JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ENVIRONMENT IMPACT ASSESSMENT OF EXPANSION OF HIGHWAYS

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Abstract: Road expansion raises the standard of already-existing roads and strengthens the linkage between major economic hubs. Highways are being built more widely due to growing traffic and the necessity to support the region's economy. In addition, the process of accession disrupts the environment and causes several alterations to the surrounding landscape. Furthermore, it has an indirect and direct impact on biotic and abiotic components. Therefore, the Environment Impact Assessment of National Highways is essential to understanding and forecasting the effects on the environment and the socioeconomic circumstances of the inhabitants. Thus, the impact of highway development on the quality of the air, water, and soil as well as the socioeconomic circumstances and health of the indigenous population is reviewed in this study.

Index Terms **– Highway, Environmental Impact Assessment.**

I. INTRODUCTION

Over the past ten years, India's fiscal growth has improved. This has been accompanied by a growing demand for natural resources and a rapid expansion of infrastructure development as a result of industrialization, urbanization, and modernization. These developments are indicators of the country's economic and technological advancement. In India, efforts to create new highways and improve the condition of already-existing roadways have mostly improved connectivity between important economic hubs. The surge in India's economy has resulted in a significant increase in infrastructure development initiatives, which lay the essential groundwork for the development of other economic sectors. The most common public sector investment is the building of new roadways, which is how the government tries to promote economic growth in both urban and rural areas1. A well-functioning transportation infrastructure, such as a highway network, is a top priority for society and is an essential part of the national, state, and local transportation systems. As such, highway projects are typically implemented to improve the people's financial, social, and efficient connectivity. From an ecological point of view, development invariably results in some degree of harm to the environment's natural resources.

Existing ecosystems are directly destroyed and removed when highways are built, and the reorganization of the regional topography. Furthermore, the topography is altered by road growth in a variety of ecological ways, as evidenced by the biotic and abiotic elements of terrestrial and aquatic ecosystems. The construction process has a major impact on air quality and is a major source of particulate matter entering the environment. Airborne ultrafine particles are also produced by land clearing, ground excavation, cut and fill operations, and the building of a specific facility, all of which contribute significantly to PM levels in the atmosphere. Additionally, it has been determined that these activities are a significant source of contaminants entering natural water bodies such lakes, rivers, and streams. Water quality is degraded physically, chemically, and biologically when pollutants from different activities, such as soil erosion, the use of fossil fuels, paint, solvents, cleaners, hazardous chemical use, and construction waste, are added to nearby water bodies through both direct and indirect discharges. The pollution of residential areas and roadside soil has become severe due to an increase in the number of motor vehicles traveling along routes. On the other hand, heavy metal pollution, primarily from automobiles, is regarded as a major environmental problem. People who live and work close to highways suffer greatly from the health and quality of life effects of dust and other air pollutants from various construction activities. Living close to major roadways has also been linked to an increased risk of respiratory complications, cardiovascular disease, and other negative health effects. Workers at construction sites have also been documented to die from lung illnesses and chronic obstruction. Changes in the land use pattern in the areas where the highway improves connectivity have resulted in adjustments to the industrial locations, trading, and other services, as well as changes to the settlement structure. These changes shed light on improvements made to the economic activity design, income generation, price inflation, and employment conditions in the area. Funds for the construction of feeder roads, power distribution networks, telecommunications facilities, and other forms of connection will be drawn in by a new land use pattern that may in turn facilitate easier access to employment markets, healthcare, and educational institutions, among other things. Therefore, as a result of such road construction, leads to changes in the echelon of human development and well-being through their impact on consumption level, educational attainment, and health status in the local economies.

In the current context, India's greatest challenge is to make monetary growth and human development sustainable while balancing the pursuit of fiscal expansion with the preservation of its natural integrity. It so necessitates recognizing, comprehending, and mitigating the ecological costs of growth without sacrificing their advantages. Therefore, it is important to carefully plan highway expansion and operations while protecting natural resources, considering the implications on society and the environment, and figuring out how to reduce these negative effects. The use of Environmental Impact Assessment (EIA) planning and development project procedures becomes crucial for such projects. It is one of the instruments used in the authorization process to give decision-makers pertinent data so they can make an informed choice. The primary goal of an environmental impact assessment (EIA) is to inform the public and decision-makers about the potential environmental effects of a project before any decisions are taken. In addition to giving facts, it makes recommendations for mitigation strategies and actions to stop or lessen such effects. In order to ensure environmentally sound and sustainable growth, the Environmental Impact Assessment (EIA) provides a methodical approach for the inspection, analysis, and evaluation of planned operations.

Nonetheless, a variety of aspects, including hydrology, the mechanics of sediment and debris transport, water and air chemistry, microclimate, and the amounts of light, wind, and noise near roadside, are all impacted by roads when it comes to the abiotic components of the terrain. As a result, the severity and scope of the effects change depending on where the road is in relation to the prevailing winds, slope patterns, and adjacent land cover. In order to provide an overview of the environmental impacts of transportation infrastructure and to structure the information according to environmental assessment terminology, a review of scientific literature on the work done regarding Environmental Impact Assessment of National Highways was conducted.

II. Review and Discussion About Effects of Highway Expansion on Ecosystem

Air Quality

One of the most well-known effects of roads on the environment is air pollution. Human diseases and higher mortality rates are linked to toxic substances found in airborne particulates, which is why this component of transportation has been under close examination for many years by academics, policymakers, and legislators. Most people agree that the primary environmental impact of road-related mobility is air pollution. By introducing metals and hydrocarbons from atmospheric sources to water bodies, air contaminants also find their way into aquatic systems. Though it is evident that poisons penetrate the environment, linger there, and interact with biota, the wider ecological implications of chemical pollution brought on by road-related mobility have not been as thoroughly researched.

The effects of road widening projects differ depending on the extent of the associated construction activity, different phases of operation, and the significance of the affected environmental feature. There were no appreciable negative effects on the environment from the NH-5 extension from its current two lanes to four lanes; nevertheless, there would be short-term effects on the project area's flora, noise levels, water and air quality, soil quality, and socioeconomic status. The EIA of the Road from Ujjain to Jaora, which demonstrated the influence of expansion on such environmental elements like air, water, and soil, was conducted to evaluate the harmful consequences of the project over humans, flora and wildlife, and environment. The significant loss of roadside trees and the elevated concentration of carbon monoxide up to 365,470 mg/cub.m. were identified to be the causes of the air pollution. Even the local air quality declined both during and after the South London road expansion project was completed.

The effects of newly constructed roads and their subsequent operation on air quality have not been extensively studied. The majority of urban road plans cannot be directly benefited from the limited number of studies that are now available for the construction of urban road tunnels. With construction activities accounting for 3.8% of all particle emissions from open sources in the US in 1976, there is enough evidence that construction activities are a major source of particulate matter (PM), which can have a significant short-term influence on air quality. PM emissions are linked to site clearing, ground excavation, cut and fill operations, and the actual constructing of the facility during road or building construction. Although the majority of the PM emissions from construction are in the coarse fraction, they also contribute to airborne ultrafine particles. Since roadways are frequently associated with elevated concentrations of ultrafine particles (UFPs, <0.1 mm), a significant decrease in traffic can enhance local and regional air quality in urban and high-traffic areas.

Soil Quality

Roads are a vital conduit between communities that carry vital commodities and food. It is a necessary facility that greatly improves social and commercial activity. But there has also been significant environmental contamination brought on by road construction, particularly on soil. Numerous publications make it abundantly evident that anthropogenic activities such as energy production, car exhaust, trash disposal, industrial processes, and the combustion of coal and gasoline can pollute roadside soils. Since metal emissions from different vehicles are contaminating the soil along roadsides, soil is a significant factor in determining the potential environmental effects of automobile emissions. Several researchers have noted the need for a better understanding of the heavy metal pollution of roadside soils34. The following heavy metals have been linked to possible risks: Cd, Cr, Pb, Zn, Fe, and Cu. Public motorways have a significant impact on the environment since they are direct sources of heavy metal pollution.

Ndiokwere looked into the effects of car emissions of Cd, Cu, Cr, Ni, Pb, and Zn on soil, vegetation, and crops along high-traffic highways. He discovered that metal concentrations decreased with distance and that metal accumulation was higher on vegetation and soil samples close to the highway than from sites farther away. The possibility of lead contamination from other heavy metals, such as those from motor lubricants, tyre wear, and autos, has drawn little attention.

Three lubricating oils have a Cd concentration of 0.20 to 0.26 ppm, and three diesel oils have a Cd value of 0.07 to 0.10 ppm, according to Lagerwerff. Four tires of various manufacturers were also found to have lead contents ranging from 20 to 90 ppm. While nickel and chromium are typically employed in chrome plating, copper and manganese are utilized in some automotive engine, chassis, and pipe components. Presumably, wear on metallic car parts that contain these metals is the source of some of the metals. According to Naser, the heavy metal concentration was found to be Ni>Pb>Cd in relation to the distances from the road, and the heavy metal content was determined to be 0 m > 50 m > 100 m > 1000 m. Heavy metals from transportation contaminated the area beside the road for an extended period of time due to the higher Ni and Pb concentrations in the soils close to the highway.

The decreasing order of the metal along the roadside soils was also documented by Abechi et al., 50: Fe > Zn > Mn > Pb > Cd > Cu.

Water Quality

The morphology of stream and river channels is affected by the transportation infrastructure in quantifiable ways, which disrupts the biota. On the one hand, motorways increase the energy of stream systems, leading to channel erosion and scouring; on the other hand, they reduce the banks of lanes near streams, resulting in sedimentation. It has been observed that functioning highways, as well as highway and road construction projects, represent a serious risk to the quality of the water. The impact of highway construction projects on Sri Lanka's natural water bodies revealed that the construction of highways and link roads posed a serious risk to the water's quality. One important criterion for assessing the water quality of various bodies of water close to construction projects was found to be the pH of the water.

In several instances, road development has resulted in severe contamination of the river. It has also been noted that discharges from road construction might sometimes be severe enough to necessitate the deployment of control measures. In a similar vein, top soil erosion was noted close to the construction site, primarily as a result of the purchase of agricultural property and building dumps, which similarly raised the SPM levels in the water. One significant source of chemical pollution at roadsides is the upkeep of the roadways and chemical spills that occur alongside them. Certain chemicals are restricted to the vicinity of the road, but others are carried farther away from the road by water. Storm water runoff from highways is a necessary way for toxic chemicals to get into aquatic bodies. Run-off contains a variety of hydrated ions and suspended debris, which vary widely in size and concentration. Heavy metals and organic compounds are mostly absorbed by the sand, silt, and clay particles found on roads and roadbeds. Additionally, a diverse range of toxins linked to automobiles are dispersed throughout the environment by roadside runoff. When it comes to water buildup and runoff from the road surface, highways serve as both a source and a sink. Although roads can speed up the drainage of water, they can also serve as obstacles to water moving downhill. Road networks and stream networks interact to increase the frequency of debris flows in the drainage basin, the overall peak flow in the stream drainage, and the density of the stream drainage.

Water that moves more quickly enters stream channels, boosting the energy of the stream system, scouring the channel, eroding the bank, and raising the risk of flooding downstream66. Since the effects of roads and contaminants in water runoff from roads to aquatic ecosystems can be both immediate and long-lasting, there has been a lot of attention paid to these issues. Water runoff can change the hydrology, add more nutrients, increase the amount of silt, and cause a buildup of other contaminants. Because of the removal of vegetation and the exposure of soil in a watershed, the proliferation of sediment load and changes in stream flows brought about by logging activities have raised concerns. Mass earth movement also causes overbank deposition in watersheds and alters the morphology of streams by depositing in channels and creating shallow pools.

Socio-economic Impacts

Because of the dynamic externalities that transportation infrastructure expansion frequently creates, such development plays a critical role in the socioeconomic and cultural development of any region. It can be a crucial component of both direct and indirect interventions aimed at reducing poverty and improving the socioeconomic circumstances of the rural population, which has long been excluded from the advantages of overall economic progress. There is a wealth of scope and scale analysts in the literature that relates transportation to economic indicators. Researchers have looked at the relationship between economic development and transportation advancements, and they have shown a strong positive association between highway transportation infrastructure and economic activity. Still, not much research has been done on the socioeconomic effects of large-scale infrastructure projects like building new roads or expanding existing ones. But it's becoming clear that a socioeconomic impact analysis that focuses on distributional issues like poverty reduction is necessary to determine the significance of a transportation infrastructure project's contribution to distributional fairness.

Apart from its broader general equilibrium, a large public investment project on road infrastructure development affects the national economy and may help to alleviate rural poverty and improve the socioeconomic well-being of the people living in its proximity in developing economies like that of rural India. There has been a noticeable improvement in the environmental conditions of the homes and businesses along the Thika highway in Kenya, particularly with regard to more markets and chances for investment. However, the environment has primarily negatively impacted the flora and wildlife. Numerous studies have demonstrated the special connection between economic development and transportation. The construction of roadway infrastructure consistently affects the sites of new manufacturing facilities. The site of new manufacturing facilities is impacted by the construction of new motorways, but there may be unfavorable repercussions in terms of displacement as well, according to some data. It has also been discovered that expanding two-lane highway density, four-lane highway construction, and interstate access promote employment opportunities for new manufacturing firms and environmental benefits.

Landscape Change and Habitat Fragmentation

Numerous writers believe that road-induced habitat fragmentation could be the essential ecological consequences of increasing road length. Even while research on ecosystem fragmentation is growing daily, there are still relatively few publications that look at how roads contribute to ecological fragmentation. Research on the effects of roads, habitat loss, and strategies to mitigate such effects is therefore more abundant. During the construction of a road network structure, numerous direct biological consequences on nearby aquatic and terrestrial ecosystems have been noted; nevertheless, they also have extensive, cumulative effects on landscapes that have received less attention. Some of the main effects of road networks on landscapes are habitat loss, poor habitat quality due to fragmentation, loss of connection due to conversion of existing land covers to roadways, and changes in land use and cover caused by roads. Due to their facilitation of deforestation, highways have been found to be substantially connected with processes of land cover change in rural regions, particularly in developing nations. The largest long-term influence on environment is thought to come from habitat fragmentation, while the effects of road construction vary and rely on the kind of road and the level

of economic development in the area. Road development has a clear correlation with regional climate change in the Amazon and the degree of deforestation and forest fragmentation.

The foundational ideas of ecology, land use, transportation, and network theory make up ecological road network theory, which offers a framework for understanding how road networks affect the environment. Consequently, a thorough examination of how a road network affects an ecosystem reveals that it covers a sizable portion of the terrain, saturates it, and produces isolated habitat patches. Reed evaluated the degree of forest fragmentation brought on by highways and deforestation in a research conducted in the Rocky Mountains. They discovered that the fragmentation of forests caused by roads was greater than the depletion of the forests. Trees may stop land slides into roadways. Even little roads can cause microclimatic changes that have an impact on the mix of flora and leaf litter, soil macroinvertebrates, animals, herpetiles, birds living in inner forests, and the diversity of species.

III. CONCLUSIONS

Road infrastructure changes the dynamics of plant and animal populations, modifies the movement of materials in the landscape, introduces foreign elements, and modifies the availability of resources like water, light, and nutrients, all of which have an impact on the biotic and abiotic components of ecosystems. Thus, it can be concluded from the discussion above that no other place has conducted a thorough analysis of the effects of highway growth. This makes it necessary to investigate how highway expansion would affect the socioeconomic status of the local population as well as the quality of the air, land, and water as well as human health.

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