

ANNEXURE - 5

COST BENEFIT ANALYSIS

PARAMETERS FOR EVALUATION OF LOSS OF FORESTS

Sr. No.	Parameter	Road, Tr. lines	Minor Irrigation projects, quarrying of stones/ metals	Medium & minor irrigation, Hydroelectric, large mining & other misc. project
1	2		4	5
1	Loss of value of timber, fuel wood & minor forest produce on annual basis, including loss of man hours per annum of people who diverted livelihood and wages from the harvest of their commodities			
2	Loss of animal husbandry productivity including loss of fodder			
3	Cost of human resettlement			
4	Loss of public facilities and administration infrastructures (roads, building, schools, dispensaries, electric line, railways etc) on forest land of which would require forest land if these facilities were diverted due to the project			
5	Environmental to soil erosion, effect on hydrological cycle wild life habitant micro climate upsetting of ecological balance	N.A. To be determined by Forest Dept.		
6	Suffering of outages	N.A.		

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COST BENEFIT ANALYSIS

PARAMETERS FOR EVALUATION OF BENEFIT, NOTWITHSTANDING LOSS OF FORESTS

Sr. No	Parameters	Roads, Transmission lines & Railway lines
1.	Increase in productivity attributable to the specific project	Due to proposed project, tremendous socio economic benefits will be generated with enormous saving in fuel consumption, saving in travel time, reduction in accidents and big boost to the rural and urban economy.
2.	Benefits to economy	As described in the Economical Analysis.
3.	No. of population benefited.	Banaskantha district and entire Gujarat State
4.	Employment potential	The proposed project will generate employment opportunities for the local people during the construction as well as operational phase. The construction will require approximately 200 full time workers / operators for a period of about 1.0 years. In addition, future induced development of the area would result in industrialization of the region and would generate more opportunities of employment for the people of the region.
5.	Cost of acquisition of facility on non-forest land wherever feasible	Nil
6.	Loss of (a) agriculture & (b) animal husbandry production due to diversion of forest land	Nil
7.	Cost of rehabilitating the displaced persons as different from compensatory amounts given for displacement	Nil As there are no displaced persons involved
8.	Cost of supply of free fuel-wood to workers residing in or near forest area during the period of construction.	Nil As no free fuel wood will be given to the workers during construction

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1.0 Economic Analysis

An infrastructure project is subjected to economic appraisal to ensure that the investment proposed would yield appropriate return to the national economy. It is therefore important that decisions about investments in roads are made on objective judgments and therefore, Economic appraisal has been carried out for different alternatives of entire Project road.

The basic purpose of the economic analysis is to enable the decision-makers in the Government to decide whether the project is worthy of investment keeping in view the benefits to the society. The Proposal for project road i.e Construction of Ambaji Bypass Road (Km 0/00 to Km.5/150) on Himmatnagar- Kheroj- Ambaji- Aburoad S.H- 9.

Road In order to assess the benefits accrued to the society, both the options of 'with project' and 'without project' have to be compared. For this purpose, the entire existing Road has been considered along with its proposed maintenance and improvement proposals.

1.1 Economic Analysis Approach

The economic evaluation has been carried out within the broad framework of social cost benefit analysis. The objective is to determine the best improvement scheme out of several proposals, which will lead to minimizing total transport costs and maximizing benefits to the road users.

The benefits accruing to society from the proposed improvement are mainly reduced vehicle operating cost, reduced travel time cost and reduced accident costs. Total transport costs comprise of two basic components as shown in **Table 1.1**.

Table 1.1: Total Transport Costs

Road Supplier Costs	Road User Costs
Construction Costs	Vehicle Operating Costs (VOC) both MT & NMT
Maintenance Costs	Travel Time Costs
Replacement Costs: Costs of Environmental Impact Mitigation Measures, Costs of Rehabilitation and Resettlement (R&R) measures	

These costs are generated using HDM – IV for every year of the analysis period (cost-benefit stream) from which economic indicator parameters that essential for viability of project namely Net Present Value (NPV), Economic Rate of Return (EIRR) and Benefit Cost Ratio (B/C) are the final economic outputs.

NPV is the present value of Net Benefits (NB) during the project period. EIRR is the discount rate at which the NPV of the Net Benefit (NB) is zero. Net Benefit is the cumulative sum of the difference between yearly benefit and yearly costs incurred after discounting.

$$NB = \sum_{n=1}^M (Benefit(n) - Cost(n))$$

Savings from vehicle emission reduction and less energy consumption due to improved facility are also important economic savings which are possible to calculate but these quantities are not converted to economic cost inside the software. So these benefits are not included.

The appraisal period (including the construction period) has been taken as 15 years after which a residual value of investment is assumed as 20%.

1.2 Project Cost and Scheduling

The project road is 5.150 km long and passes through Danta Taluka of Banaskantha district. Project road is proposed to undertake work of strengthening, rehabilitation the existing road. Accordingly, economic analysis of the project road is being carried out as follows:

Table 1.2: Alternative Details

Alternatives	Existing Chainage		Improvement
	From	To	
	0.00 Km	5.150 Km	4-lane with Paved/ Earthen Shoulder

The project road with existing carriageway width of 10.00 m is proposed for 4 lanes with paved shoulders facility which satisfies the project and traffic requirement.

The Economic analysis was carried out for 5 year benefit period (2016-2021). For performing economic evaluation, a 'project' is formulated in which comparison is made between two scenarios namely (1) without any Improvements and (2) With different Improvements.

1.2.1 Capital Cost

Project costs have been worked out being amount Rs. 162 cores. For economic evaluation base costs have been taken as factor cost of civil works and other cost related to land acquisition social environmental and utility relocations that mean Capital cost is the total construction cost of civil works for the project improvement.

The construction cost for each Alternative is tabulated in **Table 1.3** for the year 2015 at which Project will start to implement. Therefore, the project cost of present year is increased with 5 % inflation rate for two and half successive years. The construction cost of project will be utilised in three phases i.e. 70 % in first year and 30 % in second year as construction period of 1 years.

The cost estimate for each Alternative has been calculated separately based on the quantities worked out for major items of work to be executed in the project on the basis of preliminary engineering design of roads, structures and the adopted rates. A conversion factor of 0.90 has been used to convert financial cost into economic costs.

The economic cost for each Alternative is as under:

Table 1.3: Total Project Cost

Alternatives	Civil Works Cost Per km	Economical Cost per km
Alternative-2		

1.2.2 Maintenance Cost

For Two lanes with Earthen shoulder road

Routine maintenance cost	-	Rs. 0.70 lac per km per year
Periodic maintenance cost	-	Rs 25 lac per km (40mm BC)

1.3 Project Benefits

Project Benefits mainly occurs due to Reduction in Vehicle operating cost and travel time savings.

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The vehicle operating cost (VOC) components are

- Fuel
- Lubricants
- Tyres
- Spare Parts
- Maintenance Labour
- Wages of Crew
- Fixed costs including overheads, administration, interest on borrowed capital
- Depreciations
- Travel time cost

1.3.1 Vehicle Fleet

1.3.1.1 Fleet Utilization

Fleet utilization data adopted for the analysis is based on the findings of Road User Cost study in 2001, IRC SP: 30-2009. The adopted values are summarized as shown in table below.

Table 1.4: Life Norms for Vehicles

Particulars	Km Driven	Life, Year	Working Hour	Passenger
2 Axle Truck	90000	12	1950	-
Multi Axle Truck	75000	12	2100	-
3 Axle Truck	75000	12	2100	-
LCV	45500	10	1050	-
Utility Car	45500	10	1500	-
Bus/Mini Bus	125000	10	2400	45
Car / Jeep / Van	87500	10	1750	5
Two Wheeler	28800	10	636	1.5

1.3.2 Vehicle Resources

1.3.2.1 Vehicle and Tyre Cost

Economic costs of vehicle and tyre are derived from the market survey in Gujarat. Ex-Show Room Price for each category of vehicle have been collected and elements of taxes, duties, freight, dealer's margin and incentives as applicable have been removed to arrive at the economic costs. The adopted economic costs are summarized as presented in table below.

Table 1.5: Prices of Vehicles

Category	Vehicle(Rs.)	Tyre(Rs.)
2 Axle Truck	900000	7075
3 Axle and Multi Axle Truck	1000000	7075
LCV	500000	3500
Utility Car	600000	2250
Bus	850000	7500
Car / Jeep / Van	450000	2250
Two Wheeler	41000	750

1.3.2.2 Fuel & Lubricant

The details of fuel and lubricant prices for the state of Gujarat have been collected from the petrol pumps on the project road near Kheroj and Ambaji. Information on Excise, Levy, Cess, Sales Tax and Agency Charges has also been collected to arrive at economic cost for the analysis. Details of these are summarized in table below.

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Table 1.6: Economic Cost of Fuel & Lubricants

Item	Rate	Taxes and Duties			Present Economic Cost/ litre
		Excise Duty	Other Levy	Sales Tax	
Petrol	Rs./Litre	Rs./Litre 14.78	Rs./Litre 1.35	25%	43.24
Diesel	Rs./Litre	Rs./Litre 2.00	Rs./Litre 1.25	21%	38.92
Lubricants	Rs./Litre	14%	Nil	15%	96.9

1.3.2.3 Maintenance Labour and Crew Wages

Adopted values for Maintenance Labour and Crew Wages are based on the enquiries made by the Consultant with transport operators and workshops in and around the project Road. The adopted values are summarized vide in table below.

Table 1.7: Labour and Crew Wages

(Cost in Rs. per hour)

Category	Maint. Labour	Crew Wage
Truck	150	100
3 Axle and Multi Axle Truck	150	120
LCV	150	85
Utility Car	80	50
Bus	155	140
Car / Jeep / Van	100	50
Two Wheeler	50	20

1.3.2.4 Annual Overhead

Recommendations of the “Study for Updating Road User Cost Data: 2001” and IRC SP: 30-2009 are considered to arrive at annual overhead cost per vehicle and are summarised in table below:

Table 1.8: Annual Overheads

Category	Annual Overhead Cost (Rs.)
2 Axle Truck	192500
3 Axle and Multi Axle Truck	258000
LCV	128000
Utility Car	110000
Bus	155000
Car / Jeep / Van	80000
Two Wheeler	6624

1.3.2.5 Annual Interest

An Economic Interest Rate of 12% has been adopted for the analysis.

1.3.2.6 Time Value of Passengers

Time Value of Passenger (Work Trips and Non Work Trips) is arrived based on “Manual of Economic evaluation of Highway Projects in India (”IRC SP:30 -2009)”. The values of 2009 are upgraded by considering Whole Sale Price Index Ratio for the year 2009 and 2014. Non work time value of passenger is considered 15% and work time value of passenger is considered 85 % of time value of passengers as suggested in IRC SP:30 -2009 “. The adopted values are summarized as given in table below.

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Table 1.9: Time Value of Passengers

Mode of Travel	Unit	2 Wheeler	Car/ Taxi	Bus
Travel time Value RUCS-March 2009	Rs/Hour	32.0	62.5	39.5
WPI Ratio 2013/ 2009	-	1.37	1.37	1.37
Travel time Value RUCS-January 2013	Rs/Hour	37.4	73.0	46.1
Eq. Non-work Time Value in 2012	Rs./Hour	6.6	12.9	8.1

1.3.2.7 Time Value of Cargo

Average value of commodity is based on "Manual of Economic evaluation of Highway Projects in India ("IRC SP: 30 - 2009)". Equivalent cost of commodity in 2014-2015 is determined using the WPI ratio (1.37 over 2009). Average payload for each category of freight vehicles is based on axle load survey. Time-delay cost is estimated with an economic interest rate of 12% and economic conversion factor of 0.90 and provided in table below:

Table 1.10: Time Value of Cargo

Vehicle Category	Average Payload (Tonnes)	Average Running Time (hour/Year)	Time-delay Cost (Rs./Hr)
2Axle Truck	15	1950	37.00
3 Axle and Multi Axle Truck	17	2100	64.00
LCV	8.25	1050	22.0

1.3.2.8 Accident Cost

In case of accidents The value of Rs.864,000,244,000,198,000 & 435,000 has been assumed on account of loss to the economy for the Fatal,Damage,Injury and All respectively.

1.3.2.9 Social Benefit

The Social Benefit gains due to the development of the project has been considered Rs.1 lac.per annum with 10% annual growth rate over analysis period.

1.3.3 HDM Traffic

Following category of fast moving and slow moving vehicles are considered for carrying out HDM 4 Analysis.

- 2 Axle Truck
- 3 Axle Truck
- Multi Axle Truck
- LCV
- Utility Car
- Bus
- Mini Bus
- Car / Jeep / Van
- Two Wheeler

As HDM-4 does not include 3 Wheeler and Agricultural Tractor Categories of Vehicle therefore these categories are not considered in the analysis. Percentage compositions of assigned traffic in AADT on the project road as on year 2012 and adopted for the analysis for the Project road are summarized as given in table below.

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Table 1.11: Composition of Motorized Traffic assigned on Project road (MT) (%)

Section	2 Wheeler	Passenger Car+Jeep	Mini Bus	Bus	LCV	2-Axle	3-Axle and Multi Axle	AADT (Nos.)
1	69.58	20.56	1.84	2.6	3.95	1.19	0.28	3268
2	54.44	31.50	0.70	3.17	5.01	4.75	0.43	526
3	60.45	32.22	0.31	1.07	3.27	2.22	0.46	4501

Adopted traffic growth rates as per traffic analysis is Presented in **Table 1.12**.

Table 1.12(a): Traffic growth Rate of Motorized Traffic assigned on Project road (MT) (%) for section 1&2

Year	2 Wheeler	Passenger Car+Jeep	Mini Bus	Bus	LCV	2-Axle	3-Axle and Multi Axle
2011-2014	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2015-2019	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Table 1.12(b): Traffic growth Rate of Motorized Traffic assigned on Project road (MT) (%) for section 3

Year	2 Wheeler	Passenger Car+Jeep	Mini Bus	Bus	LCV	2-Axle	3-Axle and Multi Axle
2011-2014	5.1	9.3	7.4	7.4	9.5	9.5	9.5
2015-2019	5.0	8.3	6.4	6.4	8.5	8.5	8.5

1.4 Economics Internal Rate of Return

Economic Analysis has been carried out for construction option discussed above. Variables considered in for economic analysis of the project are volatile and depend on various factors. In general, in case of economic analysis is also recommended that analysis period should not be long as it may lead to erroneous results.

However, in order to be able to draw the conclusions on common platform Economic Analysis have also been carried out for 5 years of analysis period. The summary of Economic internal rate of return (EIRR) worked out, for construction option based on life cycle cost analysis is presented below.

Economic Analysis was carried out following the methodology and input data discussed in the preceding paragraphs of this chapter using HDM-4 software.

1.5 Sensitivity Analysis

The Sensitivity analysis has been carried out in order to study the viability of the project against the uncertainties in traffic forecasting and the possible variations of project cost due to unforeseen reasons. The sensitivity analysis has been performed with following situations.

S1: Base cost plus 15% and Base Benefits

S2: Base cost and Base Benefits minus 15%

S3: Base cost plus 15% and Base Benefits minus 15%

The analysis has been done by changing the cost and benefit streams independently as well as in combination. The end results of this study have been summarised below:

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Table 1.14: Results of Sensitivity Analysis

Alternatives	Economic Internal Rate of Return (%)		
	S1	S2	S3
With time saving	14.28	13.20	12.33

1.6 Conclusion

The project road is economically viable for proposed improvement in normal case as well as in various sensitivity cases as it yields more than 12% return (assumed interest rate for the analysis).

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