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ENVIRONMENTAL IMPACT ASSESMENT OF THE PROPOSED OUTER RING ROAD PROJECT FOR NEW CAPITAL OF ANDHRA PRADESH, INDIA

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ABSTRACT: Assessment of environmental impacts is necessary for any kind of major projects to safeguard the environmental sustainability. The National Highway Authority of India (NHAI) has proposed an "Outer Ring Road (ORR)" around the new capital city of Andhra Pradesh which is taken up by the Capital Region Development Authority (CRDA). This is a major project which involves acquisition of land for road construction which affects agriculture land forests, water bodies, etc. The main focus of this project is to identify the environmental impacts of the proposed ORR for the new capital of Andhra Pradesh and to present the results in such a way that decision making can be done easily. For this purpose the outline of the proposed ORR was obtained from CRDA. The road line was digitized in Arc GIS and road width is extended using buffer tool. The same road map with road width is placed on Google earth map and the affected area has been identified. All the possible effects identified are fed to the Rapid Impact Assessment Matrix for Assessment (RIAM). The RIAM calculates the impacts under four categories: Physicochemical, Biological Ecological, Social Cultural, and Economical Operational. The output of the RIAM shows that the ORR project has severe negative impacts in all the categories. Alternatively another route has been proposed by us in such a way that the impacts are minimized. These two options are compared and the results were presented in the form of bar charts. The results are very useful for better decision making.
Keywords: Environmental Impact Assessment, Outer Ring Road, CRDA, RIAM, GIS

I. INTRODUCTION

The roads are lifeline of any country. They are also important for the building the nation and are mirror of country's development. However, most of these roads on account of their location, route alignment and associated activities are invariably accompanied by significant environmental and social impacts during different phases (viz., Pre-construction, Construction and Operational phase) of the project. The nature of these impacts could be either positive or negative depending upon their potential to favourably or adversely affect the surrounding environment and also the resident community.[1,2] The aim of the present work is to explore the environmental impacts of the proposed Outer Ring Road around the new capital city of Andhra Pradesh state.[3,4]

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is an important management tool for ensuring optimal use of natural resources for sustainable development. To facilitate collection of environmental data and preparation of management plans, guidelines have been evolved and circulated to the concerned Central and State Government Departments. EIA has now been made mandatory under the Environmental (Protection Act, 1986 for 29 categories of developmental activities involving investments of Rs. 50 crores and above).

Environmental Impact Assessment (EIA) is the process by which the anticipated effects on the environment of a proposed development or project are measured. If the likely effects are unacceptable, design measures or other relevant mitigation measures can be taken to reduce or avoid those effects. The document from this process is called an Environmental Impact Statement (EIS). It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts. By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment /clean-up costs and impacts of laws and regulations.[5,6]

Outer Ring Road Project

The ORR or Vijayawada bypass was mooted in 2009, to decongest heavy vehicular traffic in the city. As per the buzz, Government has planned to construct three ring roads around the new capital. Inner Ring roads having length of 45 to 50 KMs and 75 to 80 KMs and length of Outer ring road is about 185 to 190 KMs. All these have to exist between Vijayawada and Guntur cities. 70 to 80% of the new capital will be in Guntur district and 20 to 30% in Krishna District. But new capital would become nearer to Vijayawada City.

There is a proposal to extend the existing road to 6 lanes between Vijayawada and Hyderabad. Seethanagaram near Prakasam Barriage to Amaravathi 6 lanes of road and Amaravathi to Guntur another 6 lanes of road will be built. Extending the roads from Hyderabad to Vijayawada via Daachepalli, Sattenapalli and Piduguralla is one option. Al least two bridges would construct on Krishna River. The

NHAI has directed the contractor, Gammon India, to begin works immediately. The Vijayawada ORR or bypass will take off from Mangalagiri on NH 5 and connect with NH 9 at Gollapudi on the other end of river Krishna. The road will then go through Nunna, Mustabad and again meet NH 5 at Peda Avutapally (Gannavaram). It will end at Gundugolanu in West Godavari district.

The proposed ORR will have a total length of 185 kilometres for this 4177 acres of land must be procured which costs around 4000 crores. This 8 lane road construction would cost 10 crores per kilometre.

Environmental Impact Assessment need for Outer Ring Road Project

The environmental impact of roads (both positive and negative) include the local effects of highways (public roads) such as on noise, water pollution, habitat destruction/disturbance and local air quality, and the wider effects which may include climate change from vehicle emissions. The design, construction and management of roads, parking and other related facilities as well as the design and regulation of vehicles can change the impacts to varying degrees. There is a growing awareness that road development has major environmental impacts Some of the major environmental impacts of road projects include damage to sensitive ecosystems, loss of productive agricultural lands, resettlement of large numbers of people, permanent disruption of local economic activities, demographic change, accelerated urbanization, and introduction of disease.[9,10]

Since environmental impacts from road development are quite common, such projects usually call for comprehensive environmental assessment studies, carried out by EIA professionals (both specialists and generalists) who support the main engineering team. Substantial time and effort is often required to identify potential impacts and options for minimizing them. In addition, contract clauses covering work procedures and staff training needs to be prepared, and work processes in relation to roadside communities, flora, and fauna given considerable attention. In order to conduct EIAs successfully, road agency staff need to understand the assessment process and must coordinate it with road planning, design, and construction activities, allowing sufficient lead time and funds for the necessary additional steps. New skills may have to be developed to meet the demands of the EIA process. This is especially true in the area of consultation with affected residents, interested members of the public, government departments, and other organizations (known collectively as the stakeholders). Projects limited to road rehabilitation, maintenance, minor construction, as well as to traffic management and regulation, generally involve lesser environmental concerns. These situations do not call for full-scale EAs but do require impact identification, mitigation, and a certain amount of compliance monitoring and documentation.[7,8]

About Rapid Impact Assessment Matrix software

Normal EIA would take lot of time and in most cases the weightages to be given for certain parameters may be difficult. The intangible effects cannot be properly taken in to account unless there is a numerical associated with it. Towards a solution for this problem, Rapid Impact Assessment Matrix (RIAM) has been developed which take in to account all the tangible and intangible parameters and provide a score for all of them.[11,12] The Rapid Impact Assessment Matrix (RIAM) is a method seeks to overcome the problems of recording subjective judgments by defining the criteria and scales against which these judgments are to be made; and by placing the results in a simple matrix that allows for a permanent record of the arguments in the judgment process. This paper describes system of scoring within a matrix that has been designed to allow subjective judgments to be quantitatively recorded, thus providing both an impact evaluation and a record that can be re-assessed in the future. The system is ideally suited to EIA where a multi-disciplinary team approach is used, as it allows for data from different components to be analyzed against common important criteria within a common matrix, thus providing a rapid, clear assessment of the major impacts. [13,14] The Rapid Impact Assessment Matrix (RIAM) method is based on a standard definition of the important assessment criteria as well as the means by which semi-quantitative values for each of these criteria can be collated to provide an accurate and independent score for each condition. The impacts of project activities are evaluated against the environmental components and for each component a score (using the defined criteria) are determined, which provides a measure of the impact expected from the component. [15]

II. STUDY AREA

With over 1.2 billion people, India is the most populous democracy in the world. It is a federal constitutional republic governed under a parliamentary system consisting of 29 states and 7 union territories. Among these states, Andhra Pradesh has 13 districts. Andhra Pradesh Capital Region, the new capital city of Andhra Pradesh. The entire region is under the jurisdiction of Andhra Pradesh Capital Region Development Authority, and covers an area of 8,352.69 km2 (3,224.99 sq mi) under 58 mandals, of which 29 are in Krishna district and 29 in Guntur district. The capital region covers 18 mandals fully and 11 mandals partially in Guntur district. In Krishna district, it covers 15 mandals fully and 14 mandals partially under the jurisdiction of APCRDA. Outer Ring Road is laid in the Capital Regional Development Authority Region. For clear understanding the location of the study region is shown in the figure 2.1 below.

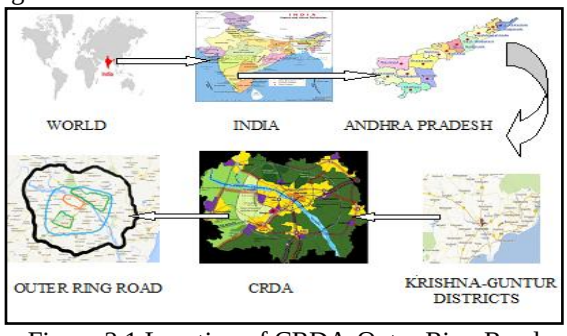

Figure 2.1 Location of CRDA-Outer Ring Road

Capital Regional Development Authority

The Andhra Pradesh Capital Region Development Authority was notified on 30 December 2014 by the Government. As per Andhra Pradesh Capital Region Development Authority Act, 2014, it replaced the Vijayawada Guntur Tenali Mangalagiri Urban Development Authority. It has a jurisdictional area of 8,352.69 km2 (3, 224.99 sq mi) spread in Guntur and Krishna districts. It also includes 214 km2 (83 sq mi) of the new capital city of Andhra Pradesh, Amravati. Under Andhra Pradesh Capital Region 58 mandals, of which 29 are in Krishna district and 29 in Guntur district. The capital region covers 18 mandals fully and 11 mandals partially in Guntur district. In Krishna, it covers 15 mandals fully and 14 mandals partially under the jurisdiction of APCRDA. The Map of Capital Regional Development Authority extent is shown in the following Figure 2.2.

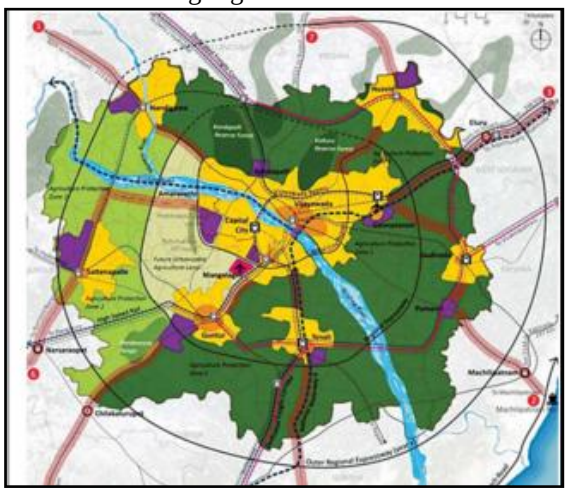

Figure 2.2 Map of Capital Regional Development Authority extent

III. METHODOLOGY

The main objective of the present study is to evaluate the various operations and activities of construction of ORR project and to identify their impacts on the environment. For this purpose first we have taken the map of the study area from CRDA officials which contain the ORR outline. This was digitized in Arc GIS to get a map of ORR. Later with the width a double line is drawn along the road using buffer tool in GIS. Now this map is imported and placed on Google earth map and by zooming in the area coming under the road was identified and noted. Like this throughout the length of the road the area which is going to be affected is observed. Correspondingly the environmental impacts associated with the road construction in that area are identified and listed. These impacts are quite different and coming to a conclusion based on these impacts is cumbersome. Hence for faster and rational assessment, rapid impact assessment matrix(RIAM) is used. The identified impacts are fed to this tool according to the procedure given. The results obtained were presented in the form of tables and bar charts. The bar charts will give an idea about whether the impacts are positive or negative. From our analysis mostly the impacts were found to be negative. In order to improve the acceptance of the project, an alternate route was proposed by us in which the impacts were minimised to the possible extent. Hence the ORR given by CRDA is named as Option-1 and the ORR proposed by us is named as Option-2. For both these options the RIAM analysis was done and the results were compared and presented. The above explained methodology is shown in the Figure 3.1 below. Geo-referenced image of CRDA in Arc GIS is shown in Figure 3.2. Figure 3.3 shows Digitized Outer Ring Road in Arc GIS. Figure 3.4 shows Buffered image placed on Google Earth. Figure 3.5 shows Image of Alternate Outer Ring Road. Figure 3.6 shows Combined Image of Option-1 &2 and Figure 3.7 Buffer lines on Google earth map for impact identification.

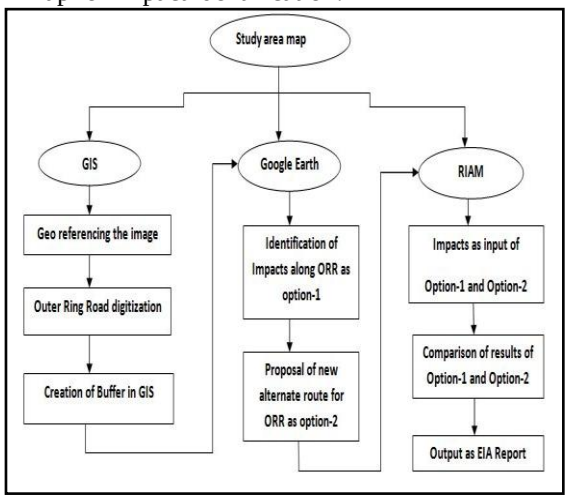

Figure 3.1 Methodology Adopted in this work

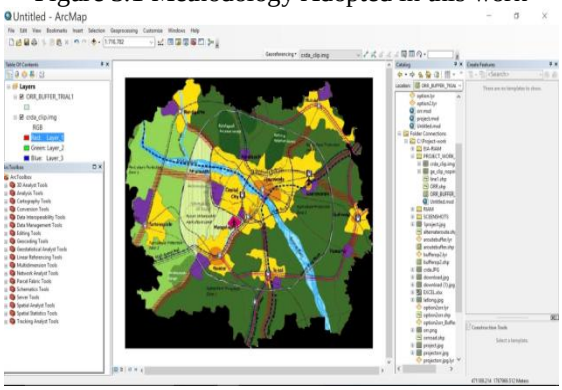

Figure 3.2 Geo-referenced image of CRDA in Arc GIS.

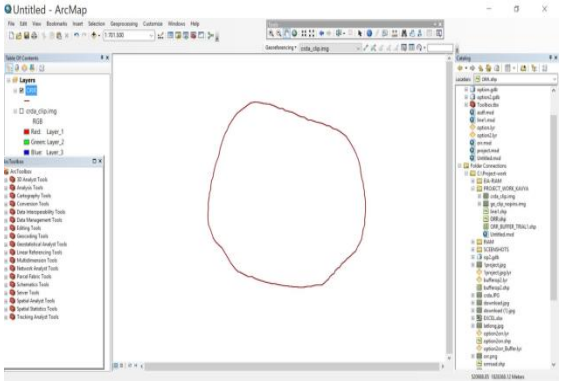

Figure 3.3Digitized Outer Ring Road in Arc GIS.

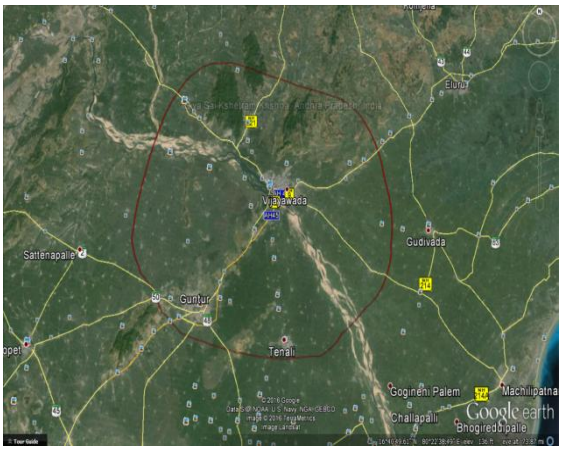

Figure 3.4 Buffered image placed on Google Earth

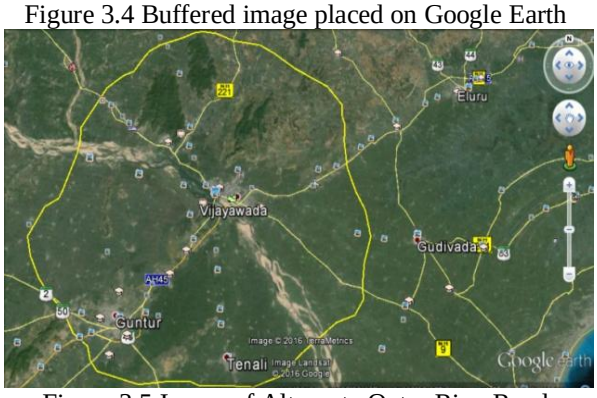

Figure 3.5 Image of Alternate Outer Ring Road

Figure 3.6 Combined Image of Option-1 &2


Figure 3.7 Buffer lines on Google earth map for impact identification

Impacts Identified

The impacts identified that are going to occur because of the proposed ORR project were categorised and listed below:

Physical/Chemical

S.No	Parameter
1	Land use
2	Landscape
3	Topography
4	Soil Erosion
5	Ground Water Quality
6	Surface Water Quality
7	Ambient Noise
8	Surface Temperature
9	Geological Changes
10	Local Climate
11	Dust & Debris
12	Odour
13	Landslides
14	Borrow Earth Pits
15	Ambient Air Quality
16	Vibrations
17	Mineral Resources
18	Quarry Material

Biological/Ecological

S.No	Parameter
1	Deforestation
2	Vegetation
3	Flora &Fauna
4	Natural Habitats
5	Biodiversity
6	Ecological Balance
7	Endemic Species
8	Aquatic Fauna
9	Livelihood
10	Residential Area
11	Water Bodies
12	Physiographic & Soils
13	Habitat Fragmentation
14	Natural Resources

Sociological/Cultural

S.No	Parameter
1	Rehabitation
2	Resettlement
3	Housing
4	Infrastructure
5	Health Aspects
6	Hygiene
7	Cultural Heritage
8	Education Centers
9	Religious Places
10	Recreation Facilities
11	Market Centers
12	Employment
13	Clinic Centers
14	Uplift of Standard Life
15	Basic Amenities
16	Labor Work
17	Traffic Problems
18	Urban Development

Economical/Operational

S.No	Parameter
1	Agricultural land
2	Commercial Establishments
3	Business Opportunities.
4	Finance
5	Land Cost
6	Land Value
7	Transportation Cost
8	Construction cost
9	Earth moving Equipment Cost
10	Large Scale Industries
11	Small Scale Industries
12	Local Area Development
13	Electricity Facilities

Assessment criteria of Rapid Impact Assessment Matrix

The criteria should be defined for both groups, and should be based on fundamental conditions that may be affected by change rather than be related to individual projects. It is theoretically possible to define a number of criteria, but two principles should always be satisfied:

1. The universality of the criterion, to allow it to be used in different EIAs.
2. The value of the criterion, which determines whether it should be treated as a Group (A) or Group (B) condition.

At this point only five criteria have been developed for use in the RIAM. Nevertheless, these five criteria represent the most important fundamental assessment conditions for all EIAs, and satisfy the principles set out above.

These criteria, together with their appropriate judgment scores are defined as:

Group (A) criteria

Importance of condition (A1)

A measure of the importance of the condition, which is assessed against the spatial boundaries or human interest sit will affect. The scales are defined:

4-important to national/international interests
3-important to regional/national interests
2-important to areas immediately outside the local condition
1-important only to the local condition
0-no importance.

Magnitude of change/effect (A2)

Magnitude is defined as a measure of the scale of benefit / disbenefit of an impact or a condition:

+3-major positive benefit
+2-significant improvement in status quo
+1-improvement in status quo
0-no change/status quo
-1-negative change to status quo
-2-significant negative disbenefit or change
-3-major disbenefit or change.

Group (B) criteria

Permanence (B1)

This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).

1-no change/not applicable
2-temporary
3-permanent.

Reversibility (B2)

This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent

Condition (B1), the effect of its effluent can be changed (reversible condition) (B2)).

1-no change/not applicable
2-reversible
3-irreversible.

Cumulative (B3)

This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a

permanent/irreversible situation. For instance, the death of an old animal is both permanent and irreversible, but non-cumulative as the animal can be considered to have already passed its breeding capabilities. The loss of post-larval shrimp in the wild is also permanent and irreversible, but in this case cumulative, as all subsequent generations that the larvae (as adults) may have initiated will also have been lost.
1-no change/not applicable
2-non-cumulative/single
3-cumulative/synergistic
It is possible to change the cumulative component to one of synergism, if the condition warrens consideration of additive affects.

IV. RESULTS AND DISCUSSION

The obtained results are presented in the form of tables and graphs in the following sections. Figure 4.1 shows Impacts fed in to RIAM. Table 4.1 shows Impacts and scores given for Option-1 Table 4.2 shows Impacts and scores given for Option-2

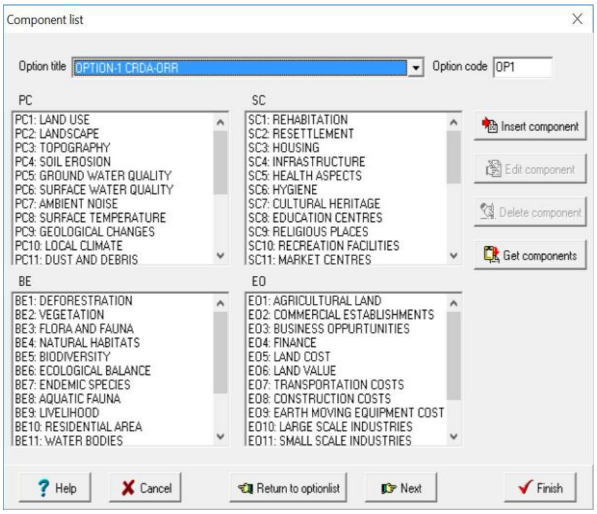

Figure 4.1 Impacts fed in to RIAM

Table 4.1 Impacts and scores given for Option-1

OPTION-1 CRDA-ORR

Physical and chemical components (PC)

Components		ES	RB	A1	A2	B1	B2	B3
PC1	LAND USE	-18	-B	1	-2	3	3	3
PC2	LANDSCAPE	-48	-D	3	-2	3	2	3
PC3	TOPOGRAPHY	-21	-C	3	-1	2	2	3
PC4	SOIL EROSION	-42	-D	2	-3	2	2	3
PC5	GROUND WATER QUALITY	-7	-A	1	-1	2	2	3
PC6	SURFACE WATER QUALITY	-7	-A	1	-1	2	2	3
PC7	AMBIENT NOISE	-16	-B	1	-2	3	2	3
PC8	SURFACE TEMPERATURE	-21	-C	3	-1	2	2	3
PC9	GEOLOGICAL CHANGES	-7	-A	1	-1	2	2	3
PC10	LOCAL CLIMATE	-7	-A	1	-1	2	2	3
PC11	DUST AND DEBRIS	-14	-B	1	-2	2	2	3
PC12	ODOUR	-7	-A	1	-1	2	2	3
PC13	LAND SLIDES	-8	-A	1	-1	2	3	3
PC14	BURROW EARTH PITS	7	A	1	1	2	2	3
PC15	AMBIENT AIR QUALITY	-7	-A	1	-1	2	2	3
PC16	VIBRATIONS	-7	-A	1	-1	2	2	3
PC17	MINERAL RESOURCES	-63	-D	3	-3	2	2	3
PC18	QUARRY MATERIAL	-7	-A	1	-1	2	2	3

Biological and ecological components (BE)

Components		ES	RB	A1	A2	B1	B2	B3
BE1	DEFORESTRATION	-24	-C	3	-1	3	3	2
BE2	VEGETATION	-7	-A	1	-1	2	2	3
BE3	FLORA AND FAUNA	-7	-A	1	-1	2	2	3
BE4	NATURAL HABITATS	-7	-A	1	-1	2	2	3
BE5	BIODIVERSITY	7	A	1	1	2	2	3
BE6	ECOLOGICAL BALANCE	-14	-B	2	-1	2	2	3
BE7	ENDEMIC SPECIES	-63	-D	3	-3	2	2	3
BE8	AQUATIC FAUNA	-7	-A	1	-1	2	2	3
BE9	LIVELIHOOD	7	A	1	1	2	2	3
BE10	RESIDENTIAL AREA	16	B	1	2	2	3	3
BE11	WATER BODIES	-7	-A	1	-1	2	2	3
BE12	PHYSIOGRAPHY AND SOILS	-7	-A	1	-1	2	2	3
BE13	HABITAT FRAGMENTATION	-14	-B	2	-1	2	2	3
BE14	NATURAL RESOURCES	-7	-A	1	-1	2	2	3

Sociological and cultural components (SC)

Components		ES	RB	A1	A2	B1	B2	B3
SC1	REHABITATION	-7	-A	1	-1	2	2	3
SC2	RESETTLEMENT	-14	-B	2	-1	2	2	3
SC3	HOUSING	-14	-B	1	-2	2	2	3
SC4	INFRASTRUCTURE	21	C	3	1	2	2	3
SC5	HEALTH ASPECTS	-24	-C	1	-3	3	2	3
SC6	HYGIENE	8	A	1	1	3	2	3
SC7	CULTURAL HERITAGE	-7	-A	1	-1	2	2	3
SC8	EDUCATION CENTRES	21	C	1	3	2	2	3
SC9	RELIGIOUS PLACES	-8	-A	1	-1	3	2	3
SC10	RECREATION FACILITIES	8	A	1	1	3	2	3
SC11	MARKET CENTRES	7	A	1	1	2	2	3
SC12	EMPLOYMENT	-21	-C	3	-1	2	2	3
SC13	CLINIC CENTRES	21	C	1	3	2	2	3
SC14	UPLIFT OF STANDARD LIFE	21	C	1	3	2	2	3
SC15	BASIC AMINITIES	7	A	1	1	2	2	3
SC16	LABOUR WORK	7	A	1	1	2	2	3
SC17	TRAFFIC PROBLEMS	-7	-A	1	-1	2	2	3
SC18	URBAN DEVELOPMENT	72	E	3	3	3	2	3
SC19	COMMUNITY DEVELOPMENT	-7	-A	1	-1	2	2	3
SC20	TRAFFIC INTENSITY	-7	-A	1	-1	2	2	3
SC21	CONNECTIVITY	8	A	1	1	3	2	3
SC22	ROAD SAFETY	-7	-A	1	-1	2	2	3

Economical and operational components (EO)

Components		ES	RB	A1	A2	B1	B2	B3
EO1	AGRICULTURAL LAND	-63	-D	3	-3	2	2	3
EO2	COMMERCIAL ESTABLISHMENTS	28	C	2	2	2	2	3
EO3	BUSINESS OPPURTUNITIES	24	C	3	1	3	2	3
EO4	FINANCE	63	D	3	3	2	2	3
EO5	LAND COST	-21	-C	3	-1	2	2	3
EO6	LAND VALUE	21	C	3	1	2	2	3
EO7	TRANSPORTATION COSTS	21	C	3	1	2	2	3
EO8	CONSTRUCTION COSTS	-63	-D	3	-3	2	2	3
EO9	EARTH MOVING EQUIPMENT COST	-6	-A	1	-1	2	2	2
EO10	LARGE SCALE INDUSTRIES	63	D	3	3	2	2	3
EO11	SMALL SCALE INDUSTRIES	21	C	1	3	2	2	3
EO12	LOCAL AREA DEVELOPMENT	24	C	1	3	3	2	3
EO13	ELECTRICITY FACILITIES	7	A	1	1	2	2	3

Table 4.2 Impacts and scores given for Option-2

OPTION-2 PROJECT-ORR

Physical and chemical components (PC)

Components		ES	RB	A1	A2	B1	B2	B3
PC1	LAND USE	7	A	1	1	2	2	3
PC2	LANDSCAPE	14	B	2	1	2	2	3
PC3	TOPOGRAPHY	7	A	1	1	2	2	3
PC4	SOIL EROSION	7	A	1	1	2	3	2
PC5	GROUND WATER QUALITY	7	A	1	1	2	2	3
PC6	SURFACE WATER QUALITY	-7	-A	1	-1	2	2	3
PC7	AMBIENT NOISE	-7	-A	1	-1	2	2	3
PC8	SURFACE TEMPERATURE	-18	-B	3	-1	2	2	2
PC9	GEOLOGICAL CHANGES	0	N	1	0	3	2	3
PC10	LOCAL CLIMATE	7	A	1	1	2	2	3
PC11	DUST AND DEBRIS	-6	-A	1	-1	2	2	2
PC12	ODOUR	-7	-A	1	-1	3	2	2
PC13	LAND SLIDES	0	N	1	0	3	2	2
PC14	BURROW EARTH PITS	7	A	1	1	2	2	3
PC15	AMBIENT AIR QUALITY	7	A	1	1	2	2	3
PC16	VIBRATIONS	6	A	1	1	2	2	2
PC17	MINERAL RESOURCES	-24	-C	3	-1	3	2	3
PC18	QUARRY MATERIAL	-7	-A	1	-1	2	2	3

Biological and ecological components (BE)

Components		ES	RB	A1	A2	B1	B2	B3
BE1	DEFORESTRATION	15	B	1	3	3	1	1
BE2	VEGETATION	-3	-A	1	-1	1	1	1
BE3	FLORA AND FAUNA	7	A	1	1	2	2	3
BE4	NATURAL HABITATS	6	A	1	1	2	2	2
BE5	BIODIVERSITY	-7	-A	1	-1	2	2	3
BE6	ECOLOGICAL BALANCE	28	C	2	2	2	2	3
BE7	ENDEMIC SPECIES	0	N	3	0	2	2	3
BE8	AQUATIC FAUNA	7	A	1	1	2	2	3
BE9	LIVELIHOOD	14	B	1	2	2	2	3
BE10	RESIDENTIAL AREA	14	B	1	2	2	2	3
BE11	WATER BODIES	12	B	1	2	2	2	2
BE12	PHYSIOGRAPHY AND SOILS	0	N	1	0	2	2	3
BE13	HABITAT FRAGMENTATION	0	N	1	0	3	2	3
BE14	NATURAL RESOURCES	7	A	1	1	2	2	3

Sociological and cultural components (SC)

Components		ES	RB	A1	A2	B1	B2	B3
SC1	REHABITATION	-7	-A	1	-1	2	2	3
SC2	RESETTLEMENT	-8	-A	1	-1	3	2	3
SC3	HOUSING	-14	-B	1	-2	2	2	3
SC4	INFRASTRUCTURE	27	C	3	1	3	3	3
SC5	HEALTH ASPECTS	-18	-B	1	-2	3	3	3
SC6	HYGIENE	7	A	1	1	2	2	3
SC7	CULTURAL HERITAGE	7	A	1	1	2	2	3
SC8	EDUCATION CENTRES	27	C	1	3	3	3	3
SC9	RELIGIOUS PLACES	7	A	1	1	2	2	3
SC10	RECREATION FACILITIES	8	A	1	1	2	3	3
SC11	MARKET CENTRES	14	B	1	2	2	2	3
SC12	EMPLOYMENT	27	C	1	3	3	3	3
SC13	CLINIC CENTRES	9	A	1	1	3	3	3
SC14	UPLIFT OF STANDARD LIFE	14	B	1	2	2	2	3
SC15	BASIC AMINITIES	7	A	1	1	2	2	3
SC16	LABOUR WORK	27	C	1	3	3	3	3
SC17	TRAFFIC PROBLEMS	14	B	1	2	2	2	3
SC18	URBAN DEVELOPMENT	14	B	1	2	2	2	3
SC19	COMMUNITY DEVELOPMENT	14	B	1	2	2	2	3
SC20	TRAFFIC INTENSITY	21	C	1	3	2	2	3
SC21	CONNECTIVITY	16	B	1	2	3	2	3
SC22	ROAD SAFETY	27	C	1	3	3	3	3

Economical and operational components (EO)

Components		ES	RB	A1	A2	B1	B2	B3
EO1	AGRICULTURAL LAND	-27	-C	3	-1	3	3	3
EO2	COMMERCIAL ESTABLISHMENTS	-27	-C	3	-1	3	3	3
EO3	BUSINESS OPPURTUNITIES	0	N	3	0	2	2	3
EO4	FINANCE	-21	-C	3	-1	2	2	3
EO5	LAND COST	-81	-E	3	-3	3	3	3
EO6	LAND VALUE	-14	-B	1	-2	2	2	3
EO7	TRANSPORTATION COSTS	-27	-C	3	-1	3	3	3
EO8	CONSTRUCTION COSTS	-81	-E	3	-3	3	3	3
EO9	EARTH MOVING EQUIPMENT COST	9	A	1	1	3	3	3
EO10	LARGE SCALE INDUSTRIES	-21	-C	3	-1	2	2	3
EO11	SMALL SCALE INDUSTRIES	-7	-A	1	-1	2	2	3
EO12	LOCAL AREA DEVELOPMENT	16	B	1	2	2	3	3
EO13	ELECTRICITY FACILITIES	9	A	1	1	3	3	3

The results of RIAM out put are shown in the form of histograms below from Figure 4.2 to 4.5

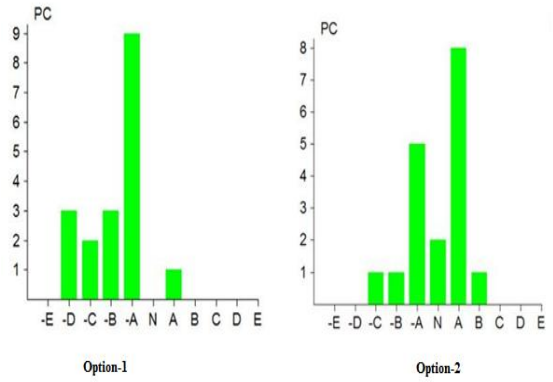

Figure 4.2 Histograms of Physical and Chemical Component of Option-1 & Option-2.

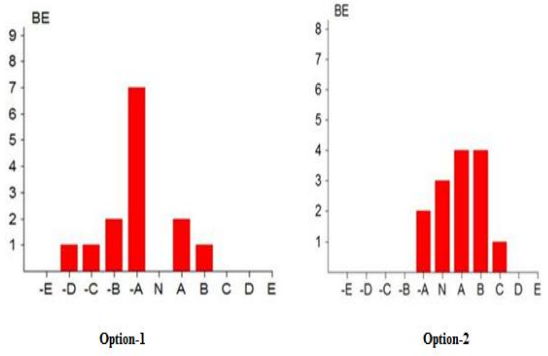

Figure 4.3 Histograms of Biological and Ecological Component of Option-1 & Option-2.

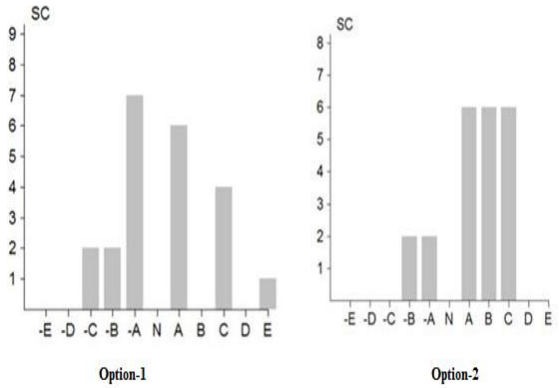

Figure 4.4 Histograms of Sociological and Cultural Component of Option-1 & Option-2.

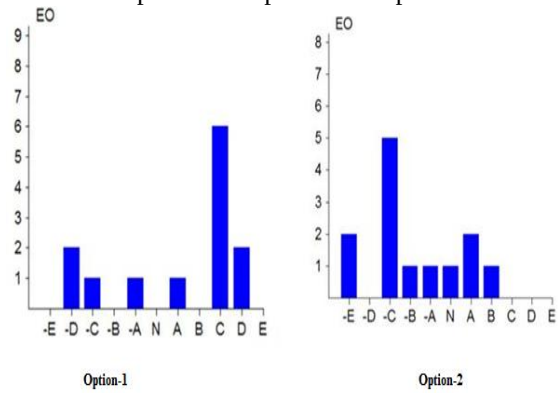

Figure 4.5 Histograms of Economical and Operational Component of Option-1 & Option-2.

Summary of RIAM scores are given in Tables 4.3 and 4.4 below

Table 4.3 Scores Summary of Option-1

Summary of scores

Range	-108 -72	-71 -36	-35 -19	-18 -10	-9 -1	0 0	1 9	10 18	19 35	36 71	72 108
Class	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	0	3	2	3	9	0	1	0	0	0	0
BE	0	1	1	2	7	0	2	1	0	0	0
SC	0	0	2	2	7	0	6	0	4	0	1
EO	0	2	1	0	1	0	1	0	6	2	0
Total	0	6	6	7	24	0	10	1	10	2	1

Table 4.4 Scores Summary of Option-2

Summary of scores

Range	-108 -72	-71 -36	-35 -19	-18 -10	-9 -1	0 0	1 9	10 18	19 35	36 71	72 108
Class	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	0	0	1	1	5	2	8	1	0	0	0
BE	0	0	0	0	2	3	4	4	1	0	0
SC	0	0	0	2	2	0	6	6	6	0	0
EO	2	0	5	1	1	1	2	1	0	0	0
Total	2	0	6	4	10	6	20	12	7	0	0

The summaries of options are shown in the following Figures 4.6 to 4.8.

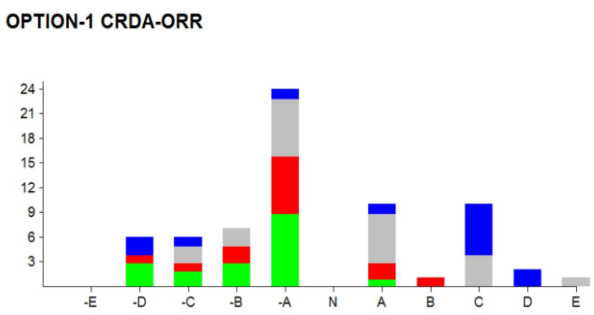

Figure 4.6 Histogram Summary of Option-1

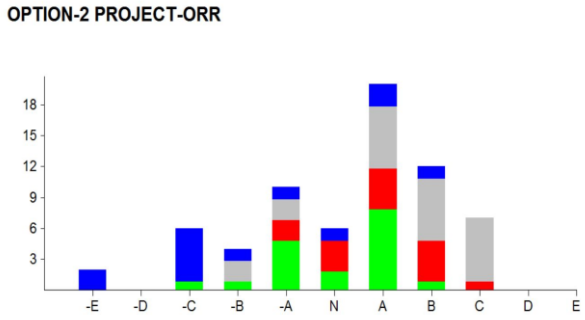

Figure 4.7 Histogram Summary of Option-2

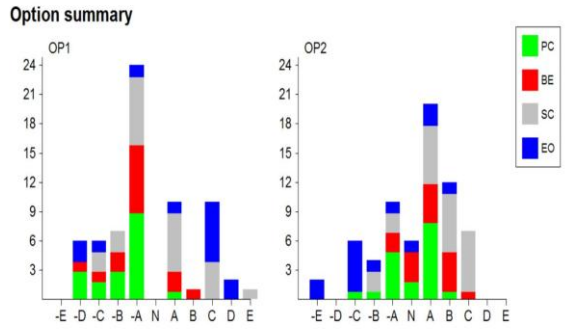

Figure 4.8 Option Summaries at a glance

IV. CONCLUSIONS

The main focus of this project is to identify the environmental impacts of the proposed ORR for the new capital of Andhra Pradesh. The objective is to present the results in such a way that a preliminary decision making can be done rapidly and easilyAll the possible effects identified are fed to the Rapid Impact Assessment Matrix for Assessment(RIAM). The RIAM calculates the impacts under four categories: Physicochemical, Biological Ecological, Social Cultural, and Economical Operational. The output of the RIAM shows that the ORR project has severe negative impacts in all the categories. Alternatively another route has been proposed by us in such a way that the impacts are minimized. These two options are compared and the results were presented in the form of bar charts.

The results shows that

- In Option-1 and Option-2 the categorization is done by considering main impacts such as agricultural area, forest, ponds, grasslands, hill regions, barren lands and built-up areas.
- In Option-2 alternate route is proposed without disturbing forest areas, built-up areas to the maximum extent.
- In Option-1 Physical and Chemical components recorded negative impacts. Biological and Ecological components have been recorded mostly negative impacts. In the Economical and Operational components the Option-1 is showing positive impacts. Sociological and Cultural components recorded both negative and positive impacts.
- In Option-2, the alternate route proposed is not passing through the forests and hence the negative impacts in Physical and Chemical components and Biological and Ecological component have been reduced. Similarly positive impacts of Sociological and Cultural components have been increased. Because of the extra length provided in Option-2, Economical and Operational components have got some negative impacts.

Hence the final decision must be taken by considering the positive and negative impacts of the Options 1 &2. Environmental degradation and Economical development are two sides of the same coin. Hence for achieving sustainability, some financial benefits must be sacrificed. Even for Option-2 proper environmental management plan must be adopted to mitigate the negative impacts.

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