1. 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 each traffic homogenous section 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. **Chenani-Sudhmahadev** road section is upgrading the road with 2 Lanes with Paved shoulders as per RFP. In order to assess the benefits accrued to the society; both the options of ‘Existing’ and ‘Proposed’ have to be compared. For this purpose, the entire existing Road has been considered along with its proposed maintenance and improvement proposals.

* 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 **Table10.1**.

**Table10.1: 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.



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 30 years after which a residual value of investment is assumed as 10%.

* 1. Project Economic Evaluation using HDM - 4

Economic evaluation for **Chenani-Sudhmahadev** road section is carried out by consideration of two alternatives In HDM – 4.

* + 1. Alternative 1: Existing

For without project consideration, project road will carry existing traffic on it without any improvement and maintenance in present condition that means No treatment is given to existing road for improving its capacity augmentation, functional and structural pavement quality and geometry standards.

* + 1. Alternative 2: Proposed

For with project consideration, Project road is rehabilitated and upgraded as 2 lanes with paved shoulders. In this alternative, project road improvements are made by improving its geometry through realignments, providing bypasses and rehabilitation to existing pavement though reconstruction and strengthening.

* 1. Project Cost and Scheduling

The existing project road is 22+713 km. Project road is proposed to undertake work of widening, strengthening and rehabilitation to facilitate the proposed road. Accordingly, economic analysis of the project road is being carried out as follows:

**Table 10.2: Section Details**

| **Homogeneous Section** | **Existing Chainage** | | **Improvement** |
| --- | --- | --- | --- |
| **From** | **To** |
| **Chenani-Sudhmahadev** | 0/000 | 22/713 | 2 lane Paved Shoulder |

The project stretch is a single-lane carriageway, the width of carriageway varies from 3.75 m to 11.0 m in entire stretch.

The Economic analysis was carried out for 30-year benefit period (2018-2048). For performing economic evaluation, a ‘project’ is formulated in which comparison is made between two scenarios namely (1) Existing and (2) Proposed.

* + 1. Capital Cost

Project cost is Rs. 230.66 Crore for project road. 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 homogeneous section is tabulated in **Table 10.3** for the year 2018 at which Project will start to implement. Therefore, the project cost of present year is increased with 5 % inflation rate for two successive years. The construction cost of project will be utilised in two phases i.e. 50 % in first year and 50 % in second year as construction period of 2 years.

The cost estimate for each section 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 0.85 has been used to convert financial cost into economic costs.

The economic cost for each package is as under:

**Table 10.3: Total Project Cost**

|  |  |  |
| --- | --- | --- |
| **Homogeneous Section** | **Financial**  **Cost** | **Economical**  **Cost** |
| **Chenani-Sudhmahadev** | 174.34 | 148.189 |

* + 1. Maintenance Cost

**For Two lanes with Paved shoulder road**

Routine maintenance cost - Rs. 1, 22,000 per km per year

Periodic maintenance cost - Rs 8,55,000 per km (40mm BC+90mm DBM)

* 1. Project Benefits

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

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. Vehicle Fleet
       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 10.4: 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 | - |
| Bus/Mini Bus | 125000 | 10 | 2400 | 45 |
| Car / Jeep / Van | 87500 | 10 | 1750 | 5 |
| Two Wheeler | 28800 | 10 | 636 | 1.5 |

* + 1. Vehicle Resources
       1. Vehicle and Tyre Cost

Economic costs of vehicle and tyre are derived from the market survey in Chhattisgarh. 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 10.5: Prices of Vehicles**

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

* + - 1. Fuel & Lubricant

Economic Prices fuel and lubricant are arrived based on ratio of WPI for all commodities of August 2010 with respected to March 2009 and applying that ratio to search out actual value**. Existing**

**Table 10.6: Economic Cost of Fuel & Lubricants**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Price/ litre as per SP 30:2009** | **WPI Ratio** | **Present Cost/ litre** |
| Petrol | 18.55 | 1.156 | 21.44 |
| Diesel | 18.20 | 1.156 | 21.04 |
| Lubricants | 56.70 | 1.156 | 65.55 |

* + - 1. 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 10.7: Labour and Crew Wages**

*(Cost in Rs. per hour)*

| **Category** | **Maint. Labour** | **Crew Wage** |
| --- | --- | --- |
| Truck | 100 | 75 |
| 3 Axle and Multi Axle Truck | 100 | 90 |
| LCV | 100 | 45 |
| Bus | 125 | 115 |
| Car / Jeep / Van | 60 | 25 |
| Two Wheeler | 40 | - |

* + - 1. 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 10.8: Annual Overheads**

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

* + - 1. Annual Interest

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

* + - 1. 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 2015. 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.

**Table 10.9: Time Value of Passengers**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mode of Travel** | **Unit** | **2 Wheeler** | **Car/ Taxi** | **Bus** |
| Travel time Value RUCS-March 2009 | Rs/Hour | 62.5 | 32.0 | 39.5 |
| WPI Ratio 2010/ 2009 | - | 1.156 | 1.156 | 1.156 |
| Travel time Value RUCS-august2010 | Rs/Hour | 31.0 | 61.0 | 39.0 |
| Eq. Non-work Time Value in 2010 | Rs./Hour | 5.5 | 10.8 | 6.8 |

* + - 1. 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 2010-2011 is determined using the WPI ratio (1.156 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 10.10: Time Value of Cargo**

|  |  |  |  |
| --- | --- | --- | --- |
| **Vehicle Category** | **Average Payload (Tonnes)** | **Average Running Time (hour/Year)** | **Time-delay Cost**  **(Rs./Hr)** |
| 2Axle Truck | 15 | 1950 | 32.00 |
| 3 Axle and Multi Axle Truck | 17 | 2100 | 55.00 |
| LCV | 8.25 | 1050 | 19.0 |

* + 1. 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
* 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 2017 and adopted for the analysis for the Project road are summarized as given in table below.

**Table 10.11: Composition of Motorized Traffic assigned on Project road (%)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Section ID** | **2-Wheeler**  **+ 3 Wheeler** | **Passenger Car+Jeep** | **Bus** | **LCV** | **2-Axle** | **3-Axle and Multi Axle** | **AADT**  **(PCU No.)** |
| PT | 96 | 409 | 185 | 183 | 105 | 77 | 1271 |

Adopted traffic growth rates as per traffic analysis is Presented in **Table10.12.**

**Table 10.12: Traffic growth Rate of Motorized Traffic assigned on Project road (MT) (%)**

| **Year** | **2 Wheeler** | **Passenger Car+Jeep** | **Bus** | **LCV** | **2-Axle** | **3-Axle and Multi Axle** |
| --- | --- | --- | --- | --- | --- | --- |
| 2017-2018 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| 2018-2023 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| 2023-2028 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| 2028-2033 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| 2033-2038 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| 2038-2043 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| 2043-2048 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |

* 1. 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 30 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.

HDM-4 outputs on Annual Discounted Net Benefit Streams with time savings is presented vide.

HDM-4 output on Benefit Cost Ratios is presented vide.

The Economic Analysis Summary with time savings (By Alternative) is presented vide **Annexure 10.1.**

The EIRR and NPV at 12% discount rate for each construction package as worked out with and without benefits due to travel time savings are summarized as under:

**Table 10.13: Results of Economic Analysis**

| **Homogeneous Sections** | **Option** | **Net Economic Benefit**  **(NPV @ 12%)** | **Economic Internal Rate of Return (12 %)** |
| --- | --- | --- | --- |
| **Chenani-Sudhmahadev** | With time saving | (58.88) | (6.93%) |

* 1. Conclusion

The proposed road in required for alternate route in future from Chenani to Srinagar via Sudhmahdev, Goha, Khelani, Khanbal.