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# Comparing Energy Consumption of Urban and Rural Dwellers of India through the Measurement of Carbon Footprint

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**ABSTRACT:** Scientists and activists have been warning the masses about the deleterious effects of climate change. With economic transformation, development, and increased standards of living, people are generating massive carbon footprints as a consequence of excessive consumption of energy. The literature is filled with the documentation of the impacts of energy consumption on climate change which have been manifested through cyclones, wildfires, flooding, reduction in the number of resources, etc. India is a developing country wherein urbanization is gaining a stronger grip in its cities. Moreover, with the recent events of massive cyclones, and cases of flooding in the country, it has become important to understand how people's energy consumption has been impacting climate change. Intending to understand the same, the present study estimates the difference between the impact and degree of climate change caused by rural and urban people on the environment. This was done by calculating and comparing the carbon footprints of 30 urban and 30 rural dwellers in India. The results found that the average carbon footprint of urban dwellers is roughly 8 times the average carbon footprint of rural dwellers. In the last section of the paper, certain ways to reduce the carbon footprint have been suggested.

**KEYWORDS:** carbon footprint, climate change, urbanization, urban and rural living, energy consumption.

## I. INTRODUCTION

It is well established that urban dwellers consume more energy resources than rural dwellers. Their lifestyles are more 'luxurious' than that of rural dwellers as they ride fancier cars, spend more money on transport, shopping, eating out, travelling, etc. However, this 'luxurious' lifestyle has an adverse impact on the environment which goes unnoticed by most people as they do not realize that they are causing it. The problem is only becoming bigger and has far-reaching and irreversible consequences. Consumption of energy resources is directly related to climate change, and therefore higher consumption of energy resources leads to more climate change. The rise in the global sea levels, stronger hurricanes, changes in precipitation patterns, longer frost-free seasons is all a result of the excess consumption of energy.

Therefore, intending to understand more about the difference between the degree of climate change caused by rural and urban households in India, a survey was conducted to estimate the difference between the impact and degree of climate change caused by rural and urban people on the environment. This was done by calculating and comparing the carbon footprints of 30 urban and 30 rural dwellers in India.

## II. BACKGROUND OF THE PROBLEM

Last year, on 16 May 2020, the Amphan cyclone hit the north-eastern states of India, including West Bengal, Kolkata, and Odisha. There were millions of people who were widely hit by this cyclone. Moreover, it hit a large number of villages in which the houses were made with readily available material like wood, stones, mud, leaves, thatch, or crop residue. There was a possibility that these houses would not be able to withstand the strong winds and would get swayed away with it. The devastation that had occurred in Bengal and stories of some of the people who got impacted by it have been a major reason behind the present study in order to understand more about cyclones, their causes, types, and impacts.



A direct relationship exists between climate change and these cyclones. Climate change increases the surface temperature of the oceans which makes the cyclones stronger and deadlier. Scientists from the National Oceanic and Atmospheric Administration (NOAA) and Princeton University in the United States conclude that there could be a five percent increase in maximum cyclonic wind speeds if the world warmed by two degrees Celsius by 2100 (Sangomla, 2021).

With this background, it is imperative to explore the effect on the environment by urban and rural dwellers. Moreover, it can be hypothesized here that the urban dwellers contribute more to climate change as compared to the rural dwellers as the resources required for everyday life are more for urban living as compared to rural dwellers.

### III. CARBON FOOTPRINT: WHY IS IT A THREAT TO THE ENVIRONMENT?

The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that are directly and indirectly caused by an activity or is accumulated over the life stages of a product. In other words, a person's carbon footprint measures the total amount of carbon emissions he/she is responsible for creating (Wiedmann & Minx, 2007). The larger the carbon footprint, the more undesirable emissions are released, the more climate change occurs. Large carbon footprints exploit natural resources on both large and small scales, from a country's deforestation activities to one home's increased use of air conditioning. All of these have a negative impact on the environment, which, in turn, have a negative impact on us. A number of studies have explored carbon footprint and its threat to the environment (Adams & Nsiah, 2019; Bailis et al., 2015; Hammond, 2007; Hertwich & Peters, 2009; Pandey et al., 2011; Rehman et al., 2019; Schmalensee et al., 1998; Weidema et al., 2008).

The following examples show the harmful effects of climate change (Mehrotra, 2021).

1. Cyclone Amphan: 16 May 2020, the Amphan cyclone hit the northeastern states of India, including West Bengal, Kolkata, and Odisha. The cyclone is said to have caused at least \$13 billion worth of damage, making it the costliest cyclone ever in the North Indian ocean. Approximately 118 people lost their lives during the cyclone. It was the fourth super cyclone and the strongest one to hit West Bengal since 1582.
2. 2021 Uttarakhand floods in Nanda Devi Park: It is believed to have been caused by a landslide or a glacier burst. The result was the flooding of the Chamoli district. At least 36 people were reported dead, while 170 are still missing.
3. Australian bushfires: From September 2019 to March 2020, the fires heavily impacted various parts of New South Wales. The fires had burnt an approximate area of 18.6 million hectares and killed 34 people. Some endangered species were believed to have been driven towards extinction, while billions of terrestrial vertebrates were affected. While at its peak, the air quality in the southern and eastern states dropped to hazardous levels.
4. California wildfires: A combination of causes like increased warming due to climate change, wind conditions, and years of fire suppression led to the California wildfires of 2020. By the end of the year, approximately 9,639 fires had burnt 43,97,809 acres of forest area, making 2020 the largest wildfire season in California's modern history.

### IV. URBANISATION IS LEADING TO MORE CLIMATE CHANGE

People migrate from rural areas to cities in hope of gaining a better standard of living: better employment and education opportunities, better health, and greater access to social services and opportunities for social and cultural activities. This rural to urban migration results in pollution, overcrowding, and poor sanitization, which makes the Earth more vulnerable to natural and human-made disasters. In addition, Urban dwellers tend to have higher levels of consumption of food and energy than those people living in rural areas, and as more people migrate from rural to urban areas, their consumption of resources increases. This naturally puts more strain on the usage of natural resources – which would eventually cease to exist in supply as it is a diminishing resource (Shamasundri, 2017).

Satterthwaite (2008) reported that the climate change impact on urban areas as a result of urbanization can be noticed through the increased occurrences of flooding, storms, sea-level rise in coastal areas, constraints on water supplies, and



other key resources, and higher temperature and heatwaves. The increasing temperature which results in heat stress which has been noted as the leading cause of weather-related human mortality both in the urban and rural contexts has been reported by Oleson et al. (2015). Through a literature review approach, Garschagen& Romero-Lankao (2015) found that urbanization has nuanced effects on the overall vulnerability towards climate change as countries with rapid urbanization and economic transformation are presented with significant challenges when it comes to their sensitivity and lack of capacities, however, the urbanized nations also have the ability to enhance response capacity. Another systematic review of scientific articles from January 2000 to May 2016 was done by Chapman et al. (2017) who identified an increased focus on research on the impact of urban growth on urban heat islands, heat stress, and the impact of urban density on anthropogenic heat.

#### V. METHODOLOGY

To understand more about the difference between the degree of climate change caused by rural and urban people of India, a survey was conducted to calculate the carbon footprints of 30 rural dwellers and 30 urban dwellers from India. The data was collected via google forms for urban dwellers and hard copies of the same form were used for rural dwellers. The data collected was then put in an online calculator, which contained various parameters like housing, transport, travelling, secondary goods, etc. The results of the same are discussed in the next section.

#### VI. RESULTS

The following tables contain the calculated carbon footprints of the sample.

Serial number	Monthly carbon footprint (in metric tons of CO <sub>2</sub> )	
	URBAN DWELLERS	RURAL DWELLERS
1	6.5	0.22
2	7.2	0.21
3	11	0.34
4	21.43	1.28
5	7	0.56
6	28	0.53
7	4.59	0.98
8	4.28	1.35
9	5.10	0.13
10	5.10	1.37
11	4.22	0.91
12	2.58	0.76
13	5.91	0.15
14	1.42	0.09
15	7.08	0.46
16	5.30	0.72
17	1.49	1.39



18	2.15	2.27
19	9.9	1.18
20	8.20	1.51
21	7.42	0.60
22	1.36	0.44
23	7.79	0.59
24	4.39	1.06
25	17.29	1.36
26	4.58	0.77
27	3.54	0.62
28	4.51	1.20
29	6.27	1.42
30	3.44	1.21
Average carbon footprint	6.96 metric tons of CO <sub>2</sub>	0.82 metric tons of CO <sub>2</sub>

From the above data, it can be readily noted that the average carbon footprint of an urban dweller is 6.96 metric tons of CO<sub>2</sub>, and the average carbon footprint of a rural dweller is 0.82 metric tons of CO<sub>2</sub>. Hence, the average carbon footprint of urban dwellers is roughly 8 times the average carbon footprint of rural dwellers making the ratio stand at 8:1. This ratio is unmistakably large, and this also confirms our hypothesis that urban dwellers consume a lot more energy resources as compared to rural dwellers.

#### VII. REDUCING YOUR CARBON FOOTPRINT

In order to hold the global temperature, rise to 2°C or less, everyone on earth will need to maintain on average an annual carbon footprint of 1.87 tons by 2050 (Sangomla, 2021). From the analysis done above, the Indian urban level is about three times this required level. Therefore, there is a pressing need for urban dwellers in India to work towards minimizing their carbon footprints.

In the following points, we have suggested a few easy changes that one can make in one day-to-day life that will reduce one's impact on the environment (Cho, 2018; Albeck-Ripka, n.d.).

1. Eating less meat: A total of 14.5% of manmade greenhouse gas emissions are contributed only by meat and dairy products. If a person refrains from eating meat daily, they will become successful in reducing their carbon footprint by a total of 8 pounds.
2. Shopping sustainably: The fast fashion industry contributes a massive amount of carbon footprint as the cheap items which quickly go out of style are dumped in landfills to decompose which results in the production of methane. Hence, everyone must take personal responsibility in only shopping and supporting companies and brands that are environmentally responsible, mindful, and sustainable. Another small step towards sustainable shopping is carrying one's own reusable bag and skipping the plastic packaging material.
3. Avoiding flying: One of the biggest single sources of greenhouse gas emissions each year is air travel. Hence by avoiding travel by air, people can help in the reduction of their carbon footprint.
4. Driving less: People are aware of a large amount of emission dissipated as a result of driving. Therefore, whenever possible instead of driving, people must try taking public transportation, carpool, or rideshares to reach their destination.



5. Switching to renewable energy resources: Using renewable energy sources (like solar panels, electric cars, etc.) is a great way of using energy sources without damaging the environment. Moreover, they'll never cease to exist.

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