

## **GHG Emission Reduction due to Construction of the Link road under the Bhoj Wetland Project**

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### **Introduction**

The Bhoj Wetland comprising of Upper and Lower Lakes of Bhopal in Madhya Pradesh is one of the 19 Ramsar sites declared by the Ministry of Environment and Forests, Government of India. The Upper Lake, the lifeline of capital city of Bhopal and arguably the largest manmade lake in central India, was created by constructing an earthen dam across the rainfed Kolans river in the 11<sup>th</sup> century AD. The Lower Lake was created by constructing another earthen dam on the downstream of Upper Lake dam, but much later i.e. in the late 18<sup>th</sup> century AD. The expansion of city functions of Bhopal after it became the capital of the state of Madhya Pradesh in 1956, caused tremendous population growth and consequent increase in anthropogenic pressure on both the lakes, resulting in deterioration of their water quality. The impact on Upper Lake was more significant since it served as the only major potable surface water source for the city till 1989 and even thereafter till date it contribute atleast 40% to the city water supply. Considering the alarming situation the Government of Madhya Pradesh had formulated an integrated conservation and management project for the environmental improvement of the lake and its catchment area. The implementation of the project was started in 1995 with the sanction of 7055 Million Yen loan fund from JBIC.

The project included both preventive and curative measures. The creation of a 4.9 Km long Link road, on the northeastern fringe of Upper Lake abutting the urban areas during 1995-1999 was one of the important preventive measures. A setback of 50-100m between the road and the lake depending upon the availability of land having three-story plantation was also created. The road became a buffer between the thickly populated urban settlement and the water body. The execution of these works resulted in easing of the traffic through the congested city area.

The road was opened for traffic in the year 2000. Later a study was conducted by the Capital Project Administration (CPA), which had executed the work of Link road, to assess the impact of diversion of traffic from the congested city and consequent reduction in emission of green house gases due to smooth plying of vehicles through the newly created Link road. The initial hypothesis of the study was that due to increase in vehicular speeds and driving conditions of vehicles, which have diverted to the Link road from the old Bhopal road would have reduced the Green House Gas (GHG) emissions even though there was not much difference in the distance traveled.

## **Site Description**

The old road passes through densely populated old part of the Bhopal city. At places the road become narrow. During peak hours i.e. 8AM to 10PM there is traffic congestion, whereas the Link road have newly constructed smooth surfaced four lanes. The distance of Link road is 4.9Km against the old road which connects both the ends of Link road has a distance of 4.4Km.

## **Methods**

The traffic volume count and speed delay survey of the Old Bhopal Road and Link Road were conducted by the CPA to assess the impact of diversion of traffic from the congested part of the Bhopal city. The methods for the survey were as follows:-

### **1. Traffic volume counts:-**

- i. The survey team, one at each entry points i.e. at Retghat and Lalghati were deployed round the clock on a 12 hour shift. Counting of various types of motor vehicles passing through each entry points was done on a hourly basis.
- ii. The Link road was closed for a day so that all the traffic is diverted through the congested city presenting a scenario as existed before the construction of the Link road. The counting of vehicles passing through the congested city was also done at both the entry points.
- iii. The vehicles were categorized as Diesel or Petrol driven.

### **2. Speed-Delay Survey**

- i. The time taken by a group of survey crew traveling through the Link road by two wheelers to a junction point was recorded. Another team cruised through the old road and reaches the same junction and the time was recorded. Thus the comparative time required for traveling through both the roads was obtained.
- ii. The above exercise with four wheelers was also done to obtain the traveling time of four wheelers.

The data obtained through the above exercise were processed in the following manner taking assumptions into account are as follows:-

- i. Given the average speed the average unit fuel consumption by each category of vehicle was calculated. It was also assumed that distance traveled by vehicles per liter of fuel gets reduced by 30% in congested roads due to reduced speed and numerous stoppages.
- ii. The total fuel consumption for baseline (with the old Bhopal road only) and new case (Link road + old Bhopal Road) was calculated using standard formulation. Subsequently emission factors were used to calculate GHG emission in equivalent CO<sub>2</sub> units. Average speed was assumed with no allowance given for peak and non-peak conditions while calculating GHG emissions.

- iii. The GHG emissions for base line case (with the old Bhopal road only) and new case (Link road + old Bhopal Road) have been compared to estimate the reductions. Due to constraints of resources and time the variables taken into considerations have been kept to the minimal.
- iv. It was also assumed that in absence on newly constructed Link road, all the vehicles which are presently traversing the Link road would have passed through the old Bhopal Road.
- v. The estimation of mobile source emissions is complex since emission levels depend on a large number of factors, including the class of vehicle and type of pollution control equipment fitted; type of fuel consumed and the average rate of fuel consumption; condition of the vehicle, which is influenced by the age and the level of maintenance; and operating conditions such as driver behavior, weather conditions, road type and traffic levels. These variables have not been taken into account in the present case, as they would be the same irrespective of the road traveled except for its traffic levels.

## Results

The GHG emission due to traffic through the old road was estimated at 41.11 carbon equivalent per day as against the new case in which the GHG emission was 32.89 carbon equivalent per day. Thus creation of the Link road has led to the reduction of 8.22 carbon equivalent tones of GHG emissions per day. The results have been presented in table 1 & 2.

Table-1 Green House Gas Emission due to traffic through the old scenario (in absence of VIP road)

Vehicle Type	Number of Vehicle	Carbon Eqi/Day
<b>2-Whl</b>	<b>46484</b>	<b>14.23</b>
<b>Cars</b>	<b>17524</b>	<b>16.10</b>
<b>Jeeps</b>	<b>3655</b>	<b>3.98</b>
<b>Auto</b>	<b>2017</b>	<b>0.79</b>
<b>Bus</b>	<b>1637</b>	<b>4.46</b>
<b>Trucks</b>	<b>286</b>	<b>0.78</b>
<b>Trolley</b>	<b>189</b>	<b>0.77</b>
<b>Total</b>	<b>71792</b>	<b>41.11</b>

Table-2 Green House Gas Emission due to traffic under present scenario (Link road + Old road)

Vehicle Type	Old Road		Link Road		Total	
	No of vehicle	Carbon Eqi/Day	No Of Vehicle	Carbon Eqi/Day	No of vehicle	Carbon Eqi/Day
2-Whl	32364	7.928	14120	3.459	46484	11.39
Cars	11134	8.182	6390	4.696	17524	12.88
Jeeps	2202	1.918	1453	1.266	3655	3.18
Auto	1685	0.531	332	0.105	2017	0.64
Bus	1244	2.710	393	0.856	1637	3.57
Trucks	201	0.438	85	0.185	286	0.62
Trolley	130	0.425	59	0.193	189	0.62
<b>Total</b>	<b>48960</b>	<b>22.13</b>	<b>22832</b>	<b>10.76</b>	<b>71792</b>	<b>32.89</b>

## **Conclusion**

The construction of new road under the Bhoj Wetland Project not only prevented direct human interference in the lake but also minimized GHG emission and other automobile exhaust which were affecting the health of the people. Another emerging point being preference of the new road over the old road despite being lengthy. The study reveals that while planning for environmental improvement projects multiple benefits/subsidiary benefits of interventions should be taken into consideration.