

A Review of Sustainability Factors for a New Expressway Corridor

R.Balakeerthana¹, Dr.K.Yogeswari²

¹B.S.Abdur Rahman Crescent Institute of Science and Technology, Chennai, 600048, India,
balakeerthana.ramesh95@gmail.com

². B.S.Abdur Rahman Crescent Institute of Science and Technology, Chennai, 600048, India,
yogeswari@crescent.education

Abstract: Infrastructure Developments are considered as the key value for a development of a country. Depend upon the infrastructure development only; the status of a country is determined. The infrastructure developments are considered in various fields. The investment by an MNC in a country will most probably depend on the infrastructure development. These kind of infrastructure development will cost in a large scale. The investments are done either by the public, private or public-private partnership. Sustainable development has to be considered as an important point in these kinds of infrastructure projects. Sustainability is highly to be valued in the current situation of infrastructure development that to in a country likes India. The Indian government has planned to construct many expressways (economic corridors) in the line of infrastructure projects. There are many factors of sustainability. This is a review of all the sustainability factors to be considered for a construction of expressways (economic corridors) and the way those are analyzed. The review will help to point out what are sustainable factors to be considered when a construction of expressway is planned and how they have to be, such that the expressway will be sustainable in terms of social, economic and environmental.

Keywords: Expressway corridor, Sustainability, Infrastructure Development, Factors of Sustainability

I. Introduction

Infrastructure developments are considered as the key value for a development of a country. The infrastructure developments are considered in the fields of transportation, water, communication, the electric system and sewage system which also attract MNC's to invest in that country. Sustainable development has to be considered as an important point in these kinds of infrastructure projects which has to be valued high in developing countries like India. This review will help to point out the various sustainable factors to be considered while construction of expressway is planned and how they have to be, such that the expressway will be sustainable in terms of social, economic and environmental.

II. Sustainable Development

Sustainable development is a dynamic process in which communities anticipate and accommodate the needs of current and future generations in ways that reproduce and balance local economic, social and ecological systems, and link local actions to global concern.

Bala Keerthana.R Tel: +919952242898

balakeerthana.ramesh95@gmail.com

2.1. Objective of Research

The main objective of the study is

- To find the factors of sustainability in the construction of economic corridors.
- To find the way of analysis of the indicators.
- To find the mitigation of the indicators that has poor impact.

2.2. Need of Sustainable Development

All the infrastructure developmental projects need sustainability. Every infrastructure development was planned, constructed and executed by the government of the country for the benefits of the nation. As said earlier the infrastructure projects have many factors of sustainability. Each sustainability factors has an impact on the project and the society. The impact may either be positive or negative. The analysis of sustainability factors will help to prolong the benefits of the factors with respect to the project.

2.3. The Dimensions of Sustainability

The sustainability with respect to any project has three dimensions which can also be represented as “3D of sustainability”. The Fig.1 represents the relationship of the various dimensions with respect to the sustainability. The three dimensions are,

- Social
- Economic
- Environmental.

These dimensions can also be termed as indicators.

2.3.1. Factors of sustainability:

The social, economic and the environmental dimensions of sustainability have many factors of sustainability in it.

Table 1. The List of Factors of Sustainability

Social Indicators	Environmental Indicators	Economical Indicators
<ul style="list-style-type: none"> • Community livability • Population • Employment • Literacy • Mobility disadvantage • Community interaction • Poverty • Safety • Non motorized transport planning • Equity 	<ul style="list-style-type: none"> • Noise pollution • Water pollution • Air quality and pollution • Loss of Agricultural land • Habitat loss • Land use impact • Climate change emissions • Resource efficiency 	<ul style="list-style-type: none"> • Industrial Development • GDP & NDP • Profit • Transportation cost- Affordability • Freight efficiency • Accessibility • Planning • Job opportunity

The Table 1 shows the list of factors to be considered in case of a new expressway corridor. The following literature review deals about the analysis of few indicators done by the various authors in the past few decades. They are population, ICSECE’19 employment, noise pollution, air pollution, water pollution, vibration to the building near by the corridor, industrial development, job opportunity, and loss of habitat, loss of agricultural land, alignment and economic growth.

III. Literature Review:

With the detailed study on various research papers done by many previous scholars, the following reviews were made. A number of studies have been carried out by the scholars in the past few decades to determine the sustainability in infrastructure constructions. The factors of sustainability were found out.

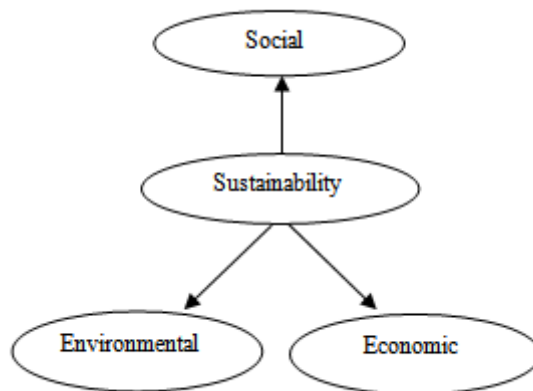


Fig.1. 3Dimensions of Sustainability

3.1. International Status:

Barbara C. Richardson (2005) conducted a study on “Sustainable transport: analysis framework” the study has identified the indicators that have been considered in the sustainability for transportation field. The analysis also gives an output framework of the interaction between these indicators. The indicators for freight transport and the passengers transport were different. The author states that the passengers transport deals with social indicators, while freight transport deals with environmental and the economic indicators. Fuel conception, safety, congestion, access were main indicators in which, some can be governed by government policies. The author concluded that the feedback and rebound effect will help to alter the system for sustainability.

Todd Litman (2006) conducted a study about the indicators of sustainability and reported the “Issues in Sustainable Transportation”. The author identified different indicators for sustainability in social, economic and environmental which also varies from the indicators identified by Barbara. The indicators were grouped to simple, conventional and compressive indicators and posses which have to be low and which have to be high. Their range helps to make sustainable transportation. They were ranged to scale of 3 for data needed to be collected. The author also stated that the transportation decision making, land use, automobile dependency, etc helps to implicate sustainable transport.

Bala Keerthana.R et.al

Paul R. Voss et al (2006) conducted a study on “Highways and Population Change”. The authors study on change of population helps to identify the change of people’s employment, social structure, and economic growth due to the expansion of highway. The census data of various decades and the field survey would help to collect data for analysis. The author used spatial lag and regression model keeping highway expansion as dependent/independent variable respectively. Finally, it was concluded that the expansion of the population will be up to 10 to 20 miles.

Antonio Estache et al (2012) had a research on “The impact of infrastructure on growth in developing countries”. The government used to launch many infrastructure development constructions in large scale. People use to think will the project be helpful to them. The research of the author puts an answer to it. The author had analyzed the importance and the growth of infrastructure in many countries by reviewing many papers and the data. From the review it was clear that each country needs a different kind of infrastructure growth respective to their need. Energy, telecommunication, transport, water and sanitization are the most important sector of development. The author finally concluded that studies found a positive impact in most cases. The infrastructure project can be easily underestimated so a proper work on it is needed.

Douh Brugge et al (2013) conducted a study on the health of the people living near by the highway and published a paper “Near-highway pollutants in motor exhaust: a review of epidemiology evidence of cardiac and pulmonary health risks”. The review of him matters a lot as it deals with the health of the people near by the highways. The author conducted the health study on people live near by the highway. The test was on the presence of nitrogen oxides, carbon monoxide, and ultra fine particles by using the light absorption method. Finally, the author concluded that the people live 200m near by the highway were affected a lot by pollutants. Cardiac and pulmonary health issues are common. The author also states that 500m was the safe level to be away from the highway.

Lei Zhang et al (2016) conducted a research on “Compressive highway corridor planning with sustainability indicators”. The author employed a technique called MOSAIC. The method helped to measure the impacts of sustainable in corridor improvements. The author took multimodal corridor improvement movements. The author evaluated many factors such as socio-economical impact, energy emission, safety, mobility, highway improvement cost and modal choice. The mathematical equation proposed by the author in terms of noise pollution and air pollution will help to measure the effects.

Stanislawbacier et al (2018) conducted a study on “Infrastructure development and its influence on agricultural land and regional sustainable development” the author conducted a study in Poland to find out the loss of land, decrease of income to the local people who gets income from the land that had lost due to the road construction, the expansion of plots at worst and the loss of land value. The analysis results were presented in terms of percentage. The theoretical and the methodology proposed by the author were ICSECE’19 very simple, but the result of analysis was deep. The author used GIS to analysis the change in land. The visual comparison of the area in various years gave the clear outcome of land loss. The author also found that the soil near by the motorway gets polluted by the pollutants from the motorway hence the author suggest making greenbelt in 90m or 100m from the motorway in order to prevent the ingression of pollutant from the motorway.

3.2. National Status:

M. Legret et al (2000) conducted a study on “Evaluation of pollutant loadings in the runoff waters from a major rural highway” the authors study is one of the most important point to be considered in terms of environmental sustainability. The author collected runoff water from the highway. The runoff water from the highway was collected from the rains of throughout the year. The rain water fell down and washes away the

chemicals that laid down in the roads from vehicles. The collected sample was tested for various pollutants such as Cl,Pb,Cu,Zn, suspended solids using atomic absorption spectrometry. The percentages of presence were tabulated. Lead and the Copper were found to be the pollutants of high percentage which were leaded from gasoline.

Dr.Prafulla A Pawar et al (2010) had a research on the Delhi Mumbai industrial corridor. The author optimized the SWOT analysis. The author had a study about the various aspects of the project in terms of its strength, weakness, opportunities and threat. The result of the project has a clear view of how the other industrial corridor will make an effect. The author has found out that the Delhi to the Mumbai industrial corridor will increase the economic activity. The industrial corridor would help to have a good connectivity between cities. The Delhi to Mumbai industrial corridor have well established and physical infrastructure growth. The author found that the road and the electrical availability or the growth in the Rajasthan state was the major weakness of Delhi to the Mumbai industrial corridor. The author also found that the amount to be paid as the compensation to the people for the land to be acquired will be more which in return increase the Delhi to Mumbai industrial corridor cost.

The figure 2 shows the alignment of the proposed and the upcoming economical corridor in India as of 2013.

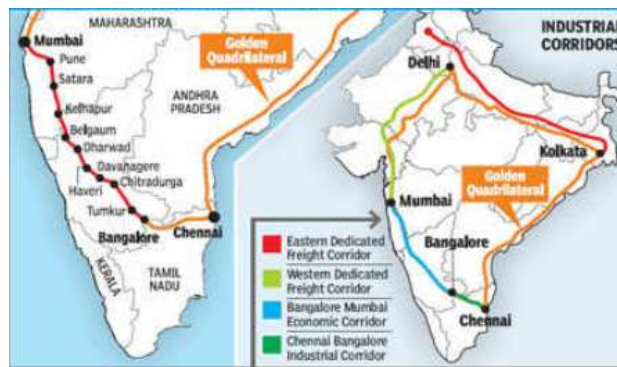


Fig.2 Economic Corridors in India

Bala Keerthana.R et.al

Aggarwal.S (2018) conducted a research on “Do rural roads create pathway out of poverty” the study by the author had a deep root of the surveys by the other researchers and the data collected by him on how a road on rural will help to create the pathway of growth. The study shows that the road has a wide variety of economic outcomes in rural areas. The result shows that due to the construction of roads the enrolment of children in school increases. While the drop out of older students also increases and those dropout students goes to marginal works as labors. The market load trips increases. The farmer also increases the use of fertilizers and adapted to changing technologies. Overall, the study by the author concludes that the rural roads laying will decrease poverty.

Kibblewhit.M.G (2018) conducted a study on “Contamination of Agricultural soil by urban and periurban highways”. The author conducted a study on various papers published before on the google scholar. The study by the author was about the effect on the agricultural lands near the urban and periurban highways due to the pollutants from the roads. The pollutants from the highway gets into the agricultural land nearby through the runoff water , splash created by the traffic up to 10m or by airborne transmission. These pollutants get into the agricultural land and pollute it. The pollution also gets into the foods that were grown on the field. The result concluded the soil up to 50m from the road get polluted to great extend. The author also report that the pollutant may extend beyond the 50m range. The author also had given some mitigation ways to prevent it. Physical and vegetation barrier will be helpful to prevent the ingress of polluted water. Better design, porous asphalt and a better drainage system is also a prevention way.

Saugato Datta (2011) studied a detail report on the Indian Golden Quadrilateral program and made a report on “The impact of improved highways on Indian firms”. The Indian government launched the golden quadrilateral program. The road passes through many villages, towns and cities. The main aim of the project was to connect the major cities of India and to increase the goods movement. The author collected data, reports and conducted survey in two years 2002 and 2005. The survey includes the cities it passes and nearby, the distance between them and the road, the total and type of firms in it. The data on the amount of goods they supply was also collected through the survey. The movement was quite slow and difficult in the year 2002 but increased by 2005. The author concludes that the economic growth will be slow, while construction period, but definitely will increase after finishing it.

3.3. Economic Corridors around the World

The following is the list of few economic corridors around the world so far

- China-Pakistan Economic Corridor
- Sarawak Corridor of Renewable Energy
- Nanning-Singapore Economic Corridor
- Bangladesh-China-India-Myanmar Forum for Regional Cooperation
- East – West Economic Corridor etc.

3.4. Inference

From the above literatures reviewed the following inference were made. The inferences are in terms of the analysis method of the factors and other observations in it.

3.4.1. Analysis methods

The following Table2 represents the methods that are identified for the analysis of indicator.

Table2. Analysis Method

Indicator	Analysis method
Population	Census
Literacy	Field survey
Employment	Field survey
Noise pollution	MOSAIC
Air pollution	MOSAIC, Emission Rate
Water pollution	Standard test accepted by the national standard
Loss of agricultural land	GIS
Habitat loss	GIS and field survey
Industrial development	Government data
GDP & NDP	Field survey
Transportation	O-D survey, the cost of the travel
Vibration	Mathematical equation proposed by L.T.Long, using Vibration sensor.
Safety	Awareness and planning
Non motorized transport planning	Transportation planning and implementation of rules
Mobility disadvantage	Geographical study and the available road facility
Freight efficiency	Panning and feedback report

3.4.2. Other Inferences

- The factors of sustainability were elaborated by many indicators in all the terms of social, economic and environmental.
- Each indicator has different types of measure of analysis to measure them.
- The indicator analysis has to be compared with previous records and the national standards for the sustainability.
- The expressway corridor construction wants a large amount of land for it which implies that the land use increases.
- Most of the times these land passes through the agricultural land which is a great loss, that to a country like India, the agricultural land loss is a great impact.
- The compensation to be paid to the land owners were also high, which in results also increases the cost of the project.
- The pollutants from the motorway get in to the agricultural land near by it either by air or by the rain water runoff and affect agriculture. Hence it is necessary to make preventive measures to stop the ingress of pollution.
- Need a prevention method to protect the nearby agriculture land from turbidity and other dirt from the roadway.
- The softwares available in the market such as GIS and Google map helps to find a new way for the plan of the economic corridor without going for a direct visit.
- However, the economic corridors act as its name economic. Yes, the economic status of the nation surely increases due to the construction of economic corridor.

The goods movement also increases as the road transport facility increases which make a smooth movement of the vehicles.

3.4.3. Mitigations

The following are the few mitigation steps to be carried out for sustainability

- To decrease the land usage alternative, design and planning may be done such as underground construction or flyovers.
- To prevent the ingress of pollutants from the run off rain water, a proper drainage design which separates the heavy metal and other pollutants from it.
- The construction of greenbelts around the agricultural land, i.e., in between the motorway and the agricultural land will prevent the ingress of pollutants from the motorway to the agricultural land.
- With the help of GIS software the alternative path with less effect to the surrounding can be chosen.
- The vegetation should be done beyond 90m from the corridor.
- Continues monitoring for the emission of pollutants should be done.
- High noise generating vehicles should not be allowed in that corridor.
- The government must implement some rules to the people in order to prevent pollution.
- The buildings near by the corridor must be constructed by considering the vibration that will get into the building and it has to be built preventing the vibration.
- Continuous health checkup has to be carried out by the people living near by the road.
- Noise barriers or noise reducers must be used in the construction to prevent noise pollution.
- The place where more amount of agricultural land to be occupied is high, alternative path or reduction of lanes can be done.

IV. Conclusion

The literature review of the factors of sustainability has done. The factors and the indicators of sustainability were found out by the review and the analysis of each of it was found. For a developing country like India, the construction of the expressway corridor will definitely help to reach a good economical status. There is no doubt in it. But it is necessary to make sure that the environment and the life hood of the locality must not be affected. Most of the expressway corridors affect the locality in social and environmental aspects. The literature review helped to forecast the problems that will arise due to the construction of a new economic corridor and preventive measures were pointed out.

Reference

- [1]. Acharya, Tridev. Yang, Intae. Lee, Dongha. (2017). GIS-based preliminary feasibility study for the optimal route selection for China-India railway through Nepal: Journal of the Korean Society of Surveying Geodesy Photogrammetry and Cartograph.
- [2]. Aggarwal. S. (2018). Do rural roads create pathway out of poverty: Journal of Development Economic.
- [3]. Antonio Estache And Gregoire Garsous. (2010). The impact of infrastructure on growth in developing countries: IFC Economics.
- [4]. Barbara C. Richardson. (2005). Sustainable transport: an analysis framework: Journal of Transport Geography 13 (2005) 29–3.
- [5]. Consultancy Services. Feedback Infra Pvt.Ltd. (2018). Feasibility study on Chennai to Salem 8way green corridor: Government Gazette.
- [6]. Dariusz Boruszko, Wojciech Dabrowski, Wiater Jozef. (2018). Development of road infrastructure in environmentally valuable areas- sustainable designing: Problems of Sustainable Development.
- [7]. Doug Brugge, Johnldurant and Christine Rioux. (2013). Near- highway pollutants in motor vehicle exhaust: a review of epidemiologic evidence of cardiac and pulmonary health risks: Environmental Health.
- [8]. Earl Shadd D. Araña, Leira Liz A. Bisain, Rae Cecil N. Acedera, John Elmer C. Guillermo and Albert A. Griño, Jr. (2017). Assessment of traffic-induced vibrations of Ozanam Building of Adamson University: MATEC Web of Conferences 169, IMETI 2017.
- [9]. Eva Ivanova and Jana Masarova. (2013). Importance of road Infrastructure in the economic development and competitiveness: Economics and Management.
- [10]. Guy Baeten. (2000). The tragedy of the highway: empowerment, disempowerment and the politics of sustainability discourses and practices: European Planning Studies.
- [11]. Kibblewhit M.G. (2018). Contamination of agricultural soil by urban and periurban highways: Environmental Pollution.
- [12]. Leizhang, Mingyang Ji Nicholas Ferrari. (2016). Comprehensive highway corridor planning with sustainability indicator: State Highway Administration Research Report.
- [13]. M.Legret, C.Pagotto. (2000). Evaluation of pollutant loadings in the runoff waters from a major rural highway: The Science of the Total Environment-ELSEVIER.
- [14]. L.T. LONG. (1993). Measurements of seismic road vibrations: International Conference on Case Histories in The Geotechnical Engineering.
- [15]. Manoj K.Jhaa Hellon G.Ogallob, Oludare Owolabi. (2014). A quantitative analysis of sustainability and green transportation initiatives in highway design and maintenance: Procedia- Social and Behavioral Sciences.
- [16]. Meha Singla, Priyanka Kapoor and Yadunand An Batchu. (2016). Impact cities based on proposed industrial corridors in India: Real Estate Research.
- [17]. Murali Krishna Gumma, Irshad Mohammad, Swamikannu Nedumaran, Anthony Whitbread and Carll Johan Lagerkvis. (2017). Urban sprawl and adverse agricultural land: A Case Study on Hyderabad, India: Remote Sensing.
- [18]. Osama Hunaidi. (2000). Traffic vibrations in building: Institute or Research in Construction.
- [19]. Paul R. Voss And Guangqing Chi. (2006). Highways and population change: Rural Sociology Society.
- [20].

- [21]. Per Angelstam, Olha Kaulyak, Taras Yamelnets. (2017). Green infrastructure development at European Union's eastern border: Effect of Road Infrastructure and Forest Habitat Loss.
- [22]. B.A.K.S.Pereraa, Raufdeen Rameezdeenb, Nicholas Chilesheb & M.Reza Hossein. (2014). Enhancing the effectiveness of risk management practices in Srilankan road construction projects: a Delphi approach: International Journal of Construction Management.
- [23]. Dr. Prafulla A.Pawar, Nitin B. (2010). Vibrant North-West India: SWOT analysis of Delhi-Mumbai industrial corridor: Industrial Risk Analysis.
- [24]. Robert A. Johnston. (2009). Indicators for sustainable transportation planning: Journal of The Transportation Research Board. D.C., 2008, Pp. 146–154.
- [25]. Saugato Datta. (2011). The impact of improved highways on Indian firms: Journal of Development Economics.
- [26]. Stanislaw Bacior, Barbara Prus. (2018). Infrastructure development and its influence on agricultural land and regional sustainable development: Economical Informatics. ECOINF 839.
- [27]. regional sustainable development: Economical Informatics. ECOINF 839.
- [28]. Todd Litman. (2006). Issues in sustainable transportation: International Journal of Global Environmental. Vol. 6, No. 4, 2006.