Estimation of carbon dioxide emissions from transportation sector in Udhampur (Jammu and Kashmir)

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Abstract: In most developing nations, the transportation industry is among the potential producers of carbon dioxide. As a result, assessment of CO_2 is critical for carbon management policies in the area. Data on fuel consumption by light and heavy transportations in Udhampur area of Jammu and Kashmir has been gathered for this research. The study solely examined fuel use by light and heavy transportations in union territory Jammu and Kashmir's Udhampur district. The carbon footprint was calculated using emission factor after the data was analyzed. The findings revealed that as the automobile numbers increased, resulting in increasing carbon dioxide emissions. The rising number of automobiles is responsible for increased carbon dioxide emissions and significant oil consumption, both of which contribute to global warming and excessive pollution.

Key Words: Carbon dioxide, Emission, Global warming, Pollution, Transportation

INTRODUCTION

As temperatures rise, so does the amount of precipitation and wind. Climate change is a long-term shift in weather patterns. The average annual surface temperature in India has risen by 0.4ºC, according to historical data, with little change in absolute rainfall. Rainfall, temperature, and water availability are all impacted by climate change in agriculturally susceptible locations (Pepin *et al*., 2022; Mall *et al*., 2006). Air pollution, excessive water consumption, deforestation, and sewage are just a few of the many variables that contribute to climate change. These changes have an impact on the number of greenhouse gases in the atmosphere. Human causes increase the atmospheric concentrations of greenhouse gases which have caused a major rise in Earth's surface temperature. It is carbon dioxide that accounts for about 77% of the total CO_2 equivalent greenhouse gas emissions worldwide. All 18 greenhouse gases have distinct global warming potentials, but under the Kyoto Protocol and the United Nations Framework Convention on Climate Change (UNFCCC), only these gases are considered for carbon accounting purposes.

The five greenhouse gases are carbon dioxide, methane, water vapor, nitrous oxide, and chlorofluorocarbons. This is the primary long-term climate change driver. About 60% of global warming is due to carbon dioxide emissions. Global warming is occurring because of the greenhouse effect being amplified throughout the globe (Zhang *et al*., 2011; Peterson *et al*., 1998; Tarmizi *et al*. 2019).

Carbon dioxide emission

1100.06 tonnes of CO_2 are released by the energy sector, which include electricity generation, transportation, commercial and institutional establishments, agriculture/fisheries, and energy-intensive industries such as petroleum refining and solid fuel manufacturing, as well as the use of biomass in the energy sector. Combustion of fossil fuels and cement industries are other major sources for emissions of carbon dioxide. Unquestionably, human activities have a negative influence on the climate and climate systems. When it comes to the economic growth of India, the climate has a crucial impact (Novak Mavar *et al*., 2021; Shahsavari *et al*., 2018; Mikulčić *et al*., 2019).

Transportation sector contributions to carbon dioxide emissions

The emissions from the transportation industry include those from road transportation, airplanes, railroads, and navigation. The transportation industry generated CO_2 emissions of 142.04 million tonnes. Road transportation accounted for 87 % of total CO_2 emissions, while air transportation accounted for just 7 %. The remaining 5 % is released by the railway industry, and 1 % is emitted by the shipping sector (Akbostancı *et al*., 2018; Talbi 2017).

According to the International Energy Agency (IEA), most recent estimates, the transportation industry is responsible for 23% of global carbon dioxide emissions. Worldwide, road transportation accounts for the greatest proportion of greenhouse gas emissions. In India, the transportation industry generates an approximate 258.10 Tg out of CO_2 from which 94.5 % is attributed to road transportation. In 2005-06, India's transportation industry used 16.9% of total energy (or 936.5 million metric tons of oil equivalents) (Hong et al. 2016). Energy is obtained from a variety of sources in these industries, including coal and diesel, as well as petroleum (gasoline). Emissions from roads, rails, and planes account for 80%, 13%, and 6%, respectively. About 60 % of India's GHG emissions come from vehicle emissions (Lin *et al*., 2017).

The main aim of this research paper is to evaluate the carbon dioxide emissions from the transportation sector based on the distance traveled by the vehicle and an increasing number of transportations in the district Udhampur province of J&K.

METHODOLOGY

The research was limited to collecting data on the fuel usage of heavy and light vehicles in Udhampur district of the Jammu and Kashmir Union Territory. Personal questionnaires and interviews were used to gather data on daily use of fuel, the health of people, and the number of registered cars. The data was then analyzed, and the carbon footprint was determined using the emission factor.

Study Area

The respondents mainly drivers of the vehicles were selected for the study from Udhampur province of J&K. Drivers of both heavy and light vehicles were interviewed at Udhampur city in Jammu province. Matadors are the main source of public transport within Udhampur city. The drivers of matadors were also interviewed from various locations in and around Udhampur city.

Collection of Data

Data was collected through survey to determine the CO_2 emissions of fuel expenditure in heavy and light cars, a database of emissions, daily intake of gasoline. The respondents themselves provided the information for this study. On the MS-EXCEL sheets, the collected data were compiled and then examined. The respondents' ages, driving experience, the average distance traveled, fuel usage, and other statistics were gathered as well.

Evaluation of Carbon dioxide emission

The entire quantity of carbon dioxide and other GHG emissions for which a person, organization, or event is accountable is usually referred to as one's carbon footprint. It may be roughly described as a measure of greenhouse gas emissions that are directly and indirectly induced by activity or are accumulated during the life stages of a product or service, represented in carbon dioxide equivalents Chandler *et al*., (2002). Emissions are shown as the number of greenhouse gases converted into CO_2 equivalents to display all emissions in a single phrase, the equivalent of CO_2. The CO_2 emission factors stated by Bhoyar et al. (2014) were used to determine the fuel consumption's CO_2 equivalent emission factors.

Statistical analysis

The MS-Excel spreadsheet was used to represent the information. The standard deviation was used for data analysis and finding the correlation between mean values.

RESULT AND DISCUSSION

Vehicle growth in J&K

Data from car registrations showed a significant rise in the number of vehicles registered during the last 10 years. Vehicle growth was unexpectedly high, according to the statistics. 737,557 automobiles were on the road in 2010, but that number is estimated to be 2,245,820 by 2021 as shown in fig.2. In 2021, there will be a total of 9,234, 21,358, and 61,293 heavy vehicles, light vehicles, and two-wheelers, as indicated in fig.3. The rising number of automobiles is a significant source of "carbon emissions.". Congestion and traffic irregularities in the region have been identified by Humayan et al. concluded that as a major issue for commuters and passengers alike. A solution is needed to help people save time and money. Analyzing the previously mentioned methodologies, their research aimed to establish a suitable strategy for imposing and developing in the designated area of interest. Consideration was given to regional travel difficulties while designing this ID. Growth in the neighborhood is slowed by several issues, such as traffic congestion, pollution, crime, and the natural environment. Commuting to and from work is becoming more difficult for many people due to the congestion and inconsistency of traffic in the region.

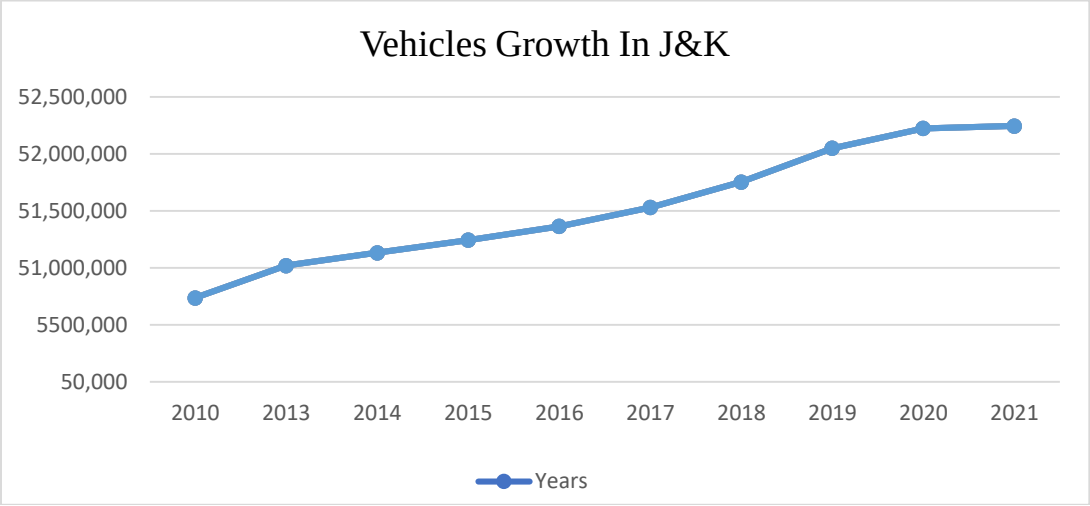

Figure 1: Vehicle growth in Jammu & Kashmir

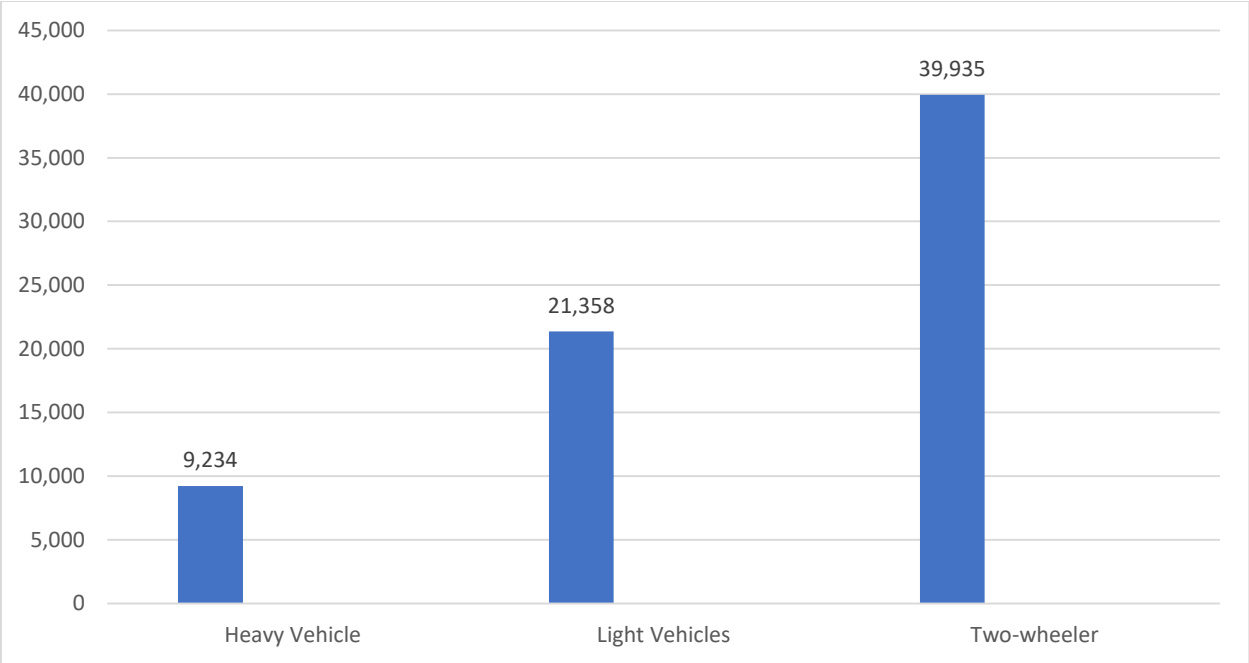

Figure 2: Vehicles registration in 2021 in Jammu & Kashmir

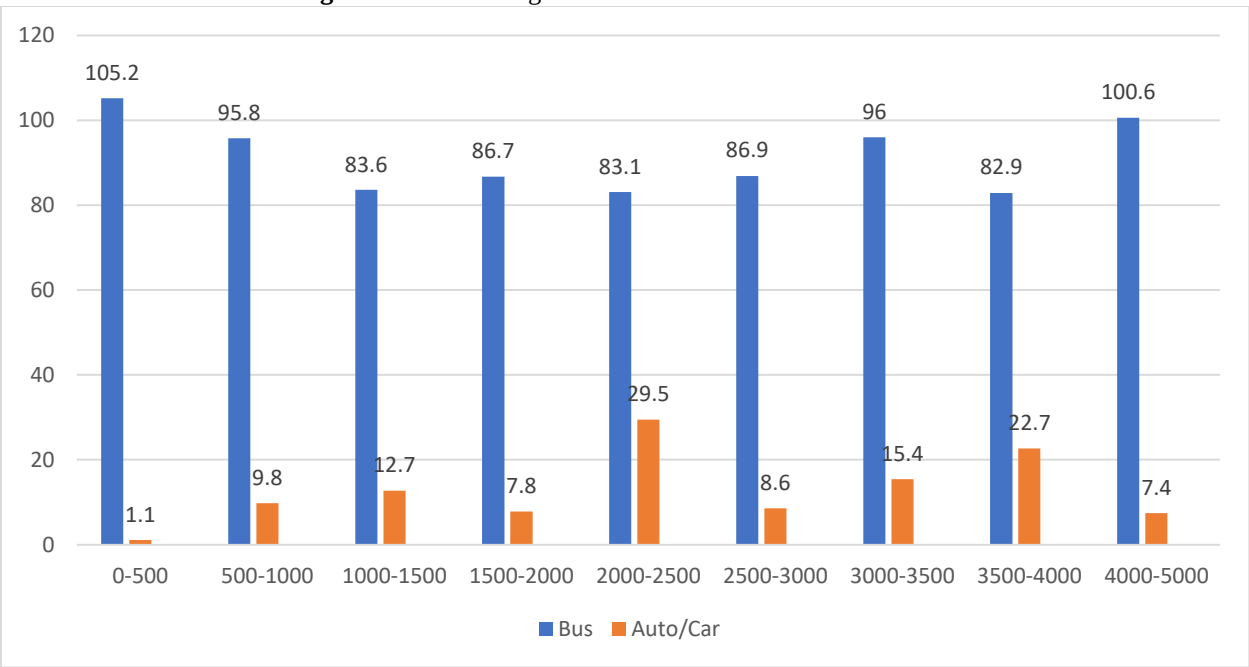

Figure 3. Average distance travelled by bus and auto/car

Carbon Emission in Jammu & Kashmir

There are nine categories based on the total distance traveled by pilgrims to Jammu and Kashmir, and the averages of these characteristics are shown in table 1. As per data, the average distance traveled by bus was 105.2, 95.8, 83.6, 86.7, 83.1, 86.9, 96.0, and 82.9 km and while the average distance traveled by car was 1.1, 9.8, 12.7, 7.8, 29.5,8.6,15.4, 22.7 and 7.4 km as shown Fig. 3. The average carbon emission in the categories 1 to 9 by bus was 9.6, 9, 7, 7.4, 8.1, 8.8, 8.5, 7.9, and 10 CO_2e respectively. The average carbon emission in the categories 1 to 9 by car is 0.1, 2.0, 2.3, 1.4, 4.9, 1.0, 2.7, 4.8, and 1.3CO_2e respectively as shown fig. 4. The highest number of carbon emissions by bus is seen in the category 1 and 9 i.e., 9.6 and 10CO_2e respectively while the lowest number of carbon emissions by bus is seen in the category 3 and 4 i.e., 7 and 7.4CO_2e respectively. The highest number of carbon emissions by auto/car was seen in the categories 5 and 3 i.e., 4.9 and 4.8 CO_2e respectively while the lowest number of carbon emissions by auto/car is seen in the category 1 and 6 i.e., 0.1 and 1.0 CO_2e respectively.

Ajit *et al.*, (2017) stated that existing agroforestry systems (AFS) have a carbon sequestration capacity of 0.88 Mg C ha-1 yr-1 for all three pools (trees, crops, and soils) working together. According to the state's estimates, AFS at the district level may offset all greenhouse gas emissions from the agriculture/irrigation sector in Jammu and Kashmir due to power consumption of 146,996 tonnes of CO_2 equivalent each year.

Table 1: Average distance travelled by respondents through bus and auto/cars and their equivalent CO_2 emissions

Category	**Distance (in km)**	**Average Distance Travelled**		**Average Carbon Emission (in g CO_2e)**	
		Bus	Auto/Car	Bus	Auto/Car
1	0-500	105.2	1.1	9.6	0.1

2	500-1000	95.8	9.8	9	2.0
3	1000-1500	83.6	12.7	7	2.3
4	1500-2000	86.7	7.8	7.4	1.4
5	2000-2500	83.1	29.5	8.1	4.9
6	2500-3000	86.9	08.6	8.8	1.0
7	3000-3500	96.0	15.4	8.5	2.7
8	3500-4000	82.9	22.7	7.9	4.8
9	4000-5000	100.6	7.4	10	1.3

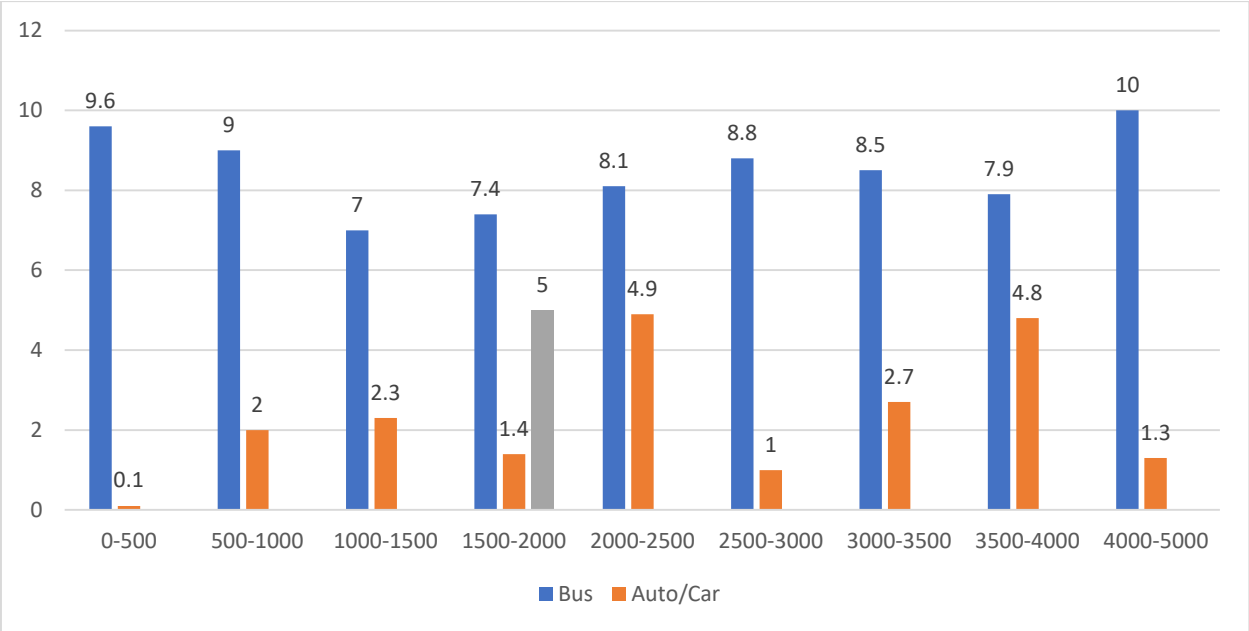

Figure 4: Average Carbon Emission

A single 26-kilometer stretch of road emits 601,333 kg (6.01 lakh kg) of CO_2 per year, which is expected to increase by a factor of 100 in the next six years, despite the introduction of Bharat Stage (BS) VI emission standards for all major on-road vehicle categories in India. Traffic is expected to double by the year 2027.Wang et al. (2016) results showed that using roadside or pursued vehicle measurements are substantially lower than those from the BC EFs. The sample stream has a 13% negative bias on average. Because they are less prone to fluctuate over time, the exhaust pipes of gasoline-powered vehicles provide excellent sites for monitoring ambient BC concentrations. S. Zhang et al. (2021) revealed that the increased emission standards and the early retirement of older heavy-duty diesel vehicles have the greatest influence on reducing BC emissions. Because BC has a shorter life expectancy than CO_2, reducing BC emissions offers a substantial opportunity to reduce global warming in the near future. In 20 years, Scenario PC3 may cut CO_2 equivalent emissions by 234.2 million tons, which would lower China's transportation sector oil consumption by almost 20% from a climate impact viewpoint if implemented.

Table 2: Calculation of CO_2 emission in kg for one year

Type of Vehicle	**Per day**	**Per month**	**No. of vehicle/year**	**Mileage on stretch km/litre**	**Fuel consumed in the stretch in one year**	**Emission of CO_2 (kg)**
Car/Jeep	84	2,520	30,240	14	58,700	155,467
Bus	35	1,050	12,600	3	98,400	270,521
Minibus	22	660	7,920	5	30,275	79,155
Trucks	46	1,380	16,560	4	27,960	70,498
Auto Rikshaw	12	360	4,320	25	2,920	7,815
Two-wheeler	49	1,470	17,640	50	7,580	17,877
Total	248	7,440	89,280	101	225,835	601,333

CONCLUSION

We conclude that the rising number of automobiles is responsible for the release of carbon dioxide and the significant amount of fuel used, because of which fossil fuels are depleting. The growing amount of carbon dioxide in the atmosphere has also harmed the natural beauty of Jammu and Kashmir. Carbon dioxide emissions also have an impact on human health since they have been linked to the development of major illnesses in the body. Additionally, it contributes to pollution in the valley. To slow down global warming in the long run, we must reduce carbon emissions soon. We should follow simple norms like using bicycles for traveling shorter distances, the buses may be replaced with zero-emission buses, which will result in a reduction in carbon emissions, use ofthe odd-even rule when it comes to the automobiles. Apart from this, certain new technological advancements are necessary for the reduction of carbon emissions, to protect the flora and fauna of the Union Territory of Jammu and Kashmir.

ACKNOWLEDGEMENTS
Author is thankful to Er. Gaurav Tiwari, Pro-Chancellor and Prof. Arun K. Pandey, Vice Chancellor, Mansarovar Global University, Sehore for encouragement and facilities.

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