Choosing An Best Economic Corridor Level Between Chennai To Salem Using Analytical Hierarchical Process (AHP) And Technique For Order Preference By Similarity To Ideal Solution (TOPSIS)

Dr. K. Yogeswari, R. Bala Keerthana

Abstract: Economic corridors are meant to increase the connectivity between major cities such that the industrial growth will happen. These kinds of economic corridors will play a vital part in the economic growth of a country. The Indian government has announced an economic corridor between Chennai to Salem. It is necessary to consider sustainability in the project for its long run. The following work is an analysis of choosing the best corridor level i.e. elevated or on ground. The indicators for sustainability are identified and evaluated. Since there are many variables it is necessary to chose the best alternative design by using multi criteria decision making. The multi criteria decision making has various options the best method has been opted. The importance of indicators is made with the help of Analytical Hierarchical Process Process (AHP) and the best alternative is arrived with the help of technique for order preference by similarity to ideal Solution (TOPSIS).

Keywords: Analytical Hierarchical Process (AHP), Economic Corridor, Multi Criteria Decision Making, Sustainability, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).

1. INTRODUCTION:

For a developing nation like India it is very necessary to built many economical corridors. As we all know, the world will mark the status of the nation depend on infrastructure growth. The sustainability is one of the most important things to be considered in these projects for their long run. The government of India have announced 8way green corridor expressway between Chennai to Salem. The main aim of the corridor project is to decrease the travel distance between these two cities and to reduce the fuel consumption. Another thing is to increase the number of industries and industrial activities along the corridor also to increase the goods and service movements in the state. It is necessary to consider the sustainability of any infrastructure projects for its long run. The corridor may be planned, constructed and functioned for any purpose. It will not be stand for a long time unless sustainability is considered in it. The corridor was proposed to be an on ground corridor. Many oppose were bloomed in terms of both social and political. It is necessary to find whether the proposed corridor will be sustainable or need an alternative.

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The following analysis done in order to find which corridor will be more sustainable either an on ground corridor (A1) and an elevated corridor (A2) using multi criteria decision making process such as Analytical Hierarchical Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The ranking of indicators were done by AHP while the best alternative was chosen with the help of TOPSIS.

1.1 OBJECTIVE OF THE STUDY:

The main objective of the study is

- To find the list of sustainable indicators for an economic corridors.
- To find the ranking and weightage of each indicators using AHP.
- To choose the best alternative using TOPSIS.

2. LITERATURE REVIEW:

Mukund Pratap Singh et al (2018) applied fuzzy AHP based multi-criteria decision-making analysis for the route alignment planning using geographic information system (GIS) in the outer region of Allahabad. The route (alignment) is to connect source point Naini and destination point Jhunsi situated in the outer region of Allahabad city. An optimum route alignment was selected with minimum effect on areas of roads intersection, land use, drainage, religious places and high slopes. The process involves identifying and selecting the best route alignment by considering many criteria's of social, environmental, economic and spatial datasets. The fuzzy AHP used to compare all the criteria's and founded their weightage of criteria in order to find the best alternative. On the basis of maximum priority weight the criteria values of each four alignment that were taken into account and weight of each criterion are calculated. The route with maximum weight was selected as optimum route. All the route networks were considered. Also the trees, rivers, urban area, industrial

area, railway and agricultural land were also taken into account for the alignment.

Stanisław Bacior, Barbara Prus (2018) conducted a study on the infrastructure development and its influence on agricultural land and regional sustainable development. The author presented a methodology and a theoretical framework in order to analyse the impact on agricultural land and sustainable development due to motorway construction using a simplified method. The author carried out a study in Poland on expansion of motorway and finds its negative impact on farmland. They made the assessment by visual comparison and GIS. It was founded by them that the loss of farmland taken over have decrease in quality of land, expenditure on transport, deterioration in relative farmstead plot were found. The economic aspect of sustainable development is influenced directly by decrease in the value of land taken over. The decrease of land value, decline of income value in vincity, decrease of income by increase of distance of plot from homestead and worsening of plots expansion were found as 52%, 31%, 6%, and 11% respectively. They suggest a greenbelt to be implemented up to 90m and up to 100m the cultivation should not be done as it will reduce the quality. Select the optimal motorway route variant so the losses of land's value in every analysed aspect could be the smallest, namely the motorway variant that runs through the lowest quality lands, crosses the smallest possible amount of local roads, runs along the outskirts of villages, does not interfere with the buildings' structure, and provides the protection of cultural and natural heritage.

Acharya, Tri Dev, Yang, In Tae, Lee, Dong Ha (**2017)** conducted a study on GIS-based preliminary feasibility study for the optimal route selection for China-India railway through Nepal. Their paper is about selecting an optimum route for China -India through Nepal. A project proposal of Rasuwa Gadhi to Birgunj Railways was found as the shortest route from China to India. The China has growing interest to connect Southeast Asia through Nepal has led to this ambitious project proposal. The concerned authorities in Nepal to be dependent on analysis and proposals from donor nations due to lack of updated geospatial data. The study explores optimal routes to connect cites using slope and land cover by Taking such considerations, based on GIS and free data. Based on reclassified slope, two shortest optimal routes were found. Two routes one passing through Baireni in Dhading and another through Kathmandu towards Birgunj is found out with the length of around 172 Kilometres. From the study done it shows that the available open source data can be used of preliminary feasibility studies and yet shows limitations for detailed economy based planning. To become self-sustained in planning of development works, Development and use of high resolution updated geospatial data is of high necessity for Nepal. They used DEM (digital elevation model) and Land cover map. By the end they found the least cost path.

Mariem besbes et al. (2017) did an analysis of a case study to choose the best performant manual workshop layout by using AHP and TOPSIS. The unit of manual assembly unit have to be arranged in such a way that it have to be more efficient flow of assembly and working process. In the case three alternatives were chosen for the assembly unit. To get an ideal assembly unit, the indicators considered by the author was flexibility, accessibility, area utilization, labour utilization. The indicators selected by the authors are both qualitative and quantitative hence the author opted analytical hierarchical process (AHP) to find the importance of the criteria's and ordered them according to their rank of importance. The consistency ratio was below 0.1 so the analysis is acceptable... Later the ranking of criteria were induced as the input for TOPSIS analysis, from which the best ideal solution was found out by the author.

Ayman a.Abdul Mawjoud et al (2016) used the ANALYTICAL HIERARCHICAL PROCESS (AHP) and GIS technique to find the ideal rural highway route location. Significant time and effort is required by the planners to find the ideal route which makes the process a difficult one hence the authors optimized the multi criteria decision making process. Three different routes were marked by them. The analysis consists of variety of data which are of different scale and sources. A questioner survey was conducted to various expertises such as decision makers and highway constructors and designers from which the indicators were chosen. The indicators identified and used in the pairwise comparison was slope, hydrology, soil bearing, land use, water resources, environmental impact, linear engineering structure and settlement area. Author created various maps for the respective indicators such as map for land use, map for water resources etc using GIS while the relative importance of the criteria's were founded by them using ANALYTICAL HIERARCHICAL PROCESS (AHP) for all the three routes. Finally an optimum route was chosen.

Marie Ridley Pryn et al (2015) had done an analysis of choosing a best model for connection across Roskilde Fjord in Frederikssund, Denmark as a case study. The author applied multi criteria decision analysis (MCDA) making do the analysis. They did a research and selected sustainability indicators such as transportation, mobility, infrastructure, operation cost, noise exposure, air pollution, local biodiversity impacts, built aesthetics, traffic demand future proofing and ,coherence with in municipality. Totally four alternatives were marked for the analysis which are high level bridge funded through user charge(1) , expanding current bridge funded through user charge(2), light rail link(3), service of free shuttle busses on existing connection funded through user charge(4). The method used to mark the best alternative are nested model, analytical hierarchical process (AHP) and SUSTAIN Decision support system SUSTAIN DSS. The ranking of the indicator is based on the terms of sustainability and the weightage of the sustainability indicators were also done by the authors. The alternative three was founded as the best one for sustainability.

Saugato Datta (2011) conducted a study on the impact of improved highways on Indian firms. The author had studied a detail report on the India's Golden Quadrilateral program. His report had a detail study about what are the major and minor cities through which the road passes by,

the distance between the cities and the proposed road, the total number of firms in that region, the type of firm, and the total amount of the goods the supply through that way. The main report or the survey was done for 2 years 2002 and 2005. It is finally concluded that the firm movement become low in the year 2002 rage as the road construction was going on and on by 2005 the movement was almost on the same scale. Those pieces of evidence suggest that improved highways facilitated productive choices that firms may have wanted to make even earlier, but were constrained from being able to make by the quality of highways available to them.

Todd Litman (2006) conducted a study on the issues in sustainable transportation. The author describes about the sustainability and the issues related to sustainable transportation. The sustainability was termed in many ways by many well positioned people. The reason for the sustainable transportation problem revolves around social, economic and environmental basis and the factors involved in each of it. The transportation impact on sustainability is deep. Both the simple, conventional and comprehensive sustainable transportation indicators were noted many policies are there to evaluate on range of 3.These indicators in which a particular programme or policy a set of indicator more vice versa. The indicators were described and valued for better range. The indicators are LOS, ATS, crash rate per mile, parking, mode split VPE, growth, planning and efficiency etc. The indicators are demographic, geographic, time,mode and trip factors. Each indicator has different characteristics such as ambiguous, not reflects impacts but can't be ignored, difficult to collect. The implication can be done by transportation decision making, automobile dependency, transportation equity, community liveability, land use. The author says that a combination of strategies needs to achieve sustainable goal. Some visions of other people were discussed.

Josias Zietman et al (2006) did a research on transportation corridor using multi-criteria decision making. The research deals with a case study of considering two freeway corridors in US (US-290) and South Africa (PWV 9). The projects were to increase the lane of existing freeways. Various applications such as net present worth (NPW) and multi-attribute utility theory (MAUT). Attributes like fuel consumption, vehicular emission, mobility and traffic safety were taken under consideration. Totally 8 alternatives were chosen by the author for both the corridors. The indicators weightage and values were pointed out. Three illustrations were taken to find the best alternative, which were illustrated and their effects on final decision. The illustrations figured out that the two approaches using MAUT produces similar results while the results based on NPW approach was quite different. The analyses illustrate1that the type of decision-making methodology, and particularly whether the sustainability effects are included, have a direct effect on the final decision. The specific findings found were taken to consider. Performance measures were identified, they were quantified at disaggregate level, the indicators weights distinguish between relative importance to various indicators. The MAUT was founded better to analyse both qualitative and quantitative indicators.

Barbara C. Richardson (2005) conducted a study on sustainable transport: analysis framework and presented an analysis framework that identifies the indicators of sustainability in transport, interaction between them in a form of framework. Also identified the policy intervention to increase the possibility of trade off among indicators in both freight and passengers components in system of transportation. Black et al (2002) described the quantifiable measures of performance in transportation policies as "indicators". The author states that the freight transport deals with economic and environmental factors while the passenger's transportation deals with societal factors, access, congestion land use and safety. Safety is not much discussed in their literature while the university and the trucking industry indicated safety as primary concern and gave 5 on scale 1-5 in both societal and economic perspective. The framework for both passengers and freight factor affecting sustainability, safety, fuel conception, congestion, access and environment was provided with all the interactions among them. It is noted that some of the factors can be governed by government policies and they were explained. The author concludes that the cause and effect method is not enough for sustainability the feedback and rebound effects helps to change the system.

2.1 INFERENCE:

From the literature review done it was found that in order to make economic corridors a sustainable one a lot of indicators have to be analysed. The indicators of sustainability found to be interconnected which reveals that a change in one indicator will directly or indirectly affect the other indicator (Barbara C. Richardson 2005). The indicators were grouped into economical, environmental and social indicators. The indicators are both qualitative and quantitative. The traffic in corridor is classified into two namely freight traffic (vehicle that carry goods and services-logistics) and passenger traffic (vehicle that carry normally people traffic). It is also inferred that it is very difficult to make a corridor to be sustainable in all aspect of indicators (Todd Litman-2006). Hence it is necessary to use a multi-criteria decision making model to find a best sustainable corridor. There are lot of multi-criteria decision making process. Some of them are analytical hierarchical process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Decision Support System (DSS), Net Present Worth (NPW) and Multi-Attribute Utility Theory (MAUT), FUZZY and Neural networking. Each criteria process has different kind of approach to find a suitable alternative. The process helps to find the weightage of criteria's and their ranking. The multi criteria decision approach made it possible to include a broad range of sustainability issues. Within the context of sustainable transportation it made it possible to include a broad range of quantitative and qualitative sustainability issues in the decision-making process. I have chosen AHP to rank the criteria of alternatives by pairwise comparison of criteria and TOPSIS for choosing the best alternative.

3. About Chennai to Salem 8way Green corridor expressway:

The main necessity of the study is to find the best economic corridor between Chennai to Salem. The government of India have announced many economic corridor connecting major cities in India. The Chennai to Salem 8way green corridor expressway is one among them. The main aim of the Chennai to Salem 8way green corridor expressway project is to increase the activities and establishment of many industries along the corridor. Another main reason is to increase the movement of industrial goods and services in freight movement. It is also to reduce the time travel and distance. Another reason is to decrease the fuel consumption. With the construction of corridor the government of India aims to increase an economic growth of the nation. But in order to get a long successful run of the project the corridor must be sustainable. The figure 3.1 represents the existing and proposed alignment between the Chennai to Salem. Already two main routes were existing between the two cities: existing route 1via Villupuram-Attur (352.70Km), existing route 2 via Vellore-Dharmapuri (334.28 Km). The new expressway corridor proposed by the government is via Kanchipuram-Krishnagiri-Dharmapuri (277.3Km). The existing routes were 4 or 2 lanes while the proposed one is 8 lanes.

3.1 BACKGROUND OF STUDY

A lot of land is required to lay the new corridor. As said earlier many protest bloomed against this project. The previous economic corridor projects shows a economical growth to the (Saugato data 2011) hence the corridor will definitely lay a path to the growth of nation From the literature review it is found that the sustainability has three dimension factors namely Social factors (1), Environmental factors (2) and Economic factors (3). Each factor has many indicators. The analyses of sustainability by the authors prove that the selected indicators for analysis vary according to the author/investigator. It is found that analytical hierarchical process (AHP) and technique for order preference by similarity to ideal solution (TOPSIS) is one of the best ideal ways to find the best corridor for sustainability. In this case the two alternatives was corridor on ground (A1) and elevated corridor (A2) and the criteria as social indicator, economic indicator and economic indicator. The figure 2.1 indicates the terms of sustainability. (Zietsman et al., 2003) Experts mostly concerned about sustainability issues such as social equity, safety, and the environment. The conventional evaluation techniques for transportation decision-making focus primarily on the quantifiable financial and economic aspects of the investment. The major advantage of a multi-criteria analysis is its ability to account for a wide range of differing, yet relevant indicators.

4. METHODOLOGY:

From the literature reviewed the following methodology is proposed. This flow of analysis will help to accomplish the objective. The fig 4.1 shows the methodology of work.

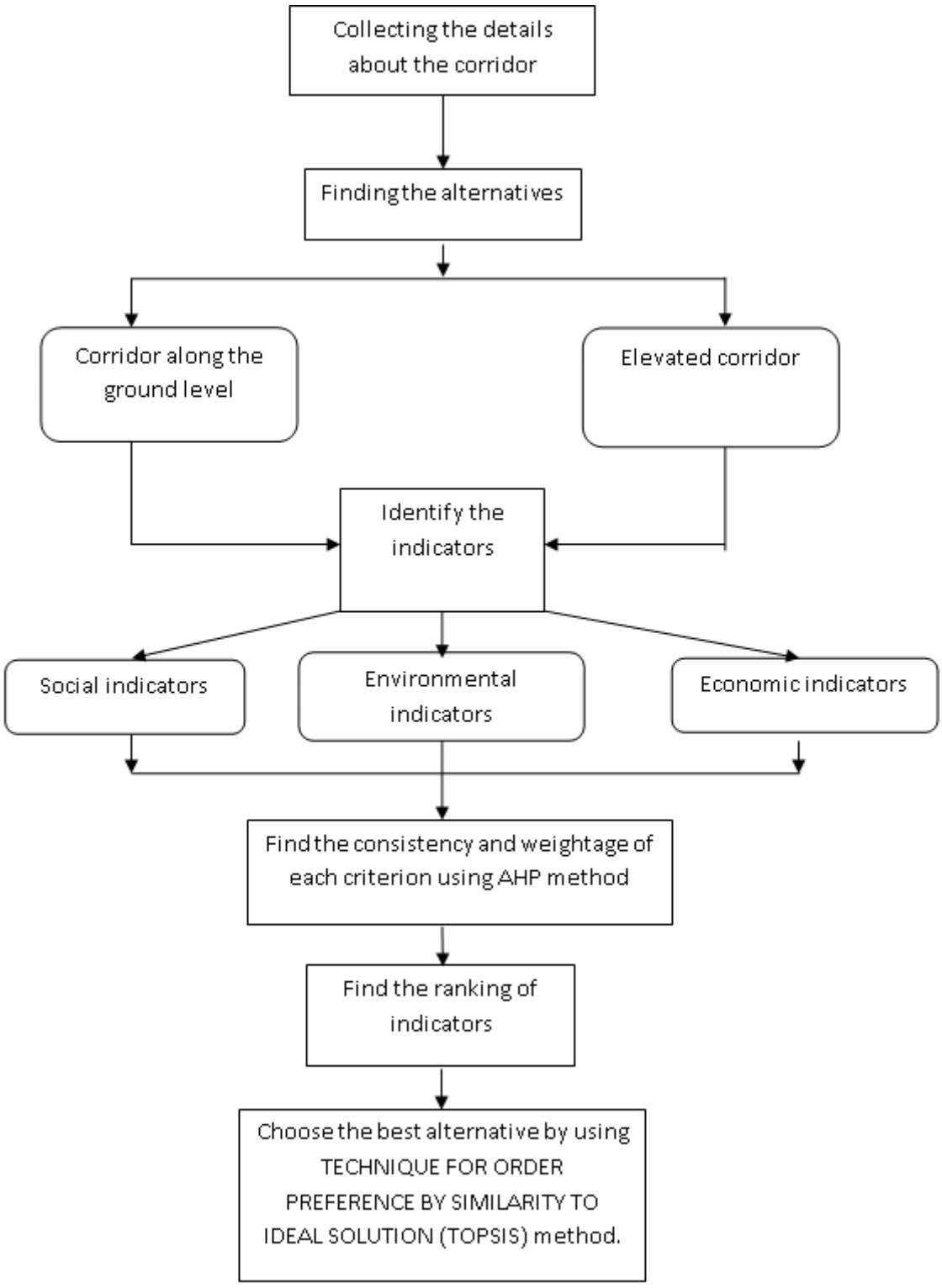

Fig 4.1 *Flow chart of methodology*

4.1 SUSTAINABLE TRANSPORT:

The sustainable transportation has various definitions. Each is outlined and formed by various experts in various ways. Basically a sustainable transportation has to provide access and development of society in a safety manner to human and ecosystem. A sustainable transportation must be affordable, efficient and must balance a regional development. It has to benefit the successive generations too. A sustainable transportation system has to ensure that the major issues of environmental stewardship, economic development and social equity have to be addressed within the transportation sector The Fig 3.2 represents the three dimensions of sustainability.

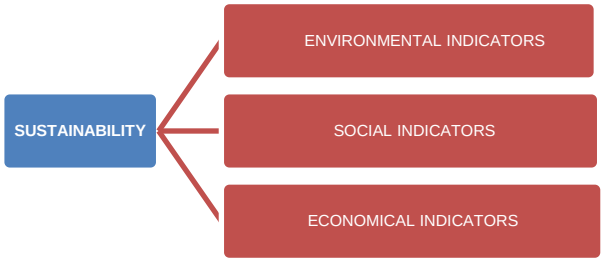

Fig 3.2 *Dimensions of sustainability*

4.2 ANALYTICAL HIERARCHICAL PROCESS (AHP)

In the year 1970 Thomas L.Saaty has developed a technique in order to analyse and organize complex decisions. The technique is based on psychology and mathematics. This technique is named as Analytic Hierarchy Process AHP which is mainly used to find the hierarchy. The AHP is one of the techniques which are used in multi criteria decision making. Various fields such as government, healthcare institutions, business and so on uses this method. The consistency ratio gives the judgement of decision, criteria weightage and ranking. The figure 4.2 represents AHP flow chart of the alternative and the indicators (criteria).

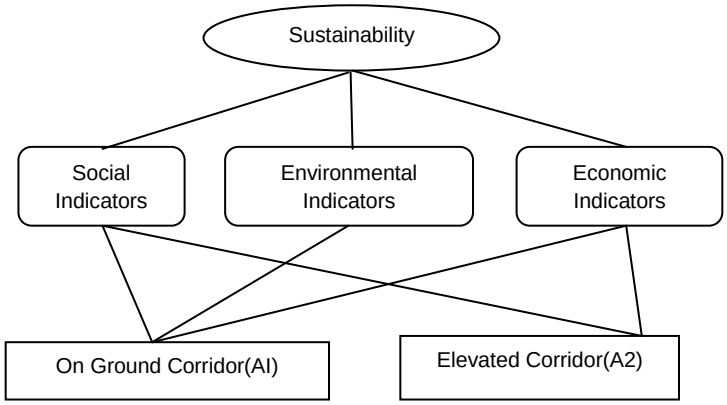

Fig 4.2 *Flow chart for Analytical Hierarchical Process (AHP) analysis.*

From the literature review and some case studies (included in reference) the sustainability of indicators in various past cases were also considered for doing the pairwise comparisons.

4.3 TECHNIQUE FOR ORDER PREFERENCE BY SIMILARITY TO IDEAL SOLUTION (TOPSIS):

One of the other most important multi-criteria decision making technology is Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). This method was proposed by Hwang and Yoon in the year 1981. The concept of the TOPSIS method is to choose the best alternative that has the farthest distance from the negative-ideal solution and the shortest distance from the positive ideal solution. Based on the distance the quality of the solution the best and the worst solutions were found out. The process follows by generating an evaluation matrix with the help of ranking obtained from the AHP method. With the help of positive and negative ideal solutions the best alternative is chosen.

5. ANALYSIS

The two alternatives were on ground corridor (A1) and elevated corridor (A2). The elevated corridor was taken as an alternative because one of the main reasons for opposing the expressway is a great loss of agricultural and flora loss. The elevated corridor will reduce these land loss. The elevated corridor is more sustainable in that case but, a sustainable corridor is not just a one that has less or nil loss of agricultural land. A sustainable corridor has to be sustainable in most cases of indicators. As there were lot of criteria the multi-criteria decision making was utilized In this case the two alternatives was corridor on ground (A1) and elevated corridor (A2) and the criteria as social indicator, economic indicator and economic indicator. The sub criteria's of social indicators are Population, Male to female ratio, literacy and employment. The sub criteria's of environmental indicator are loss of agricultural land, loss of flora, water quality, noise pollution, air quality and vibration. The sub criteria's of economic indicators are GDP, industrial development, per capita income and the transportation distance and cost. The indicators are identified from the literature review. The social indicators deals with the local community liveability, jobs they do for their living and soon. The analysis of environmental indicators will help to find out how the surrounding would be affected or degraded due to the construction of new corridor. The environmental indicator analysis is required because the human life would be better due to the development of nature. The economical indicator analysis is done for the economical growth status of the local to the nation level depend on the corridor range and details. The use of criteria weights is a controversial issue because it opens up the analysis to a certain amount of subjectivity. It could, however, serve as an important tool to allocate the relative importance of the various criteria, as they are perceived, by the decision makers. For illustration purposes, researchers followed a dual approach for this research, one that includes criteria weights and one without criteria weights. In the un-weighted case it is assumed that all the criteria are equally important and the analysis is free from subjectivity. The table 5.1 represents the indicators taken for the analysis and its explanation.

TABLE 5.1 *Explanation of Criteria*

CRITERIA/INDICATOR	EXPLANATION
Industry and GDP	Deals with the growth of industries and their profits along the corridor and its near by.
Transportation	Deals with the facilities of public and private mode of transportation
Per capita income	The increase in daily capita of a person due to the growth, developments and benefits of corridor
Loss of agricultural land	The amount of loss of agricultural land on the proposed alignment
Loss of flora	This criteria deals with the loss of dense flora on the alignment that affect the habitat of fauna
Air quality	The vehicle that moves on the corridor emits pollutants that affect the atmosphere and health of the localities
Water quality	The organic and inorganic substance from the road gets to the nearby agricultural land which affect the soil and the products that grown on it
Noise pollution	The noise that generated on corridor during construction and by vehicle that moves on it after construction will create a disturbance to human ears.
Vibration to nearby building	The vibration that was created due to pot holes and construction time of corridor which transmit through the land and hits the buildings
Population	The change of population and its density
Literacy	Percentage of literacy and the institutions and so on
Employment	Employment opportunities
Male to female ratio	Trips generation which was mostly by males in rural

5.1 ANALYTICAL HIERARCHICAL PROCESS (AHP) analysis:

The social / environmental / economic indicators were done a pairwise comparison separately for the sustainability in both the cases (corridor on ground and elevated corridor) the Table 5.2 gives the degree of preferences for sustainability. ANALYTICAL HIERARCHICAL PROCESS (AHP) comparison table is based on importance. For the analysis, instead of importance sustainability is opted.

TABLE 5.2 *Comparison Scale for Analytical Hierarchical Process (AHP)*

Verbal judgments	Degree of preferences
Equal sustainability	1
Moderate sustainability	3
Strong sustainability	5
Very strong or demonstrated sustainability	7
Extreme sustainability	9
For compromise between the above values	2,4,6,8

The indicators of sustainability were identified from the literature review with respect to the social, environmental and economic factors. There are n numbers of sustainability factors from which I have chosen few with respect to the Chennai to Salem 8way green corridor expressway. The following table 5.3 to 5.8 shows the pairwise comparison of the indicators. The table 5.3 and d5.4 is the pairwise comparison of the social indicators for the both corridor on ground and elevated.

TABLE 5.3 *Social Indicator –On Ground Corridor*

	Population	Male To Female Ratio	Literacy	Employment
Population	1	2	2	0.17
Male To Female Ratio	0.5	1	2	0.25
Literacy	0.5	0.5	1	0.2
Employment	6	4	5	1

TABLE 5.4 *Social Indicator – Elevated Corridor*

	Population	Male To Female Ratio	Literacy	Employment
Population	1	1	5	0.2
Male to female ratio	1	1	2	0.2
Literacy	0.2	0.5	1	0.2
Employment	5	5	5	1

TABLE 5.5 *Environmental Indicator–On Ground Corridor*

	Loss of agricultural land	Loss of flora and fauna	Water quality	Air quality	Noise pollution	Vibration at building
Loss of agricultural land	1	1	5	6	4	9
Loss of flora and fauna	1	1	4	4	3	4
Water quality	0.2	0.25	1	1	3	5
Air quality	0.17	0.25	1	1	2	4
Noise pollution	0.25	0.33	0.33	0.50	1	3
Vibration at building	0.11	0.25	0.20	0.25	0.33	1

TABLE 5.6 *Environmental Indicator – Elevated Corridor*

	Loss of agricultural land	Loss of flora and fauna	Water quality	Air quality	Noise pollution	Vibration at building
Loss of agricultural land	1	1	5	2	3	1
Loss of flora and fauna	1	1	3	0.50	0.33	0.33
Water quality	0.2	0.33	1	0.25	0.33	0.50
Air quality	0.50	2	4	1	3	4
Noise pollution	0.33	3	3	0.33	1	4
Vibration at building	1	3	2	0.25	0.25	1

TABLE 5.7 *Economical Indicator –On Ground Corridor*

	Transportation	Industry and GDP	Per capita income
Transportation	1	2	3
Industry and GDP	0.5	1	3
Per capita income	0.33	0.33	1

TABLE 5.8 *Economical Indicator – Elevated Corridor*

	Transportation	Industry and GDP	Per capita income
Transportation	1	0.33	4
Industry and GDP	3	1	5
Per capita income	0.25	0.20	1

From the analysis of different indicator pairwise is consolidated to a single table. The Table 5.9 shows the result of analysis of various indicators. The priority of the indicators, rank and consistency ratio was also tabulated. The table 5.9 is the consolidated table of all the indicators with respect to the rank, priority and consistency ratio.

TABLE 5.9 *Analysis of the Indicators for Ranking of Sustainability*

S.no	Factor	Indicator	Corridor on ground			Elevated corridor		
			Priority	Rank	Consistency ratio	Priority	Rank	Consistency Ratio
			%					
1	Social	Population	16.8	2	0.062 (6.2%)	18.7	2	0.09 (9.3%)
2		Male to female ratio	12.9	3		13.8	3	
3		Literacy	8.6	4		7.0	4	
4		Employment	61.7	1		60.6	1	
5	Environmental	Loss of agricultural land	38.2	6	0.07 (7.7%)	26.0	2	0.16 (16.8%)
6		Loss of flora	29.5	5		10.6	5	
7		Water quality	11.7	2		4.7	6	
8		Air quality	9.9	3		26.7	1	
9		Noise pollution	7.1	4		19.0	3	
10		Vibration to nearby building	3.5	1		13.0	4	
11	Economical	Industry and GDP	33.3	2	0.056 (5.6%)	62.7	1	0.08 (8.9%)
12		Transportation	52.8	1		28.0	2	
13		Per capita income	14.0	3		9.4	3	

From the table 5.9 it is inferred that the consistency ratio of most cases are <0.1 hence the ranking of all the criteria's were good so the values can be taken to chose the best alternative.

5.2 ANALYSIS OF TECHNIQUE FOR ORDER PREFERENCE BY SIMILARITY TO IDEAL SOLUTION (TOPSIS)

The above table 4.8 gives the ranking of the indicators based on their sustainability with respect to their factors. Now with the help of the ranking of indicators obtained the best alternative corridor will be chosen with the help of the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. The ranking of respective indicators to both the corridor alternatives, the normalized decision value is founded and tabulated. The weightage of the indicators were also taken from the Analytical Hierarchical Process (AHP) analysis (Table VIII). Now, the weighted normalized decision value is also founded. All these values are tabulate in Table 5.10. The weightage is the value of priority obtained from the AHP analysis. The normalised value of the indicators was obtained

TABLE 5.10 *Evaluation of normalised decision value, and weighted normalized decision value*

Indicator	Corridor on Ground			Elevated corridor		
	NORMALISED DECISION VALUE	WEIGHT-AGE	WEIGHTED NORMALIZ-ED DECISION VALUE	NORMALISED DECISION VALUE	WEIGHT-AGE	WEIGHTED NORMALIZED DECISION VALUE
Industry and GDP	0.8944	0.3330	0.2978	0.4472	0.6270	0.2804
Transportation	0.4472	0.5280	0.2361	0.8944	0.2800	0.2504
Per capita income	0.7071	0.1400	0.0990	0.7071	0.0940	0.0665
Loss of agricultural land	0.9487	0.3820	0.3624	0.3162	0.2600	0.0822
Loss of flora	0.7071	0.2950	0.2086	0.7071	0.1060	0.0750
Water quality	0.3162	0.1170	0.0370	0.9487	0.0470	0.0446
Air quality	0.9487	0.0990	0.0939	0.3162	0.2670	0.0844
Noise pollution	0.8000	0.0710	0.0568	0.6000	0.1900	0.1140
Vibration to nearby building	0.2425	0.0350	0.0085	0.9701	0.1300	0.1261
Population	0.7071	0.1680	0.1188	0.7071	0.1870	0.1322
Male to female ratio	0.7071	0.1290	0.0912	0.7071	0.1380	0.0976
Literacy	0.7071	0.0860	0.0608	0.7071	0.0700	0.0495
Employment	0.7071	0.6170	0.4363	0.7071	0.6060	0.4285

After finding the weighted normalized matrix value the positive and negative weighted normalized rating is found out and tabulated in Table 5.11

TABLE 5.11 *Weighted Normalised Rating Table (matrix)*

Indicators	weighted normalized ratings	
	V_j^+	V_j^-
Industry and GDP	0.2978	0.2804
Transportation	0.2504	0.2361
Per capita income	0.0990	0.0665
Loss of agricultural land	0.0822	0.3624
Loss of flora	0.0750	0.2086
Water quality	0.3070	0.0446
Air quality	0.0844	0.0939
Noise pollution	0.0568	0.6000
Vibration to nearby building	0.0085	0.1261
Population	0.1322	0.1188
Male to female ratio	0.0976	0.0912
Literacy	0.0608	0.0495
Employment	0.4363	0.4285

The positive weighted normalized and the negative weighted normalized value of the normalized rating matrix is obtained from the weighted normalized decision value. It is necessary to find the best alternative between the on ground corridor and the elevated corridor. The Table 5.12 gives the final answer for the sustainable corridor.

TABLE 5.12 *Result of Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)*

Alternative	Euclidean distance from Ideal alternative		Performance score	Ranking
	S_i^+	S_i^-	P_i	
Corridor on ground	0.412	0.5572	0.5749	2
Elevated corridor	0.2958	0.5771	0.6611	1

6. RESULT AND DISCUSSION:

From the table 5.12 the alternative 1(Corridor on Ground) is ranked lower than the alternative 2(elevated corridor). The figure 6.1 represents the ranking of alternatives.

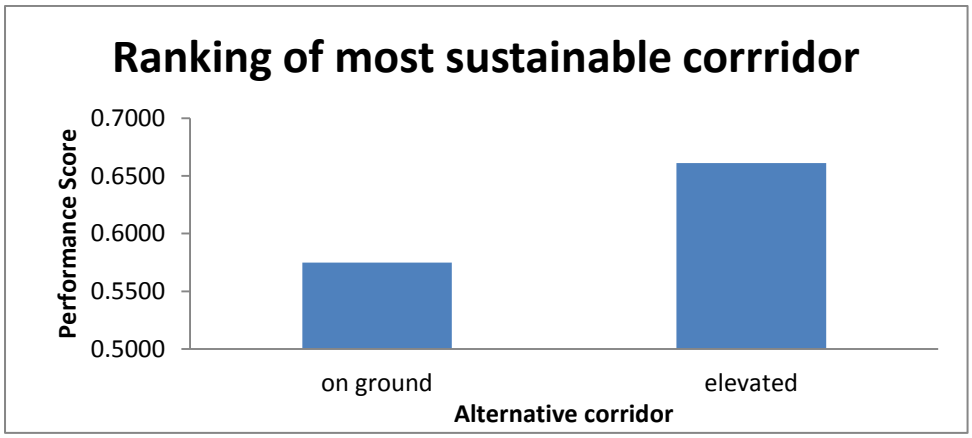

Fig 6.1 *Ranking of alternatives*

The alternative 1 obtained performance index of 0.5749 and obtained 2nd ranking while the alternative 2 obtained a performance index of 0.6611 and hired rank 1. As said earlier the loss of green land is a major problem to on ground corridor while the elevated one will optimize less amount of land. The sustainability of a corridor results from the sustainability of indicators. Hence the elevated corridor is a most sustainable one.

7. CONCLUSION:

From the analysis the following figure 4.1 is founded out. It is clear that the alternative 2 is more sustainable than the alternative 1. Hence the corridor can be laid as an elevated one such that it will be helpful to all the people along the corridor. One important point of the infrastructure project is, the project has to involve in the development of nation while it must not degrade the quality of life of the people and environment where it lies. It must be helpful and process a growth of the people where it is constructed. Hence it is found out that the economic corridor on elevated level will be more sustainable.

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REFERECES:

[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] Ayman A. Abdul-Mawjoud (2016). Using the analytic hierarchy process and GIS for decision making in rural highway route location: International Journal of Civil Engineering and Technology (IJCIET) Volume 7, Issue 2, March-April 2016, pp. 359–375.

[5] Barbara C. Richardson. (2005).Sustainable transport: an analysis framework: Journal Of Transport Geography13 (2005) 29–3.

[6] Consultancy Services. Feedback Infra Pvt.Ltd. (2018).Feasibility study on Chennai to Salem 8way green corridor: Government Gazette.

[7] Dariusz Boruszko, Wojciech Dabrowski, Wiater Jozef. (2018). Development of road infrastructure in environmentally valuable areas- sustainable designing: Problems of Sustainable Development.

[8] 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.

[9] 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.

[10] Emad S. Bakhoum David C. Brownl (2012). A hybrid approach using AHP–TOPSIS–entropy methods for sustainable ranking of structural materials: International Journal of Sustainable Engineering volume 6,No 3, :212-224

[11] Eva Ivanova And Jana Masarova. (2013). Importance of road Infrastructure in the economic development and competitiveness: Economics And Management.

[12] Guy Baeten. (2000). The tragedy of the highway: empowerment, disempowerment and the politics of sustainability discourses and practices: European Planning Studies.

[13] Joumard, R.; Nicolas, J.-P. 2010. Transport project assessment methodology within the framework of sustainable development, Ecological Indicators 10(2): 136–142.

[14] Josias Zietsman, Laurence R. Rilett and Seung-Jun Kim, 2006. Transportation corridor decision-making with multi-attribute utility theory. International Journal for Management and Decision Making, Vol. 7, Nos. 2/3, 2006

[15] Kibblewhit M.G. (2018). Contamination of agricultural soil by urban and periurban highways: Environmental Pollution.

[16] Leizhang,Mingyang Ji Nicholas Ferrari. (2016). Comprehensive highway corridor planning with sustainability indicator: State Highway Administration Research Report.

[17] Legret.M, Pagotto.C (2000). Evaluation of pollutant loadings in the runoff waters from a major rural highway: The Science of the Total Environment-ELSEVIER.

[18] LONG.L.T (1993). Measurements of seismic road vibrations: International Conference on Case Histories in The Geotechnical Engineering.

[19] Mahmoodzadeh, S., Shahrabi, J., Pariazar, M., and Zaeri, M.S., 2007. Project selection by using fuzzy AHP and TOPSIS technique. International Journal of Human and Social Sciences, 2 (7), 397–402

[20] 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.

[21] Mariem besbes,Roberta Costa Affonso,Marc Zolghadri, Faouzi Masmoudi, Mohamed Haddaret al (2017). Multi criteria decision making for the selection of a performant manual workshop layout: a case study: International Federstion of Automatic Control, Elsevier.

[22] Marie Ridley Pryn, Yannick Cornet & Kim Bang Sallingetl (2015); Applying sustainability theory to transport infrastructure assessment using a multiplicative analytical hierarchical process (AHP) decision support model: Transport (Taylor and Francis series.) Special Issue on Smart and Sustainable Transport / 2015 Volume 30(3): 330–341

[23] Meha Singla, Priyanka Kapoor And Yadunand An Batchu. (2016). Impact cities based on proposed industrial corridors in India: Real Estate Research.

[24] Mukund Pratap Singh, Pitam Singh and Priyamvada Singh, 2019. Fuzzy AHP‐based multi‐criteria decision‐making analysis for route alignment planning using geographic information system (GIS). Journal of Geographical Systems-march 2019.

[25] 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.

[26] Osama Hunaidi. (2000). Traffic vibrations in building: Institute or Research In Construction.

[27] Paul R. Voss And Guangqing Chi. (2006). Highways and population change: Rural Sociology Society.

[28] Per Angelstam, Olha Kaulyak, Taras Yamelnets. (2017).Green infrastructure development at European Union's eastern border: Effect of Road Infrastructure and Forest Habitat Loss.

[29] Per Angelstam, Taras Yamelynets (2017); Green infrastructure development ar European union's eastern border: Effects of road infrastructure and forest habitat loss: Journal of environmental management-feb 2017

[30] Pereraa, Raufdeen Rameezdeenb,.B.A.K.S 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.

[31] Pryn, M. R. 2013. Sustainable Decision Support – a Contextual Analysis of the Importance of Planning Criteria Using MCDA. Department of Transport, Technical University of Denmark.

[32] Dr. Prafulla A.Pawar, Nitin B. (2010). Vibrant North-West India: SWOT analysis of Delhi-Mumbai industrial corridor: Industrial Risk Analysis.

[33] Roberts.R, Goodwin.P. 2002. Weight approximations in multi-attribute decision models, Journal of Multi-Criteria Decision Analysis 11(6): 291–303

[34] Robert A. Johnston. (2009). Indicators for sustainable transportation planning: Journal of The Transportation Research Board. D.C., 2008, Pp. 146–154.

[35] Saaty, T. L. (1990). How to make a decision: The Analytic Hierarchy Process, European Journal of Operational Res., 48, pages 9-26

[36] Salling, K. B. Et al (2015). Sustainable transport project evaluation and decision support: indicators and planning criteria for sustainable development, International Journal of Sustainable Development & World Ecology 22(4): 346– 357.

[37] Saugato Datta. (2011). The impact of improved highways on Indian firms: Journal of Development Economics.
[38] Stanislaw Bacior, Barbara Prus. (2018). Infrastructure development and its influence on agricultural land and regional sustainable development: Economical Informatics. ECOINF 839.
[39] Todd Litman. (2006). Issues in sustainable transportation: International Journal of Global Environmental. Vol. 6, No. 4, 2006.
[40] Tsade HK. (2016). Atomic Absorption Spectroscopic Determination of Heavy Metal Concentrations in Kulufo River, Arbaminch, Gamo Gofa, Ethiopi: Journal of Environmental Analytical Chemistry.
[41] Velasquez, M et al (2013). An Analysis of MultiCriteria Decision Making Methods: International Journal of Operations Research ,Vol. 30, pages 56-66
[42] Zanakis, S.H., et al., 1998. Multi-attribute decision making: a simulation comparison of select methods. European Journal of Operational Research, 107, 507–529