after the analysis of the different parameters so considered. Mitigation measures were also suggested.

## 2.2 ENVIRONMENTAL AND SOCIAL IMPACTS

The focus of this section is on the identification of probable impacts and thereafter-suggesting mitigation measures.

The impact assessment has been devised for the following stages:

- Planning and designing stage
- Construction stage
- Operational stage

Planning and design plans the road alignment, required bypasses, construction details, materials of construction etc., which ultimately decides the impact during later phases. Most of the impacts are during construction and operation phase. While some of the construction phase impacts are temporary, some also are permanent. Operation phase impacts are continuous in nature.

Environmental parameters are broadly classified into three groups.

1. Physical Environment
2. Biological Environment
3. Social Environment

**Physical environment includes** Water Resources, Water Quality, Air Quality, Noise and Land environment.

**Biological Environment includes** Flora, Terrestrial fauna, Avifauna, Aquatic flora & fauna, Plantation.

**Social Environment includes** Rehabilitation, Employment, Agriculture, Housing, Culture etc.

### 2.2.1 Impacts on Social and Cultural Environment

Some of the immediate social issues is acquisition of private properties mainly buildings and the agriculture land, as the right of way is limited in most part of project road. Another important issue is encroachment within the right of way particularly near the major settlement sites. Efforts should be made to minimise the adverse impact on people as well as properties by integrating social aspects at different level of project design. The widening of the road may involve loss of livelihood and properties of affected persons, which should be addressed in the preliminary land acquisition / resettlement plan.

### 2.2.2 Soil

Soil at and around a construction site may become contaminated due to air movement followed by deposition of construction contaminants as well as water runoff of construction contaminants. Soil may constitute a sink for pollutants and some of those may accumulate in soil and persists over longer periods of time. Elevated levels of soil contaminants human health, elevated levels can negatively affect plants, animal health, microbial processes, and overall soil health. Some contaminants may reduce yields or cause visible damage to crops. Even relatively low concentrations of certain contaminants can alter soil chemistry and impact organisms that depend on the soil or plants for their nutrition and habitat.

Selected quality soil is required for embankment portion of road. The existing road is in plain terrain and as such, there is minimum possibility of barrow areas becoming ponds to allow stagnation of water and create adverse effect on health and hygiene. Various aspects of soil like texture, permeability & porosity were tested (Samsher Prakash, 2002).

### 2.2.3 Noise

Noise is usually associated with construction work although modern preventive measures may substantially reduce the amount of noise (in the neighbouring community). Noise may adversely affect health including effects such as stress, sleep disturbance, high blood pressure and even hearing loss**.** Possible sound effects during the operation phase can be reduced by buffering of noise. Noise levels can increase due to vegetation loss during site clearance, increased noise level due to excavators/machinery etc, operation and maintenance of heavy vehicles and equipments, asphalt preparation and crushing and also from the vibrations of blasting operations.

### 2.2.4 Ecological Resources

The construction of highways can have a substantial impact on the degradation and loss of natural ecosystems, especially in less developed areas. Perhaps more importantly, the fragmentation of habitats caused by highway development is often severe. Transportation routes can be described as, disturbance corridors that disrupt the natural, more homogeneous landscape.

In forest environments, these disturbances can cause:

(1) Dramatic physical disruption to the continuous vegetative community

(2) Disruption to the structure and function of habitat

(3) Impacts to resident wildlife, which must negotiate, tolerate, and cope with the habitat barriers.

## 2.3 CONCLUDING REMARKS

From the literature review, it can be settled that effectiveness of EIA process suffers from failures restricting not only from one domain, but from different ones: technical, methodological & procedural. Public participation is an important component of the whole process and it should be strictly incorporated and monitored. The EIA process should be upgraded & improved effectiveness will depend on strength of government agency coordination, integrated decision-making adequate training to various stake holders and supporting infrastructure for purposeful monitoring and enforcement. To remove existing constraints the EIA system should be regularly revisited for progressive refinement.

## 2.4 GAP ANALYSIS

According to the previous studies, the EIA is a very important process to address any type of environmental impacts before they occur. As much as this process is important, it needs frequent updates in order to be more effective.

So, the use of qualitative measure of the socio-economic factor, calculated by analysing two different surveys together to determine the socio-economic growth of an area can be a new update in the EIA process.

# CHAPTER 3

# STUDY AREA

Any developmental project would give rise to certain direct and indirect impacts on various environmental and social attributes like air, water, soil, noise, flora and fauna, private property, livelihoods and on the community property resources. The developmental projects like widening of road infrastructure would improve the socio-economic status of the local population, bring a better connectivity, and improve industrial sector as well as the tourism in the area. Infrastructure development particularly speed up the movement and transportation of goods. In a country like India it is a guiding factor for the socio-economic development. Proper transportation of goods requires comprehensive transport systems and increasing road traffic requires better roads. Hence, it becomes necessary to widen the existing road carriageways, in the form of new bypasses and roads.

## 3.1 DETAILS OF THE STUDY AREA

The study area is the widening of the existing highway (NH-73, new NH-344) from Panchkula to Barwala. Figure 3.1 shows the map of the study area.

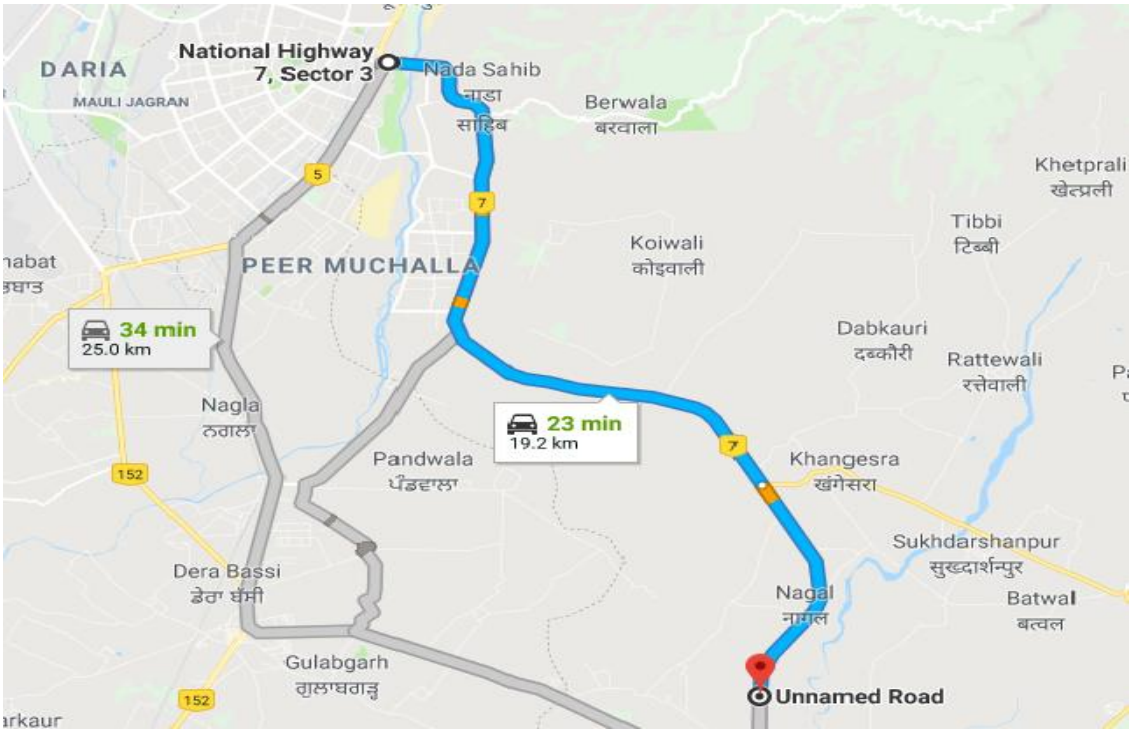


Figure 3.1: Map of Study Area

### 3.1.1 History of the Project

The existing 108 km long stretch of NH-73 (New NH 344) is between Panchkula and Yamunanagar which connects Haryana to the state of Uttar Pradesh and passes through the cities, Barwala, Sahjadpur, Saha, Jagadhari cities.

The traffic volume in this stretch of national highway was increasing day by day & demanded four laning. National Highway Authority of India (NHAI) divided the existing 105.570 km stretch of NH-73 into three sections and invited separate bids for each.

The project was divided into three packages. Package-I and Package-II were awarded on Engineering, Procurement and Construction (EPC) mode. The balance length of 19.2 km was awarded on EPC mode to M/s Gawar Construction Ltd. which starts from km 157.190 near Barwala town and ends at km 176.430 at Panchkula (Majri Chowk), as shown in Table 3.1. The project is to be completed in 24 months from the date of commencement of the project, that is, 22nd September, 2016.

Table 3.1: Details of the Widening Project

| **NH No.** | **Section** | **Length** | **Total Project Cost** | **Concessionaire's Name** |
|---|---|---|---|---|
| NH-73 (new NH-344) (Package III) | 4 Laning of Panchkula-Yamunanagar, From km 157.190 to km 176.430 | 19.2 km | Rs.209 crores | M/s Gawar Construction Ltd. |

*-As per NHAI*

### 3.1.2 Highway Details

As per NHAI, four Laning of Panchkula to Barwala (Package-III), NH-73 (new NH-344), section from Km 157.190 to Km 176.430 is of 19.2 km. The estimated cost of the project is Rs. 209 crore and is being finished by M/s Gawar Construction Ltd. (Table 3.1)

Panchkula and twin cities of Jagadhari and Yamunanagar are important commercial and industrial centres of Haryana. Development of Panchkula-Yamunanagar Section from km 157.190 to km 176.430 (Panchkula to Barwala) will improve connectivity to various villages

and towns and confer boost to the economy of the area by way of providing access to various places of business and agricultural importance.

Apart from the widening of the existing highway, the project includes:

- 4 major Bridges,
- 25 minor Junctions,
- 3 major Junctions,
- 1 Vehicular Underpass,
- 1 Flyover,
- 1 Pedestrian Underpass,
- 10 Bus Bays
- 2 Overhead Bridges for wildlife crossing, and;
- 9 km long service road on both sides.

### 3.1.3 Land Acquisition

Land acquisition is a very important factor in any type of development. In highway construction as well as the highway widening, land is required to provide the most feasible (socially, economically and financially) construction of the road.

The state wildlife board meeting was held on 20$^{th}$ Feb, 2014 which recommended the proposal for the use of land as follows, with the condition that NHAI shall take mitigatory steps:

Wildlife Area = 3.609 Ha

(Kholi-Hi-Ratan Wildlife Sanctuary)

Forest Area = 32.482 Ha

Govt. and Private Land = 62.583 Ha

*-As per NHAI*

Few more specifications of the highway:

- The alignment of the new highway has been designed for a speed of 100 Km per hour.
- The vertical gradient is maintained upto 2.5% in compliance with specification.

- A camber of 2.0% has been proposed for main carriageway & paved shoulder portion using Pavement Quality Concrete (PQC) and feasible pavement respectively to take care of surface drainage.

As per NHAI, there will be 2 overhead bridges also for the wildlife to cross the highway safely. These overhead bridges are introduced for the very first time in India and should look like a natural bridge for the wildlife (as stated by NHAI officials). Approximately, 50 lakh rupees are spent to make up for the wildlife disturbance due to this project.

### 3.1.4 Plantation

For widening the project road from two to four lane it is estimated that around 8000 trees were cut down and the proposal was moved to Forest Department for clearance. This will be accomplished only after the finalization of new alignment of the project. 8 times tree will be planted on the sides of the project road or any suitable land to be arranged by the Forest Department as per the requirement under the trees cut or uprooted. Necessary amount of Rs 7.99 crores as plantation expenses and land Plans & Value/Management is to be deposited with the forest department when they arrange the land themselves.

## 3.2 SAFETY MEASURES

The anticipated safety measures are listed below (for all options and stages):

- Provision of Metal Beam Crash Barrier at embankments with height more than 3m, approaches to bridges and underpass
- Concrete railing has been proposed on bridges and underpass
- Pedestrian guardrails have been proposed along footpaths in urban sections
- Road delineators and studs are proposed at horizontal curves with radius less then 1000 m and intersections etc.

# CHAPTER 4

# METHODOLOGY

To cover up all the parameters of the proposed dissertation in a systematic and time bound manner following methods were used:

## 4.1 RECONNAISSANCE SURVEY

Reconnaissance survey was done for collecting initial information about the physical features of the site and locating certain important points along the site.

## 4.2 DATA COLLECTION

Data collection on various parameters were done as follows:

**Soil:** Two soil samples each were collected from five different locations alongside the highway. One sample was collected from the road area itself and the other from the residential/ agricultural area nearby to compare any kind of quality change due to the construction of the highway.

The samples of soil were tested in laboratory. The tests performed are as follows:

- Test for texture, to determine the type of soil and hence its properties was done.
- Test for permeability and porosity, which directly influenced the agricultural strengths of the soil.

The coefficient of permeability was determined in general accordance with IS: *2720 (Part 17)* - 1986 Methods for test of soil (Part 17: Laboratory Determination of Permeability)

**Socio-Economic Characteristics:** For collection of Socio-Economic data, a questionnaire was prepared for conducting site interviews (Annexure-A). Local people of different occupations were asked these questions. Data collected by interviewing the people about the ongoing highway construction through the surveys was recorded and then evaluated by using the weightage given by 10 experts. Benefits as well as adverse impacts, both areas were covered in the questionnaire for the experts (Annexure-B).

**Noise:** Five different locations were selected and noise was measured with the help of an Android based mobile application named, 'Sound Meter'. Noise was measured at a regular interval of 10 minutes for one hour at each location during Day Time and Night Time.

**Biological Characteristics (Flora):** For the collection of data for the number of trees cut along the proposed site, during the construction, NHAI was consulted.

### 4.3 DATA ANALYSIS

The data so collected above was analysed and comparisons were made for various parameters. The standards given by Ministry of Environment, Forest & Climate Change (MOEF&CC) and Central Pollution Control Board (CPCB) were compared to the values obtained from the site under consideration. Graphical representations of the same were made.

# CHAPTER 5

# RESULTS AND DISCUSSIONS

In this chapter, results of the various tests done were analysed. Further discussions were made and qualitative measure of the socio-economic factor was calculated.

## 5.1 IMPACTS ON VARIOUS SOCIO-ECONOMIC PARAMETERS

In order to find out the public's point of view on various socio-economic impacts of the construction, public consultation was done. A questionnaire was made and the respective public were asked the questions (Annexure-A). It is an important process through which the public's interest on matters affecting them during the construction phase are pursued. The main objectives are to improve the effectiveness, transparency and public involvement in major-scale projects.

### 5.1.1 Data Collection

A questionnaire (Annexure-A) was prepared and the people living near the present highway NH-73 were consulted. Carried out with a basic objective of the incorporation of the local and location-specific issues into the design of the project, a consultation programme in the stages of project planning and implementation stage was carried out. The community should not only be consulted they should be actively involved in environmental matters. The consultation programme is used as a tool to inform and educate the stakeholders about the acceptability of the proposed project both, before and after the development decisions are made and to understand the nature and extent of environmental and socio-economic impacts due to the project.

### 5.1.2 Results

The responses from the public to the questionnaire so prepared was collected for analysis. The questionnaire prepared for the consultation was based on the EIA guidance manual for highways prescribed by MOEF. A total of 12 questions were prepared and asked individually, as shown in Figure 5.13. Graphical representations of the results were made as follows:

**Q1.** Do you think the land value will increase due to the new highway facility? Rate (0-10)

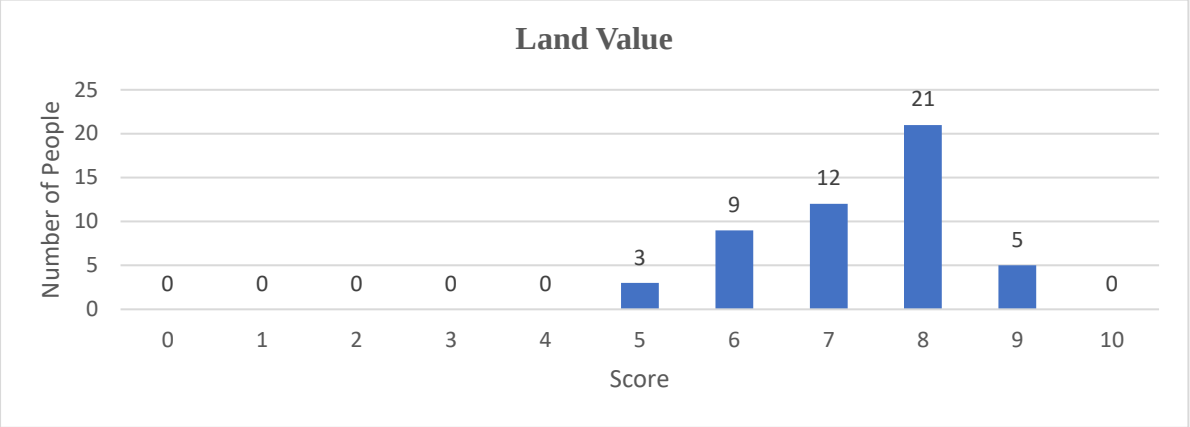


Figure 5.1: Questionnare response for Land Value

In Figure 5.1, it can be seen that most of the response of the public was close to the fact that the land value will increase due to the new highway construction. Very few believed that the land value will not be much affected after the contruction of the new and improved highway.

**Q2.** Do you think job opportunities will increase due to the new highway facility? Rate (0-10)


Figure 5.2: Questionnare response for Job Opportunities

Jobs or employment are the most frequently asked parameter after any construction. Employment directly influence the socio-economic growth of any area. According to the Figure 5.2, most of the public believed that the employment sector will flourish due the construction of the new highway.

**Q3.** Is the noise due to the construction bearable? Rate (**0-10**)

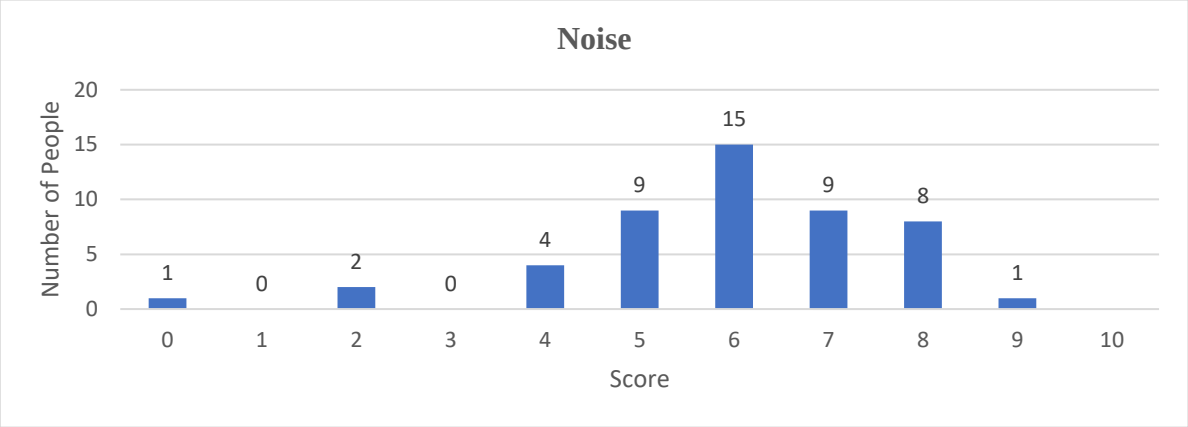


Figure 5.3: Questionnare response for Noise levels

The most common outcome for the noise levels being bearable or not was average. In figure 5.3, it can be seen that most of the people vary from the range 5 to 8, which represents that people were not very much satisfied with the noise level incresed due to the construction. However, most of the people were in favor of the construction, even after the noise levels getting higher than usual.

**Q4.** Any religious place destroyed/ moved for the new highway facility? (**YES/NO/Can't Say**)

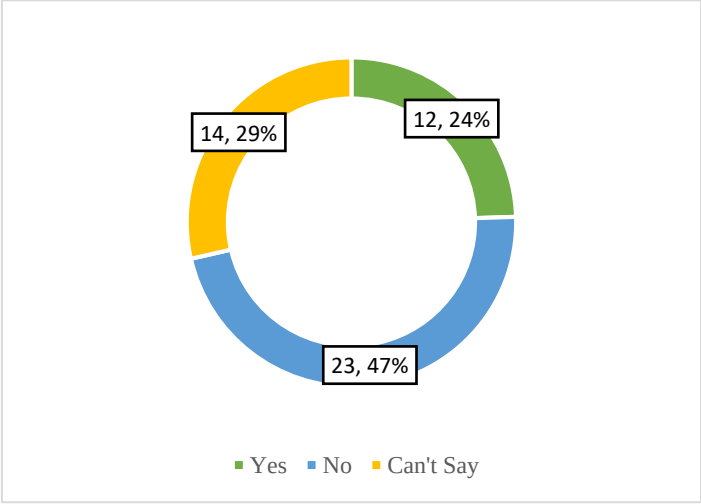


Figure 5.4: Questionnare response for movement of any religious place

Figure 5.4 shows that for the data collected, 47% people said that no religious place was destroyed or moved. 24% people believed that some religious places were moved for the better construction of the highway and 29% were unable to give any answer about the situation.

**Q5.** Do you think people will now prefer the new highway facility? (**YES/NO/Can't Say**)

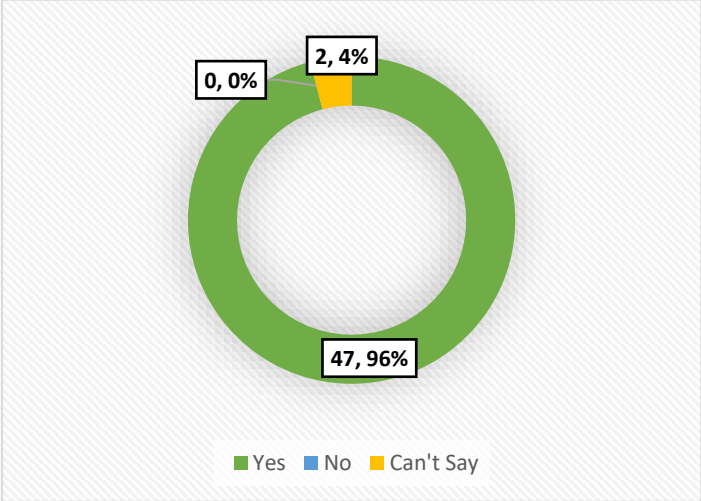


Figure 5.5: Questionnare response for preference for new highway

According to the survey and representation in Figure 5.5, it can be concluded that 96% of the people would prefer the new highway and only 4% were unable to respond to the situation. No one believed that they would not prefer the new highway, which is desirable for socioeconomic growth due to the highway construction.

**Q6.** Any cemeteries destroyed/ moved for the new highway facility? (**YES/NO/Can't Say**)

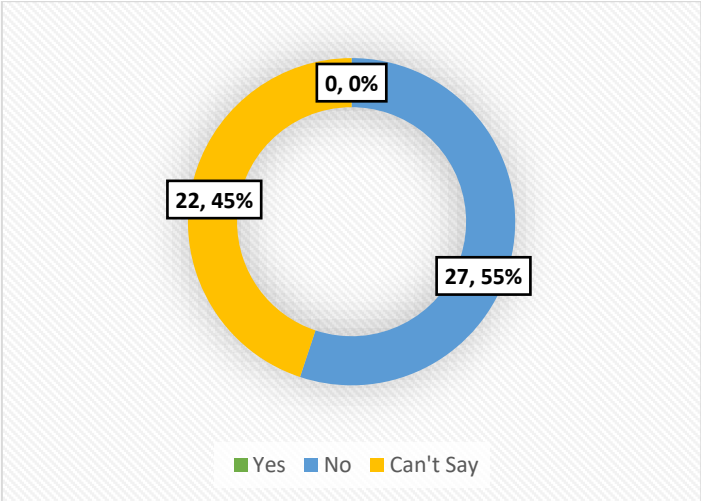


Figure 5.6: Questionnare response for cemetries moved

Figure 5.6 shows, 55% people were confident that no cemetery was destroyed or moved and 45% were not aware of any situation like that, so they couldn't say anything. No one believed that any cemetery was destroyed or moved during the construction of the new highway facility.

**Q7.** To what extent the new highway facility will reduce the travel time? Rate (**0-10**)

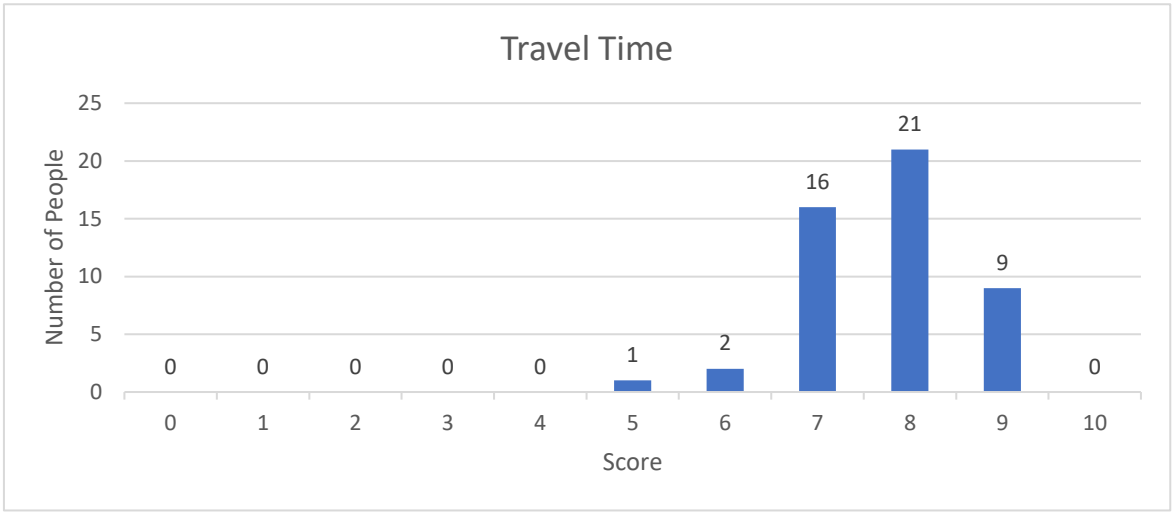


Figure 5.7: Questionnare response for travel time reduction

Figure 5.7 shows that most of the people believed that the travel time will reduce after the widening of the highway. Response by most of the people was positive.

**Q8.** Will the new highway facility reduce the road accident numbers? Rate (**0-10**)

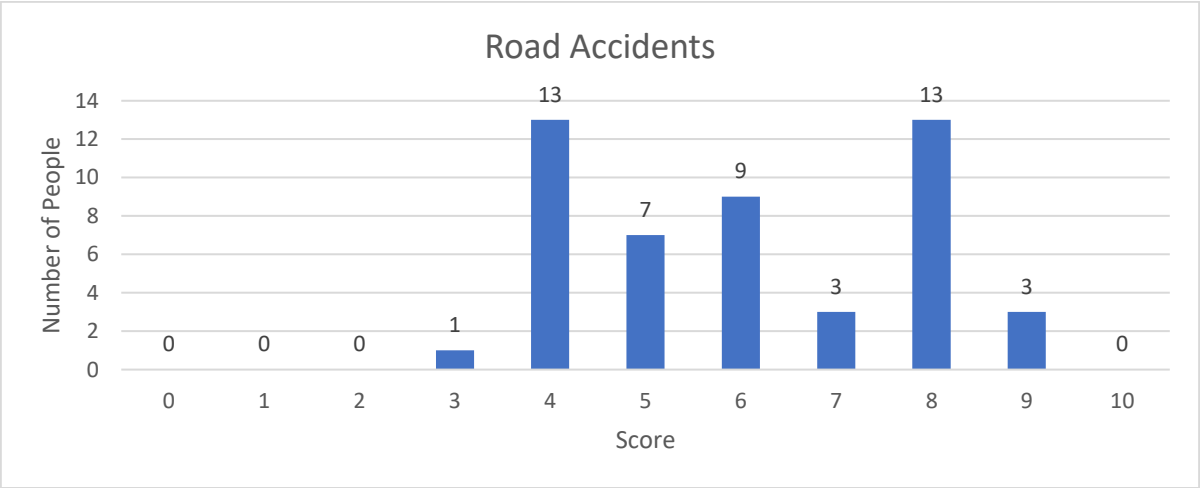


Figure 5.8: Questionnare response for Accident numbers

According to the analysis, two results were observed, as shown in Figure 5.8. Some people believed that the new highway facility will help in reducing the accident numbers while some were convinced that the widening of the existing highway might not reduce the accident numbers drastically.

**Q9.** Is the construction of the new highway facility destroying the natural habitat of wildlife?

Rate (**0-10**)

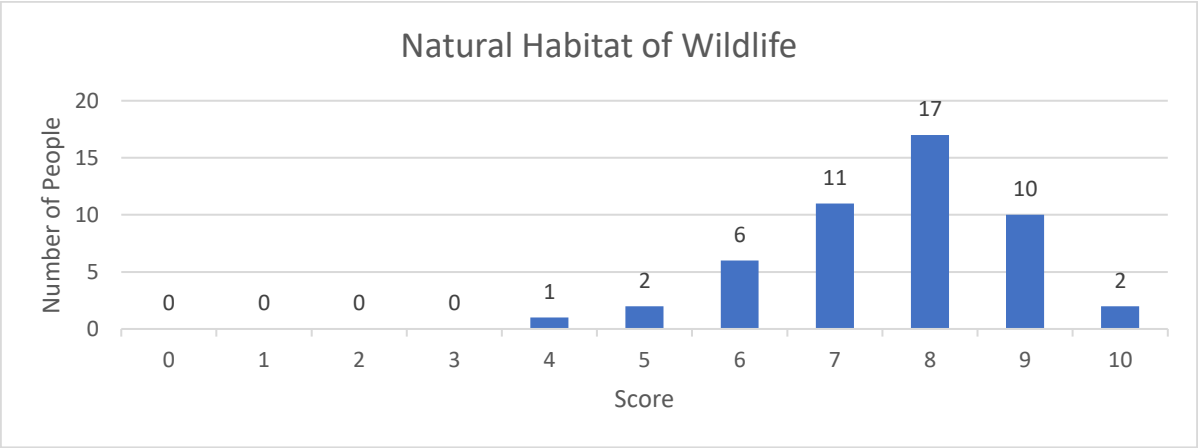


Figure 5.9: Questionnare response for natural habitat of wildlife

Figure 5.9 shows that most the people of the study area strongly believed that the natural habitat of the wildlife had been tampered with. However, as per NHAI, provisions have been made to restrict any kind of long term effect on the natural habitat of the wildlife.

**Q10.** Was the construction of the new highway necessary? (**YES/NO/Can't Say**)

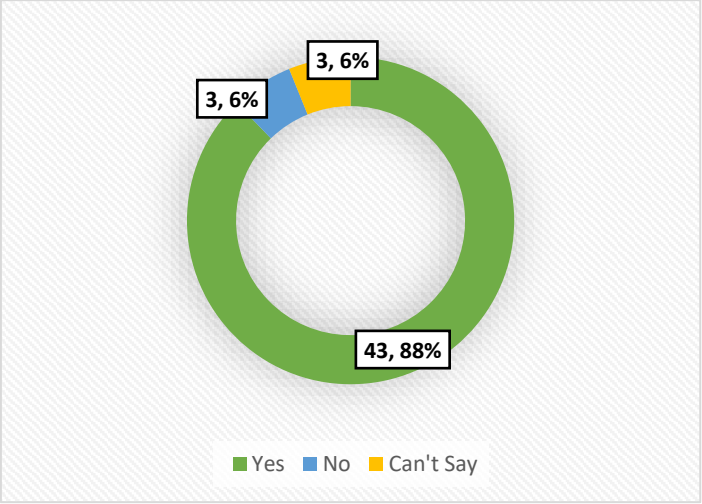


Figure 5.10: Questionnare response for necessity of construction

Figure 5.10 shows the collective response of the public for whether the construction or the widening of the highway was necessary or not. 88% of the people consulted said that the widening was necessary. 6% people were convinced that the construction was not necessary and other 6% were unable to give any response.

**Q11.** During the construction, did resettlement happened? (**YES/NO/Can't Say**)

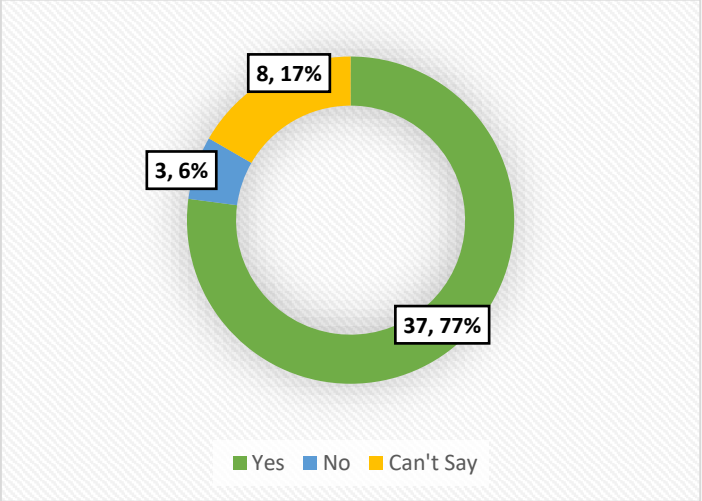


Figure 5.11: Questionnare response for resettlement

As per the results and as shown in Figure 5.11, 77% of the people were convinced that resettlement happened, while 6% denied about any such information and 17% were unable to give a positive or negative response to the question.

**Q12.** After resettlement, compensation was provided to the displaced people? (**YES/NO/Can't Say**)

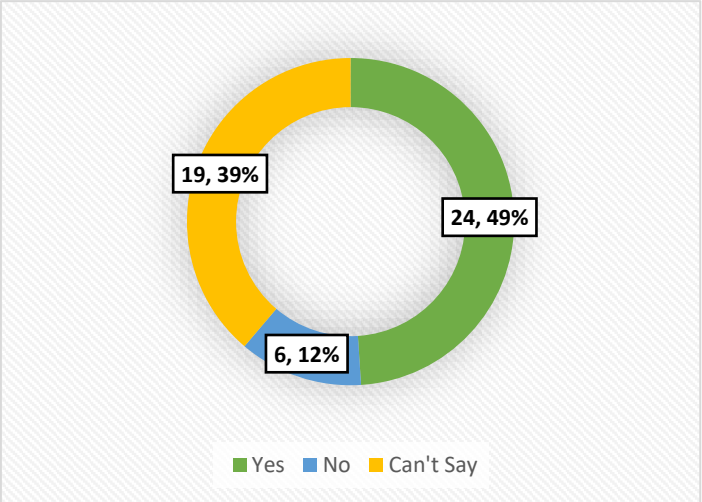


Figure 5.12: Questionnare response for compensation

The results as shown in Figure 5.12, show that 49% people were positive that the compensation had been done for any kind of resettlement. 12% denied for any compensation received. While, the rest of the 39% were unable to react positively or negatively on the matter.

Figure 5.13: Data collection for the socio-economic impacts along the road.

### 5.1.3 Qualitative Measure of the Socio-Economic Factor

Further calculations were done to calculate the qualitative measure of the socio-economic factor. A group of experts (5 engineers and 5 educationalists) were asked to give the weightage for the four different aspects (Annexure-B) which directly influence the socio-economic growth of a region. The weightage given by different experts were compared to the scores given by the public. The qualitative measure of the socio-economic factor was then calculated. The scores given by the public as shown in Table 5.3 were compared to the weightages given by the experts as shown in Table 5.2 and the results were calculated and shown in Table 5.3. Table 5.1 shows the qualitative value of the measure of socio-economic growth on a lower scale of (0-2) having exceptionally low to a higher scale of (8-10) having exceptionally high.

Table 5.1: Qualitative measure of socio-economic growth

| S. No. | Qualitative measure of socio-economic growth | Scale |
|---|---|---|
| 1 | Exceptionally low | 0-2 |
| 2 | Low | 2-4 |
| 3 | Average | 4-6 |
| 4 | High | 6-8 |
| 5 | Exceptionally high | 8-10 |

Table 5.2: Weightage from experts

| S. No | Land Value (%) | Job Opportunity (%) | Travel Time (%) | Accidents (%) |
|---|---|---|---|---|
| 1 | 30 | 20 | 30 | 20 |
| 2 | 30 | 10 | 40 | 20 |
| 3 | 15 | 15 | 40 | 30 |
| 4 | 30 | 20 | 40 | 10 |
| 5 | 30 | 30 | 30 | 10 |
| 6 | 20 | 40 | 25 | 15 |
| 7 | 15 | 45 | 20 | 20 |
| 8 | 25 | 35 | 30 | 10 |
| 9 | 30 | 30 | 25 | 15 |
| 10 | 20 | 40 | 20 | 20 |
| Average | 24.5 | 28.5 | 30 | 17 |

These values were then compared to get the qualitative measure of the socio-economic factor as follows:

$[(SL) \times (0.245)] + [(SJ) \times (0.285)] + [(ST) \times (0.30)] + [(SA) \times (0.17)]$

Where,

SL = Score for Land Value

SJ = Score for Job Opportunity

ST = Score for Travel Time; and

SA = Score for Accidents.

For Example,

Person 2 gave the score for Land Value, Job Opportunity, Travel Time and Accidents as 6, 2, 9 and 7, respectively.

After putting the values in the equation,

$[(6) \times (0.245)] + [(2) \times (0.285)] + [(9) \times (0.30)] + [(7) \times (0.17)] = 5.93$

Same was done for the rest of the public scores and were calculated as shown in Table 5.3.

Table 5.3: Results after evaluation

| S. No | Land Value | Job Opportunity | Travel Time | Accidents | Result |
|---|---|---|---|---|---|
| 1 | 8 | 6 | 8 | 5 | 6.92 |
| 2 | 6 | 2 | 9 | 7 | 5.93 |
| 3 | 6 | 4 | 7 | 5 | 5.56 |
| 4 | 9 | 8 | 8 | 6 | 7.90 |
| 5 | 7 | 6 | 7 | 6 | 6.54 |
| 6 | 6 | 6 | 8 | 4 | 6.26 |
| 7 | 6 | 6 | 7 | 6 | 6.30 |
| 8 | 8 | 7 | 8 | 8 | 7.71 |
| 9 | 5 | 5 | 8 | 8 | 6.41 |
| 10 | 8 | 6 | 8 | 6 | 7.09 |
| 11 | 7 | 7 | 7 | 4 | 6.49 |
| 12 | 8 | 6 | 7 | 4 | 6.45 |
| 13 | 8 | 7 | 7 | 4 | 6.73 |
| 14 | 7 | 2 | 8 | 6 | 5.70 |
| 15 | 7 | 7 | 8 | 8 | 7.47 |
| 16 | 8 | 7 | 8 | 8 | 7.71 |
| 17 | 8 | 7 | 8 | 7 | 7.54 |
| 18 | 7 | 5 | 7 | 4 | 5.92 |
| 19 | 8 | 7 | 7 | 5 | 6.90 |
| 20 | 7 | 8 | 7 | 8 | 7.45 |
| 21 | 7 | 6 | 8 | 4 | 6.50 |
| 22 | 8 | 6 | 8 | 8 | 7.43 |
| 23 | 8 | 6 | 7 | 6 | 6.79 |
| 24 | 9 | 8 | 9 | 4 | 7.86 |
| 25 | 6 | 3 | 9 | 7 | 6.21 |
| 26 | 8 | 4 | 8 | 8 | 6.86 |
| 27 | 5 | 5 | 8 | 4 | 5.73 |
| 28 | 8 | 7 | 9 | 8 | 8.01 |
| 29 | 9 | 9 | 9 | 9 | 9.00 |

| | | | | | |
|---|---|---|---|---|---|
| 30 | 7 | 4 | 8 | 9 | 6.78 |
| 31 | 8 | 4 | 8 | 4 | 6.18 |
| 32 | 9 | 7 | 7 | 5 | 7.15 |
| 33 | 6 | 5 | 6 | 5 | 5.54 |
| 34 | 5 | 5 | 8 | 7 | 6.24 |
| 35 | 7 | 5 | 7 | 6 | 6.26 |
| 36 | 6 | 5 | 8 | 3 | 5.80 |
| 37 | 9 | 8 | 7 | 4 | 7.26 |
| 38 | 6 | 5 | 7 | 4 | 5.67 |
| 39 | 8 | 7 | 9 | 9 | 8.18 |
| 40 | 8 | 6 | 7 | 6 | 6.79 |
| 41 | 8 | 7 | 9 | 6 | 7.67 |
| 42 | 7 | 7 | 7 | 8 | 7.17 |
| 43 | 7 | 7 | 9 | 8 | 7.77 |
| 44 | 8 | 4 | 6 | 5 | 5.75 |
| 45 | 8 | 7 | 8 | 8 | 7.71 |
| 46 | 8 | 6 | 8 | 4 | 6.75 |
| 47 | 6 | 5 | 8 | 4 | 5.97 |
| 48 | 8 | 7 | 9 | 5 | 7.50 |
| 49 | 8 | 7 | 5 | 7 | 6.64 |
| Total | | | | | 334.15 |
| Average | | | | | **6.82** |

After the evaluation, the average of the results was taken, that is, 6.82 as the qualitative measure of the socio-economic factor. According to Table 5.1, high socio-economic growth of the area is predicted after the construction of the highway.

## 5.2 NOISE

Five different locations were selected as shown in Figure 5.14 and noise was measured with the help of a mobile application. Noise was measured at the regular interval of 10 minutes for one hour at each location during Day Time and Night Time and average was taken.


Figure 5.14: Noise Testing Locations

### 5.2.1 Day Time (8am to 6pm)

The data collected in the day time for the five selected locations is shown in Table 5.4:

Table 5.4: Noise levels in day time.

| **Location** | **Minimum (dB)** | **Average**<br><br>**dB(A) Leq** | **Maximum (dB)** |
|---|---|---|---|
| Nada Sahib (N1) | 35 | 68 | 84 |
| Wings Hospital (N2) | 36 | 61 | 87 |
| Ramgarh (N3) | 30 | 57 | 84 |

| | | | |
|---|---|---|---|
| Billa (N4) | 34 | 65 | 73 |
| Jalauli (N5) | 25 | 57 | 77 |

The prescribed limit according to the CPCB guidelines (Annexure-C), is 75 for Industrial area, 65 for commercial and 55 for residential area during day time. Location N4 was recorded to be higher than the prescribed limit. The value given are in dB(A) Leq which denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

### 5.2.2 Night Time (10pm to 1am)

The data collected in the night time for the five selected locations is shown in Table 5.5:

Table 5.5: Noise Levels in night time.

| **Location** | **Minimum (dB)** | **Average**<br>**dB(A) Leq** | **Maximum (dB)** |
|---|---|---|---|
| Nada Sahib (N1) | 26 | 54 | 76 |
| Wings Hospital (N2) | 30 | 60 | 79 |
| Ramgarh (N3) | 29 | 51 | 73 |
| Billa (N4) | 31 | 62 | 77 |
| Jalauli (N5) | 24 | 50 | 68 |

The prescribed limit according to the CPCB guidelines (Annexure-C), is 70 for Industrial area, 55 for commercial and 45 for residential area during night time. Location N4 was recorded to be the noisiest location among the other locations. The presence of working generators contributed to the high noise levels at night time. The value given are in dB(A) Leq which denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

## 5.3 SOIL

Soil samples were taken from different locations, as shown in Figure 5.15, alongside the highway and a little far away from the actual highway and were analysed. The results were calculated and further tabulated.


Figure 5.15: Soil Sample Collection Sites

### 5.3.1 On Road

The soil samples were collected near the road to check the permeability and porosity of the soil due to the construction. Table 5.6 shows the results of the testing done as follows:

Table 5.6: Results of soil testing (on road)

| Location | Texture | Permeability | Porosity (%) |
|---|---|---|---|
| Nada Sahib (S1) | Sandy Loam | $1.02\times 10^{-4}$ cm/s | 35 |
| Moginand (S2) | Sandy Loam | $1.4\times 10^{-4}$ cm/s | 40 |
| Ramgarh (S3) | Sandy Loam | $1.6\times 10^{-4}$ cm/s | 39 |

| | | | |
|---|---|---|---|
| Mattewali (S4) | Silty Loam | $1.4\times 10^{-4}$ cm/s | 41 |
| Barwala (S5) | Sandy Loam | $1.4\times 10^{-4}$ cm/s | 40 |

### 5.3.2 Off Road

The soil samples were collected away from the road construction so as to compare the permeability and porosity of both the samples. The collection of the sample was done after a minimum of 100m away from the point of collection of the first sample. Table 5.7 shows the testing done as follows:

Table 5.7: Results of soil testing (off road)

| **Location** | **Texture** | **Permeability** | **Porosity (%)** |
|---|---|---|---|
| Nada Sahib (S1) | Sandy Loam | $1.5\times 10^{-4}$ cm/s | 42 |
| Moginand (S2) | Silty Loam | $4.7\times 10^{-4}$ cm/s | 48 |
| Ramgarh (S3) | Silty Loam | $9.8\times 10^{-4}$ cm/s | 51 |
| Mattewali (S4) | Sandy Loam | $1.05\times 10^{-4}$ cm/s | 36 |
| Barwala (S5) | Sandy Loam | $0.5 \times 10^{-4}$ cm/s | 38 |

According to the results shown in Table 5.6 & Table 5.7, locations S1, S4 & S5 showed no significant change in the values of permeability and porosity. Whereas, Locations S2 & S3 showed that the soil near the highway was less permeable as compared to the other set of values for the same location. Less permeable soil near the highway could be a problem when it comes to drainage. So, proper drainage system is advised.

Also, the texture of the soil throughout the stretch was recorded as loamy, that is, mixture of sand, silt and clay. this type of texture is ideal for good agricultural practices.

After the comparison of the data analysed, it can be said that the soil present in the site is good for agricultural practices even after the construction of the highway.

# CHAPTER 6
# MITIGATION MEASURES

As far as possible, avoidance and reduction of adverse impacts approaches were adopted. For each impact, mitigation measures were documented.

## 6.1 MITIGATION MEASURES FOR NOISE POLLUTION

For noise pollution following mitigation measures are suggested:

- All construction equipment plants, machinery and vehicles should follow prescribed noise standards.
- Sign of horns should be posted at sensitive locations.
- All construction equipment used shall confirm to a standard of less than 90 dB.
- At construction sites within 150m of human settlements, noisy construction shall be stopped between 10.00 PM and 6.00 AM.

## 6.2 MITIGATION MEASURES FOR TREE CUT

- For widening the project road from two to four lane it is estimated that around 8000 trees were cut down and the proposal was moved to Forest Department for clearance.
- 8 times tree will be planted on the sides of the project road or any suitable land to be arranged by the Forest Department as per the requirement under the trees cut or uprooted.
- Necessary amount of Rs 7.99 crores as plantation expenses and land Plans & Value/Management is to be deposited with the forest department when they arrange the land themselves.

## 6.3 MITIGATION MEASURES FOR WILDLIFE DISTURBANCE

- 2 overhead bridges for the wildlife to cross the highway safely are designed.
- The overhead bridges should look like a natural bridge for the wildlife.

- Road safety signage like no pressure horn, slow drive, wild life area shall be displayed on the road.
- 50 lakh rupees were spent to make up for the wildlife disturbance due to this project.

## 6.4 MITIGATION MEASURES FOR SOIL POLUTION

- Proper drainage system should be maintained during construction stage.
- A landfill site should be selected for disposal of the solid waste of the construction workers.

# CHAPTER 7

# CONCLUSIONS

Based on surveys and the data analysis it can be said that the construction and widening of road are likely to have long-term benefits for all road users and for inhabitants of villages/ towns near the road. Road users will be benefited from reduced travel time, vehicle operating cost, traffic congestion, road accidents and saving of fuel. Local residents have increased economic employment opportunities, improved access to facilities, educational institutions, hospitals, nursing homes industries, roadside amenities hotels and eating-places. The provision of four laning and service roads interconnected by underpasses and flyovers will remove conflict between slow non- motorized traffic and fast motorized traffic for local residents and therefore making their daily life routine safer.

Based on the results it can be further concluded that:

1. Noise levels recorded at the locations in the day time were below the prescribed limits according to the guidelines of CPCB. Therefore, no changes are required.
2. The noise levels recorded in the night time at Location N4 were slightly higher than the prescribed limits according to the guidelines of CPCB. The residential area, that is, Billa Village, has the noise levels higher than the limits. This higher noise level can be justified by the generators working at the time of testing.
3. Soil testing done at five different locations for agricultural practices were compared on the basis of permeability and porosity. Three out of five locations showed no significant changes, whereas, the other two locations were showing low permeability and porosity after the construction.
4. Qualitative measure of the socio-economic factor was calculated and further concluded that the construction of the new highway is not obstructing the socio-economic growth of the respective area but helping it grow.

## 7.1 FUTURE SCOPE OF STUDY

The present study mainly focuses on the socio-economic growth, noise problem (if any), soil quality and also the number of trees cut down for the widening. Noise was checked using a mobile application, so, the use of an equipment can be further done to check any changes. Various other soil tests can further be done apart from the tests in the present study. The expert survey taken for the calculation of the qualitative measure of the socio-economic factor was done for a total of 10 experts. So, more experts can be involved for better statistical results.

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# ANNEXURE-A

**Name: ……**

**Contact no: ……**

**Occupation: ……...**

1. Do you think the land value will increase due to the new highway facility?

   Rate (**0-10**) (……)

2. Do you think job opportunities will increase due to the new highway facility? Rate (**0-10**) (……)

3. Is the noise due to the construction bearable? Rate (**0-10**) (……)

4. Any religious place destroyed/ moved for the new highway facility?

   (**YES/NO/Can't Say**) (……)

5. Do you think people will now prefer the new highway facility?

   (**YES/NO/Can't Say**) (……)

6. Any cemeteries destroyed/ moved for the new highway facility?

   (**YES/NO/Can't Say**) (……)

7. Will the new highway facility reduce the travel time?

   Rate (**0-10**) (……)

8. Will the new highway facility reduce the road accident numbers?

   Rate (**0-10**) (……)

9. Is the construction of the new highway facility destroying the natural habitat of wildlife? Rate (**0-10**) (……)

10. Was the construction of the new highway necessary?

    (**YES/NO/Can't Say**) (……)

11. During the construction, did resettlement happened?

    (**YES/NO/Can't Say**) (……)

12. After resettlement, compensation was provided to the displaced people?

    (**YES/NO/Can't Say**) (……)

# Annexure-B

Name:_____

Occupation:_____

- To what extent the following factors affect the socioeconomic growth of a region, after as well as during the construction of a highway.

1. Land Value ……%
2. Job opportunities ……%
3. Travel Time ……%
4. Accidents ……%

Total : 100 %

# Annexure-C

**Ambient Air Quality Standards in respect of Noise**

| Area Code | Category of Area / Zone | Limits in dB(A) Leq* | |
|---|---|---|---|
| | | Day Time | Night Time |
| (A) | Industrial Area | 75 | 70 |
| (B) | Commercial Area | 65 | 55 |
| (C) | Residential Area | 55 | 45 |
| (D) | Silence Zone | 50 | 40 |

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A “decibel” is a unit in which noise is measured.

“A”, in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period.