

**METHODOLOGY FOR ESTIMATING INVESTMENT IN ROADS**

1. The forecast of the demand of roads has been done in three phases over the 10 year horizon
  - Phase 1: At the end of 3 years
  - Phase 2: At the end of 7 years
  - Phase 3: At the end of 10 years
2. To arrive at the final investment figures the demand for roads has been estimated.
3. The methodology for estimating road requirements has been split into two components
  - Component 1: Strengthening of the existing road network
  - Component 2: Enlargement of the existing road network

**a) Component 1: Strengthening of the existing road network**

This component focuses on the quality of the road network given the present network length. Hence, improving the quality of the road network would mean upgrading the road network from lower quality roads to higher quality roads. Roads in the decreasing order of quality in the state are:

- BT Top roads- Four lane
- BT Top roads- Double lane
- BT Top roads- Single lane
- WBM Roads
- Kutcha Roads

The following table shows the result of Component 1

**TABLE 1  
Strengthening the existing network**

	Existing km	After 3 years km	After 7 years km	After 10 years km
<i>National Highways</i>	1827	1827	1827	1827
BT-Single lane	1195	595		
BT-Double lane	632	914	1195	882
BT-Four lane	0	318	632	945
<i>State Highways</i>	2074	2074	2074	2074
BT-Single lane	1440	1698	1489	1279
BT-Double lane	166	376	585	795
BT-Four lane	0	0	0	0
WBM	407	0	0	0
Kutcha	61	0	0	0
<i>MDR and ODR</i>	3094	3094	3094	3094
BT-Single lane	2397	2746	3094	3094
BT-Double lane	0	0	0	0
WBM	631	316	0	0
Kutcha	66	33	0	0
<i>Village/rural Roads</i>	28392	28392	28392	28392
BT-Single lane	3938	7686	11914	15210
WBM	13234	11206	8918	7134
Kutcha	11220	9500	7560	6048

**Assumptions & Rationale for estimation**

- **National Highways:**
  - There would be no single lane NH by the end of the tenth year
  - 50% of all NH's at the end of 3 years would be double lane
  - The busiest two lane NH's- NH6, NH43 & NH200 would be converted into 4 lane NH's by the 3<sup>rd</sup>, 7<sup>th</sup> and 10<sup>th</sup> year respectively
- **State Highways:**
  - All WBM and Kutcha SH's would be converted into BT topped Single lane SH's by the 3<sup>rd</sup> year
  - The combined SH road length in the three most important districts of Raipur, Bilaspur and Durg would be converted into double lane BT top roads by the end of 10<sup>th</sup> year- one third of the required length conversion after each phase. Since 8% of SH (or about 240 km) are already double lane, the existing double lane BT top roads have been assumed to be equally distributed across all the districts
- **MDRs and ODRs:**
  - 50% of all the WBM and Kutcha roads in this category would be converted into BT topped single lane roads at the end of 3 years and the remaining at the end of 7 years
- **Village/ Rural roads**
  - For the strengthening the road network under the category of Village/ Rural roads, the number of villages not connected by the BT topped roads is used as the driver for upgradation (Table 2)
  - The sum of length of WBM and Kutcha roads per village has been assumed to be equal across all villages. The total length of WBM and Kutcha roads among village roads is about 24,527 km. This gives an average road length of 2.078 km per village. This has been used as the basis for connecting villages
  - The number of villages getting converted is multiplied by the 2.078 km to arrive at the total km to be converted into BT roads at the end of each phase
  - The ratio of WBM and Kutcha roads at the end of each phase has been taken as constant
  - The data regarding the number of villages having no BT topped roads connectivity is given in Table 2

TABLE 2  
**Population Density in Villages Vs. Road Connectivity**

Population/village	<500	500-1000	1000-1500	>1500	Total
Total Villages	12224	5054	1467	862	19607
Villages connected with BT topped roads	2868	2844	1233	860	7805
Rest	9356	2210	234	2	11802

- All 'Rest' with population density >1000, 50% of the 'Rest' with population density between 500-1000 per village and 5% of the 'Rest' with population density <500 have been assumed to be connected by BT topped roads by the end of 3<sup>rd</sup> year

- Remaining 50% of the 'Rest' with population density between 500-1000 per village and the remaining 10% of the 'Rest' with population density <500 have been assumed to be connected by BT topped roads by the end of 7th year
- The remaining 20% of the 'Rest' with population density <500 have been assumed to be connected by BT topped roads by the end of 7th year

**b) Component 2: Enlargement of the existing road network**

The enlargement of the road network would entail a projection regarding the absolute increase in the road network. The enlargement in the road network under the different category (i.e. NH, SH etc.) could be on two counts- upgradation from one category to the other & construction of a totally new road. The estimate for enlargement of the road network is given in the table below. The table includes the upgradation undertaken in the previous component.

**TABLE 3  
Road network after each phase (Category-wise)**

	Existing	After 3 years	After 7 years	After 10 years
	km	km	km	km
<i>National Highways</i>	1827	2151	2675	3150
BT-Single lane	1195	595	0	0
BT-Double lane	632	1238	2043	2205
BT-Four lane	0	318	632	945
<i>State Highways</i>	2074	2442	3037	3576
BT-Single lane	1440	2067	2452	2782
BT-Double lane	166	376	585	795
BT-Four lane	0	0	0	0
WBM	407	0	0	0
Kutcha	61	0	0	0
<i>MDR and ODR</i>	3094	3809	4910	5939
BT-Single lane	2397	3461	4910	5939
BT-Double lane	0	0	0	0
WBM	631	316	0	0
Kutcha	66	33	0	0
<i>Village/rural Roads</i>	28392	34283	44188	53449
BT-Single lane	3938	7686	11914	15210
WBM	13234	14362	17428	20649
Kutcha	11220	12234	14846	17590
<b>Total</b>	<b>35387</b>	<b>42686</b>	<b>54810</b>	<b>66115</b>

**Assumptions & Rationale for estimation**

- *All Roads:*
  - The forecast for the rate of growth of all roads in Chhattisgarh is obtained from the benchmark CAGR of roads in the national level. The CAGR of the roads in national level is given in Table 4 on the following page

TABLE 4  
National Level Data to evaluate CAGR

	1990-91	1999-00	CAGR (9 YR)
All Roads	2001944 km	3300000 km	6.44
NH	33650 km	52000 km	5.59

- The CAGR of 6.46% has been used to calculate the total road length at the end of each of the Phases
- *National Highways:*
  - The growth rate of NH in Chhattisgarh has also been assumed at the CAGR national level NH growth rate of 5.59%
  - It has been assumed that all the new NH's would be double lane BT roads. Further, all the new NH's constructed would be upgraded from the Single lane BT roads into double lane SH and notified as NH
- *State Highways:*
  - It has been assumed that SH would grow at the same CAGR as national highways i.e. 5.9% over the next ten years
  - All the new SH's would be single lane BT roads
  - All the new SH's constructed mainly by upgrading MDRs and ODRs into BT roads and notifying them as SH
- *MDRs / ODRs and Village Roads:*
  - The sum of MDR/ ODR and the Village roads is arrived after subtracting the new NH and SH's from the total new roads to be constructed
  - The ratio of MDR/ODR to Village roads is assumed to remain constant over the entire period
  - All the new MDR/ ODR's are assumed to be single lane BT roads
  - All the new MDR/ ODR's constructed would be upgraded from the WBM/ Kutcha Rural roads
  - All the new Village roads would be of the 'WBM' or the 'Kutcha' roads, which would be constructed afresh
  - In the case of new Village roads to be constructed the ratio of WBM and Kutcha roads has been assumed to be same as the existing ratio

**c) Cost for construction per km of road length:**

The cost estimates for construction of a kilometer of different types of roads is given in Table 5:

TABLE:5  
Cost of Construction per Km of Road

Description	Cost Rs in lakh/ km
New BT road-Four lane	800
New BT road-Double lane	400
New BT road-Single lane	100
New WBM road	15
New Kutcha Road	9

BT road- Single to Double lane	50
Bt road- Double to Four lane	200
Kutchra road to WBM road	8
WBM road to BT road -Single lane	4
Kutchra road to BT road -Single lane	11

**d) Investment Required:**

Based on the estimated requirement for roads at the end of the 3<sup>rd</sup>, 7<sup>th</sup> and the 10<sup>th</sup> years, and the unit cost of construction of the road, the investment required is given below.

➤ **Investment under Component 1:**

TABLE:6  
Investment under Component 1(in Rs crores)

	After 3 years	After 7 years	After 10 years	Total
<i>National Highways</i>	1573.6	1552.0	1252.0	4377.5
BT-Four lane	1273.6	1254.4	1252	3780.0
BT-Double lane	300.0	297.6	0.0	597.5
<i>State Highways</i>	127.8	104.8	104.8	337.3
BT -Double lane	104.8	104.8	104.8	314.3
BT-Single lane	23.0	0.0	0.0	23.0
<i>MDR and ODR</i>	16.3	16.3	0.0	32.5
BT-Single lane	16.3	16.3	0.0	32.5
<i>Village/rural Roads</i>	270.3	304.9	237.7	812.9
BT-Single lane	270.3	304.9	237.7	812.9
<b>Total</b>	<b>1987.8</b>	<b>1977.9</b>	<b>1594.4</b>	<b>5560.2</b>

➤ **Investment under Component 2:**

TABLE:7  
Investment under Component 2(in Rs crores)

	After 3 years	After 7 years	After 10 years	Total
<i>National Highways</i>	162.2	262.0	237.6	661.7
BT-Double lane	162.2	262.0	237.6	661.7
<i>State Highways</i>	50.0	80.8	73.2	204.0
BT-Single lane	50.0	80.8	73.2	204.0
<i>MDR and ODR</i>	15.4	23.8	22.2	61.4
BT-Single lane	15.4	23.8	22.2	61.4
<i>Village/rural Roads</i>	960.5	1595.6	1487.7	4043.8
WBM	591.2	982.1	915.7	2489.0
Kutchra	369.3	613.5	572.0	1554.8
<b>Total</b>	<b>1188.2</b>	<b>1962.2</b>	<b>1820.7</b>	<b>4971.0</b>

➤ **Total Investments- Strengthening and enlargement of the road network**

**TABLE:8  
Total Investment (in Rs Crores)**

	After 3 years	After 7 years	After 10 years	Total
<i>National Highways</i>	1735.8	1813.9	1489.6	5039.2
BT-Four lane	1273.6	1254.4	1252.0	3780.0
BT-Double lane	462.2	559.5	237.6	1259.2
<i>State Highways</i>	177.8	185.5	178.0	541.3
BT-Double lane	104.8	104.8	104.8	314.3
BT-Single lane	73.0	80.8	73.2	227.0
<i>MDR and ODR</i>	31.7	40.0	22.2	93.9
BT Single	31.7	40.0	22.2	93.9
<i>Village/rural Roads</i>	1230.8	1900.6	1725.4	4856.7
BT-Single lane	270.3	304.9	237.7	812.9
WBM	591.2	982.1	915.7	2489.0
Kutcha	369.3	613.5	572.0	1554.8
<b>Total</b>	<b>3176.0</b>	<b>3940.0</b>	<b>3415.1</b>	<b>10531.2</b>

**e) O&M Costs of the road network**

- The cost per km of maintaining the roads under different categories is given in table 9. The cost includes the cost of regular maintenance and the cost of relaying every 5 years (in the case of BT roads). This cost has been taken on an annualised basis

**TABLE:9  
O&M Costs per Km of road**

Category	Cost (in lakh Rs/km)
BT Road- Four lane	1.3
BT Road- Two lane	2.5
BT road- Single lane	4.8
WBM Road	0.3
Kutcha Road	0.3

- Based on the above unit costs and the total road length at the end of the different phases, the total O&M costs is given in the table below

TABLE:10  
Total O&M cost forecasts per annum (in Rs. Crores)

	After 3 years	After 7 years	After 10 years
<i>National Highways</i>	54.0	81.4	100.5
BT-Single lane	7.7	0.0	0.0
BT-Double lane	30.9	51.1	55.1
BT-Four lane	15.3	30.3	45.4
<i>State Highways</i>	36.3	46.5	56.0
BT-Single lane	26.9	31.9	36.2
BT-Double lane	9.4	14.6	19.9
WBM	0.0	0.0	0.0
Kutcha	0.0	0.0	0.0
<i>MDR and ODR</i>	46.0	63.8	77.2
BT-Single lane	45.0	63.8	77.2
WBM	0.9	0.0	0.0
Kutcha	0.1	0.0	0.0
<i>Village/rural Roads</i>	179.7	251.7	312.4
BT-Single lane	99.9	154.9	197.7
WBM	43.1	52.3	61.9
Kutcha	36.7	44.5	52.8
<b>Total</b>	<b>316.0</b>	<b>443.5</b>	<b>546.2</b>

