TECHNICAL ARTICLE

Traffic Impact Analysis of Closing Cubbon Park for all motorized vehicles in Bengaluru City

by

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1. Background

Cubbon park (Figure-1) is a landmark lung space in the heart of Bengaluru City, spread over an area of about 300 acres and is also a vibrant ecological zone. From the point of view of Quality of Life (QoL) or Liveability of the city such green spaces are extremely important for people across all walks of life. Rich and poor alike, such parks provide valuable spaces to socialize, breathe fresh and clean air, and live a healthy life, in fast motorizing and urbanizing city like Bengaluru.

Considering the importance of the park, many citizen groups and other stakeholders in the city have been requesting for complete ban of motorized vehicles in the Cubbon park. Off course, there are several examples across the world like, Central Park in New York, where city authorities have completely banned motorized traffic to preserve such lung spaces and improve QoL of their city. It is therefore important to view such measures in a holistic manner.

2. Aim & Methodology of this Study

The aim of this technical article is to understand the traffic impact; in terms of V/C (Volume to Capacity Ratio of the roads), total vehicle kilometres travelled (VKT) by all motorized modes, and vehicular emissions (CO_2 & $PM_{2.5}$) over the whole Bangalore Metropolitan Region (BMR) network, due to the closure of Cubbon park to motorized vehicles. The research methodology used for this study is shown in Figure-2. Since, Cubbon park is located in the Central Business District (CBD), a large number of Origin-Destination (OD) trips in the city would get impacted, in terms of change in route choice, due to closure of Cubbon park for motorized traffic and therefore, it is prudent to assess its impact over the BMR network rather than just on the local roads and network in the vicinity of Cubbon park, to get a holistic picture of the traffic impact and associated exhaust emissions.

A conventional macro-simulation framework in terms of four-stage Travel Demand Modelling (TDM) is adopted for the travel demand forecasts and scenario evaluation. The calibrated travel demand model for BMR utilized for forecasting is obtained from the CLIMATRANS project

report '*Sustainable Transport Measures for Liveable Bengaluru by Verma et. al. Indian Institute of Science, Bangalore*'.

The two scenarios considered for the analysis in this study are described below:

- **Business as Usual Scenario (BAU)** – 2020 Scenario without closing the Cubbon park to traffic, with traffic at pre-COVID-19 level.
- **Cubbon Park No Traffic Scenario (CPNT)** – 2020 Scenario where the Cubbon park is closed for traffic (all motorized vehicles), with traffic at pre-COVID-19 level.

The estimated modal share for the year 2020 is represented in Figure 3.

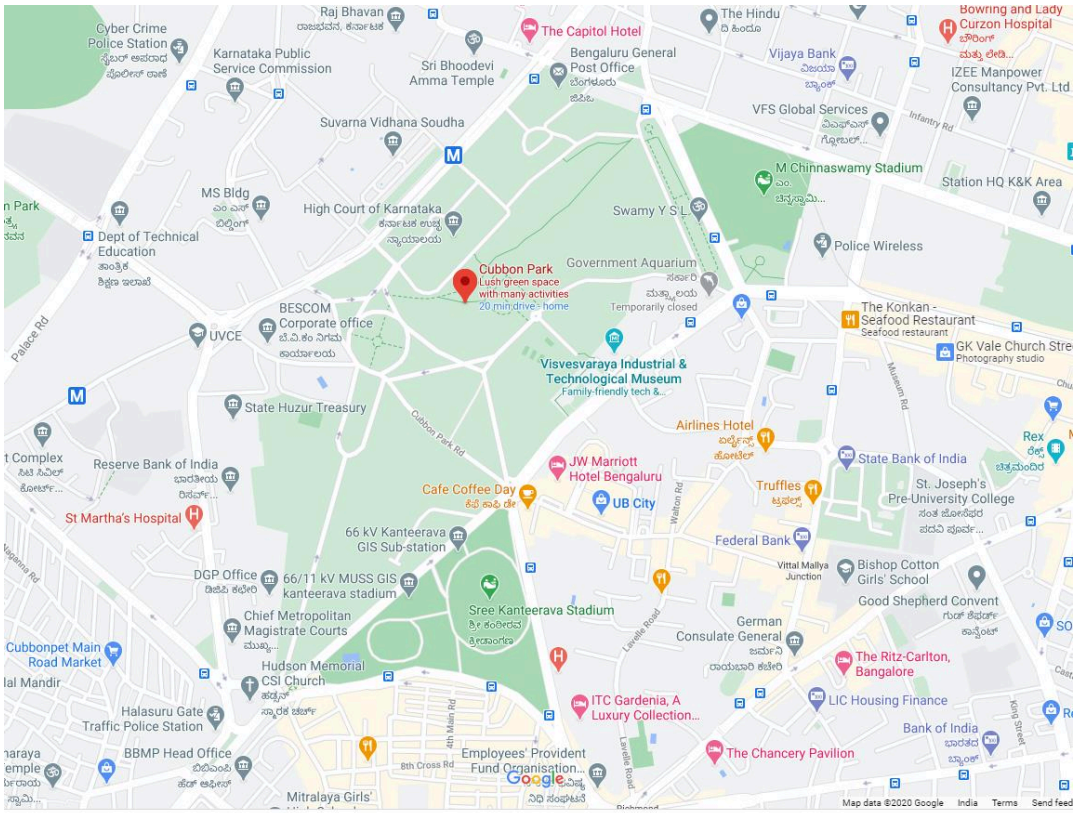

Figure-1: Cubbon Park, Bengaluru, India (Source: Google)

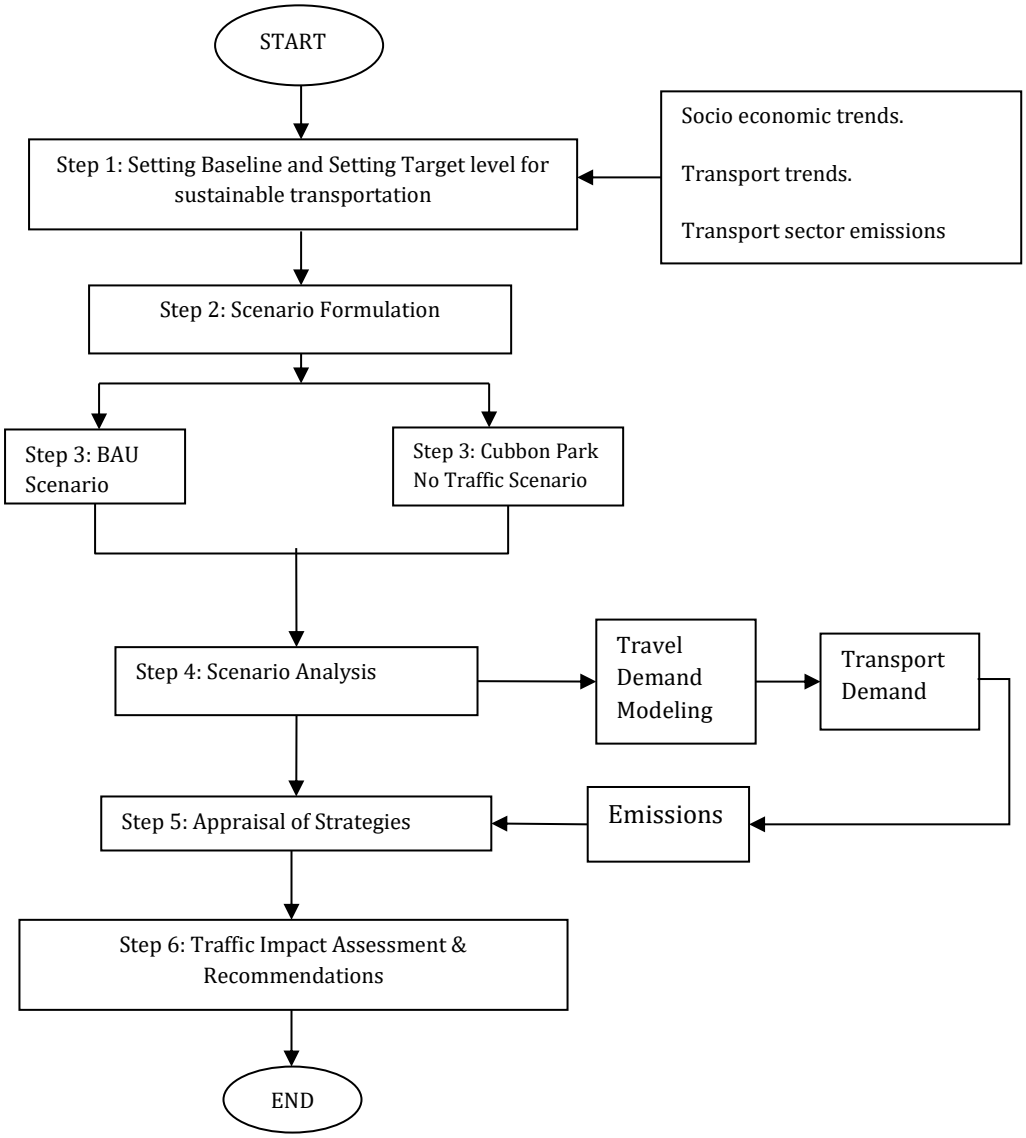

Figure-2: The Research Methodology

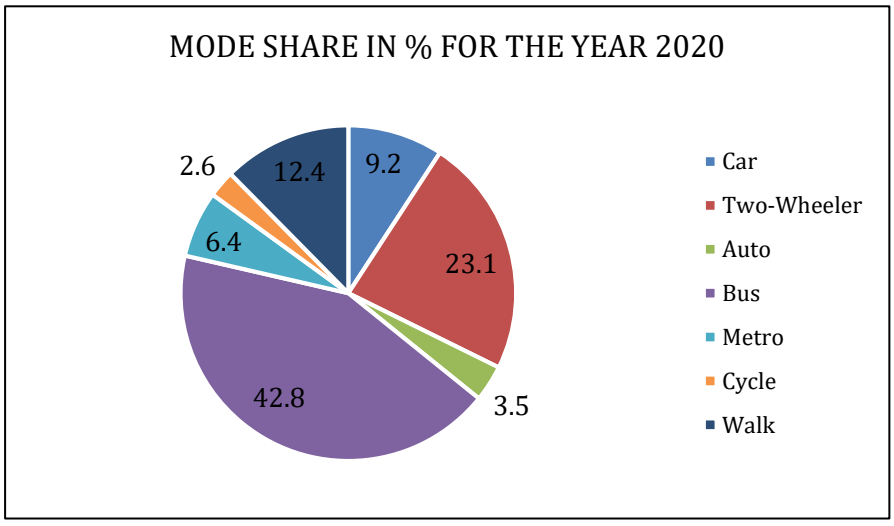

Figure 3. Model Estimated Modal Share for the year 2020

The Origin-Destination (OD) trips in the whole BMR are assigned to the road network using User Equilibrium Trip Assignment method and Vehicle kilometres travelled (VKT), Volume on links and volume/capacity ratio (V/C) are estimated. Under the User Equilibrium traffic assignment condition every user (in other words, traveller) choses route that minimizes his/her individual travel time or distance and will only increase it if they decide to change their path. Under the Cubbon park traffic ban scenario, many OD trip pairs will adjust their chosen route in such a way that the User Equilibrium state is reached again. This will then lead to changes in the traffic impact parameters that we are considering to study. While we also considered the impact on mode choice due to closure of Cubbon park for motorized traffic, the model estimates did not find any noticeable change in the current mode share, based on the current supply and state of different alternative modes like, public transport, walking, and cycling etc.

3. Result and Analysis

Figure-4 shows the total model estimated Vehicles kilometres travelled (VKT) under the two scenarios (BAU and CPNT). Also, Figure 5A and 5B shows the trip assignment result over the BMR network (darker links depicting higher congestion) under the BAU and CPNT scenario, respectively. From the results, it is very interesting to note that the Cubbon Park No-Traffic Scenario (CPNT) is actually resulting in the reduction in the total VKT over BMR network by 0.44% (from 32.08 million km per day in BAU to 31.94 million km per day in CPNT). The main reasons for such result could be that; in the revised user equilibrium under CPNT the travellers are re-adjusting their routes in a such a manner that it is resulting in overall reduction in the total VKT. This also means that in the BAU scenario when Cubbon park is open for traffic, some travellers who are passing through Cubbon park, end up taking longer route between their OD pair with the perception of avoiding traffic outside Cubbon park, which will then also result in higher total exhaust emissions from vehicles over the whole BMR network.

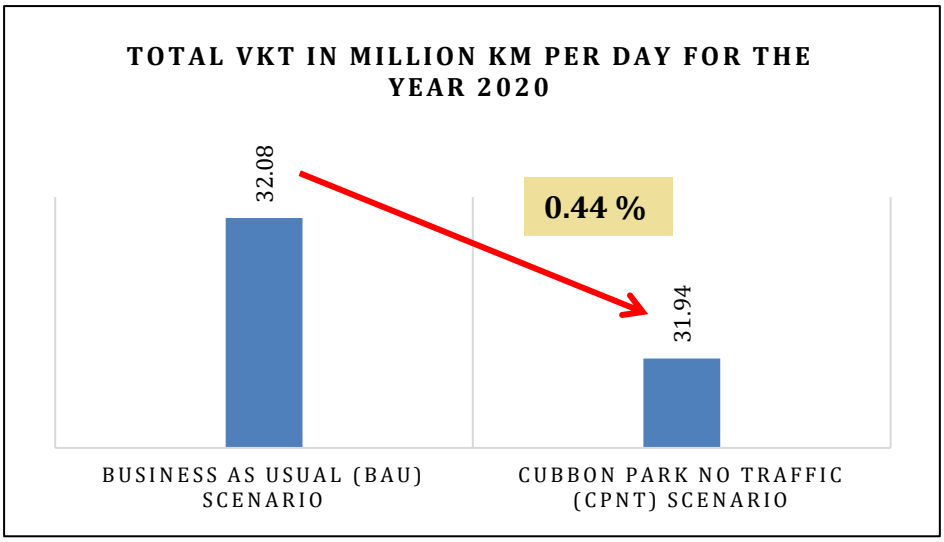

Figure 4. Total Vehicle Kilometres Travelled in 2020 for BAU and CPNT Scenarios

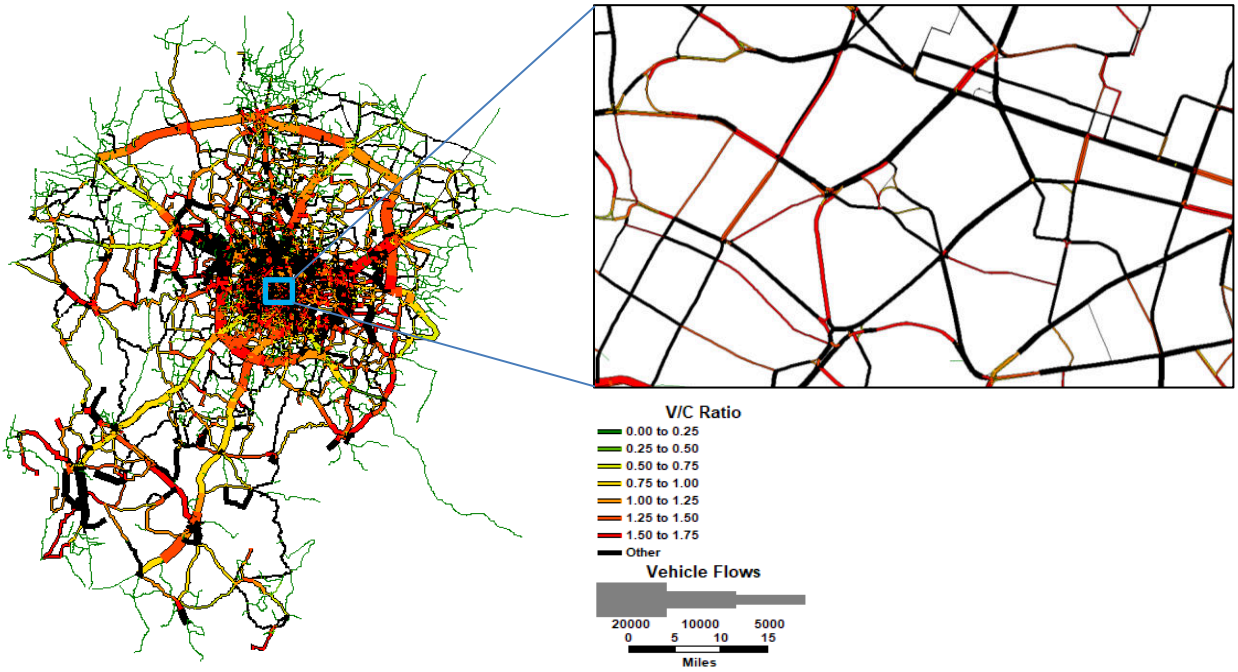

Figure 5A. Trip Assignment of Vehicles in 2020 for BAU Scenario

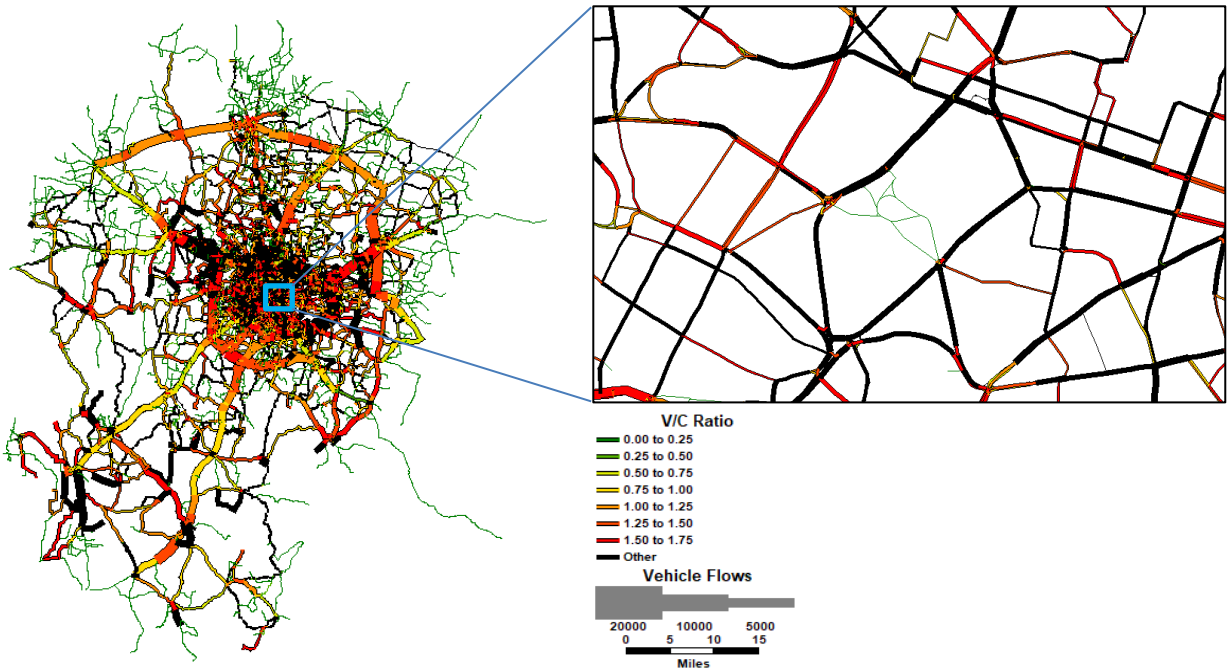

Figure 5B. Trip Assignment of Vehicles in 2020 for CPNT Scenario

To understand the traffic impact on the roads in the immediate vicinity of Cubbon park, the critical links on these adjoining roads around Cubbon Park were chosen to check the change in V/C for two scenarios. The same is shown in Table 1.

Table 1: V/C estimates in and around Cubbon Park

	V/C (Year 2020)	
Location	**BAU**	**CPNT**
Cubbon park road	1.54	NA
Dr. Ambedkar road	1.97	2.01
Nrupathunga road	1.68	1.83
Kasturba road	2.19	2.16
CK Jaffer Sharief road	1.7	1.84
Raj Bhavan road	2.35	2.64

From Table-1, it can be seen that the chosen roads are functioning at the worst Level of Service (LOS) "F" i.e. V/C ratio greater than 1, even under the BAU scenario. Further, it can be seen from the table that the CPNT scenario will result in incremental increase in the V/C ratio on all roads, except Kasturba Road which will see a slight decrease, which means that there is no major impact of traffic ban inside Cubbon park on these adjoining roads and they continue to function at worst LOS "F". In other words, there is no substantial reduction in traffic or improvement in V/C ratio and LOS on these adjoining roads even if allow Cubbon park to be opened for traffic. On the contrary, as indicated in Figure-4, the CNPT scenario will result in net reduction in VKT over the whole BMR.

Further this article tries to estimate the total exhaust emissions of CO_2 (Figure 6A & 6B) and $PM_{2.5}$ (Figure 7A & 7B) under each of the two scenarios. The emission factors are estimated

by Sharma et.al. 2018 based on World Energy Outlook report by IEA, 2015 and are reported in CLIMATRANS project report.

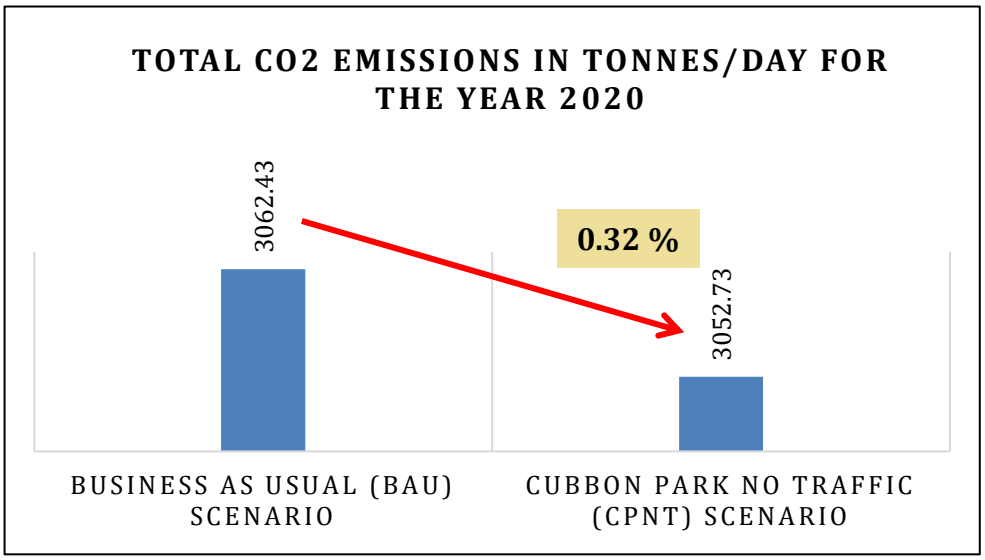

Figure 6A. Total CO_2 Emissions (Tonnes/Day) in 2020 for BAU and CPNT Scenarios

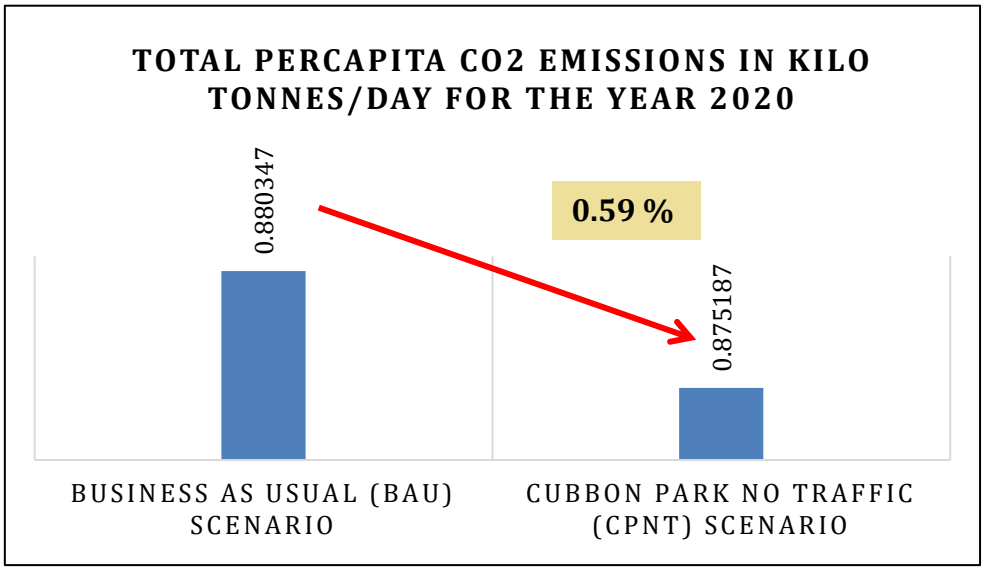

Figure 6B. Total Percapita CO_2 Emissions (Kilo tonnes/Day) in 2020 for BAU and CPNT Scenarios

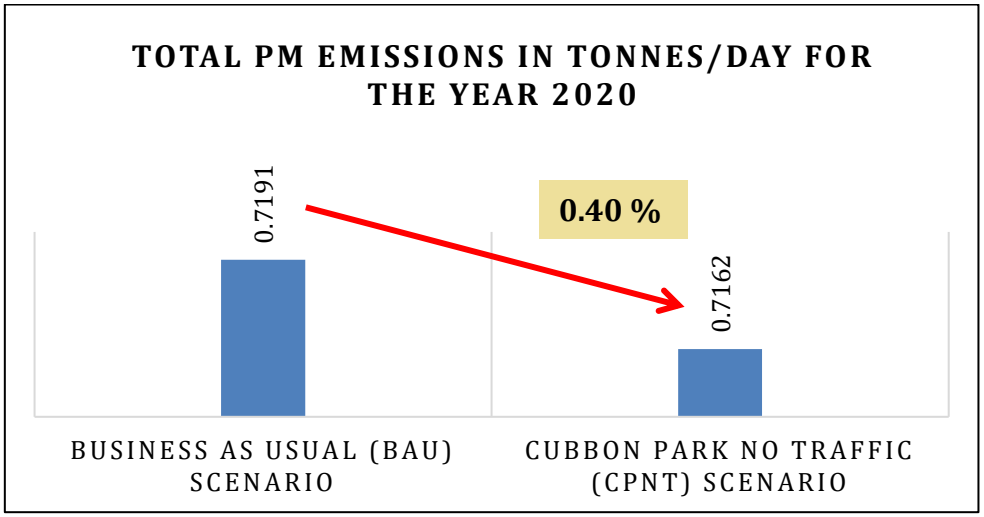

Figure 7A. Total $PM_{2.5}$ Emissions (Tonnes/Day) in 2020 for BAU and CPNT Scenarios

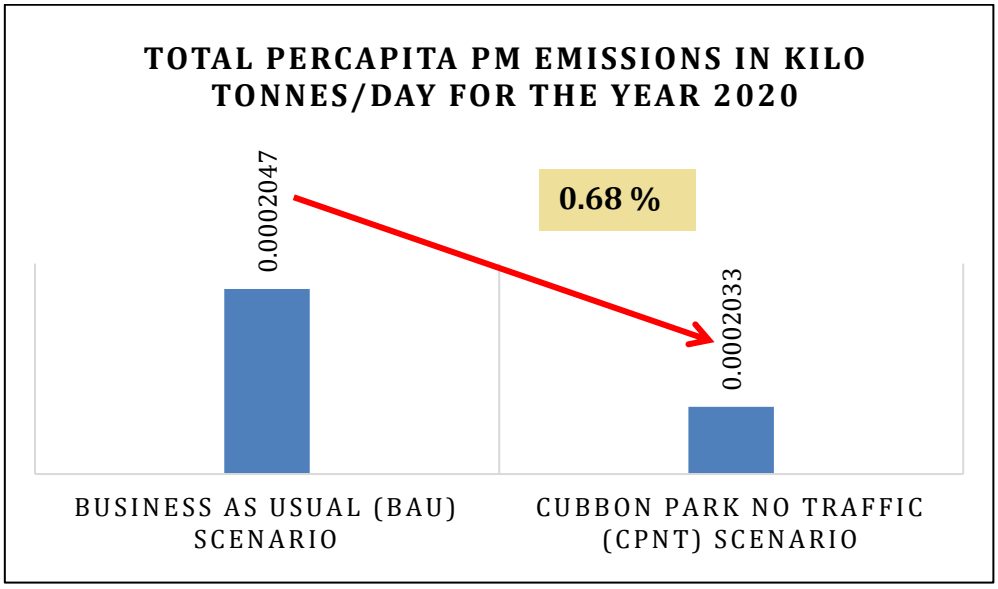

Figure 7B. Total Percapita $PM_{2.5}$ Emissions (Kilo tonnes/Day) in 2020 for BAU and CPNT Scenarios

It can be seen from Figure 6A & 6B, that under CPNT scenario (as compared to BAU), the CO_2 emissions over the BMR network will reduce by 0.32% in total and 0.59% in per capita. Similarly, from Figure 7A & 7B, it can be seen that the $PM_{2.5}$ emissions over the BMR network

will reduce by 0.41% in total and 1.33% in per capita under CPNT scenario. This shows that under the Cubbon park no traffic (CPNT) scenario there will be a net reduction in CO_2 and $PM_{2.5}$ as compared to when the traffic is allowed inside Cubbon park, which is due to net reduction in total VKT under the CPNT scenario.

4. Summary and Conclusions:

This technical article is an academic exercise done by the authors (not funded by any organization or individual) to assess the traffic and emission impact of banning motorized traffic through Cubbon park. The authors hope that this study will provide scientific decision support to the Govt. of Karnataka to take informed decision on such matters. The study uses a macro-simulation approach to understand these impacts over the whole BMR network by comparing Business as Usual (BAU) and Cubbon Park No Traffic (CPNT) scenario. The following are the main conclusions from the analysis of results: -

i. There will be a net reduction in total motorized VKT, under CPNT scenario, of 0.44% (from 32.08 million km per day in BAU to 31.94 million km per day in CPNT).
ii. There is no substantial reduction in traffic or improvement in V/C ratio and LOS observed on the roads adjoining Cubbon park even if the park is opened for traffic. These adjoining roads will continue to function at worst LOS "F". Therefore, opening of Cubbon park to traffic will not result in any noticeable gains on the roads surrounding it, whereas banning traffic through Cubbon park will help city preserve an important lung space and an ecologically sensitive area and will enable access to people across all walks of life to a socially vibrant and environment friendly space thereby improving the QoL of individuals.
iii. Under the Cubbon park no traffic scenario (CPNT) there will be a net reduction in CO_2 and $PM_{2.5}$ emissions as compared to when the traffic is allowed inside Cubbon park (BAU).

5. Recommendations:

i. Based on the modelling results and its analysis, the closure of Cubbon park to motorized traffic will result in net benefits in terms of overall VKT and emissions and will also lead to preservation of an important green and ecological space for the well-being of people and improvement in their QoL**. It is therefore, recommended to ban motorized traffic completely inside Cubbon park permanently**.
ii. The roads adjoining Cubbon park and elsewhere in CBD are already congested and functioning at worst LOS even if traffic is allowed inside Cubbon park. To mitigate this, the more permanent and sustainable measure is to strength and improve public transport (bus, metro etc.) network as well as LOS in the CBD area, which coupled with dis-incentivization of personal modes (cars and two wheelers) by measures like banning

traffic in Cubbon park, will induce mode shift towards more sustainable modes like public transport, walking, and cycling.

iii. Further, local and low-cost traffic management measures (junction improvements, one-way/two-way, traffic signal timings etc.) can be worked out for some immediate and short-term relief in roads adjoining Cubbon park.

iv. Since, there are existing institutions/organizations functioning inside the Cubbon park, banning traffic through park will result in some in-convenience to them in terms of commuting and accessibility. To mitigate these difficulties, the following are some recommendations:-

   a. A survey can be done in each of the existing institutions/organizations functioning inside the Cubbon park, to map and cluster the OD of their employees and visitors, understanding which, targeted improvements in bus and metro services connectivity can be done to make it easy for them to use public transport to reach Cubbon park.
   b. To improve the last mile connectivity to Cubbon park from nearby metro stations and bus stops, a service quality assessment of pedestrian and cycling facilities in and around Cubbon park can be done by DULT together with other concerned agencies. With the result of this assessment, targeted improvements in walking and cycling facilities can be done to improve last mile connectivity of public transport to Cubbon park (wider and good surface quality footpaths, cycles paths, cycle sharing systems with docking locations inside Cubbon park as well as nearby public transport stations and stops, electric micro-mobility options for last mile, electric rickshaws/carts inside Cubbon park to specially help elders and physically challenged etc.)
   c. Based on feasibility and without impacting the ecology of Cubbon park, underground parking with very limited capacity (say 1/3rd of existing parking demand) can be established at a convenient location for those still traveling by their own vehicles to reach Cubbon park. Providing only a limited parking capacity will ensure that we induce mode shift of majority of travellers coming to Cubbon park, towards public transport, walking and cycling.

v. A blueprint and long-term plan can be prepared to make Cubbon park a more socially vibrant space. Without impacting the environment and ecology of the park, the blue print can suggest ways to increase recreational activities and other forms of social engagements inside the park, which will also contribute to improvements in health and well being of people in the city.

Note

For the details of travel demand model and emission factors and specific solutions for Bengaluru on the above lines, please refer to the **CLIMATRANS** project report of IISc Bengaluru titled "**Sustainable Transport Measures for Liveable Bengaluru**". The same can be downloaded from the link below: -

http://civil.iisc.ernet.in/~ashishv/CLIMATRANS/CLIMATRANS%20-%20Full%20Report%20-%20February%202019.pdf