

ONE STEP IN CARBON FOOTPRINT, ONE STEP BEHIND IN THE SUSTAINABLE DEVELOPMENT OF INDIA

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ABSTRACT

India's population is multiplying at a staggering pace and is expected to become the world's most populous country by 2025. As stated in Fisher's lecture, when developing countries grow parallelly in both, population, and income; they tend to degrade the environment. Carbon footprint is signified as the biggest obstacle for achieving sustainable development. For every step that we progress in sustainable development, one ecological footprint can take us back to start. Based on the "National Footprints Account Research" 2014, India is a "Biocapacity Debtor". Carbon footprint reveals the amount of carbon emitted by an activity or an organization. The rate of increase of carbon dioxide emissions is more than every other major energy consuming country. Although India has set ambitious targets on renewable energy, most likely it will fail to accomplish them. If we continue to utilise the resources in the same way, by 2030, even two earths will not meet our needs. This study will elucidate on the correlation between different income groups (based on World Bank's classification) of the country's population to their respective carbon footprint along with its causes, consequences and measures for the same. The carbon footprint of a household increases with its income, from 19.3 to 91.5 tons of CO₂ per annum which occurs due to striking changes in lifestyle. Two surveys have been carried out: Study 1: Income based Carbon Footprint- A study was done by carrying out sample surveys of the various income groups, hence calculating and interpreting their carbon footprint. Study 2: Student Survey-To understand the awareness of the current generation regarding carbon emissions, a sample survey was carried out among 115 students across different colleges and schools in India regarding their daily lifestyle decisions. These studies highlight on how individual's small yet crucial steps and giant leaps by industries, higher income strata and the government can prove to be reformative.

Keywords: *Carbon Footprint, Sustainable Development, Environment Pollution*

INTRODUCTION

Climate change and Global warming are consequential threats in the attainment of Sustainable Development Goals (SDGs) and calls for immediate global response. It is believed that unless urgent actions are undertaken to reduce pollution, the universe would fall prey to an environmental catastrophe. (Stern, 2007). The Global Footprint Network says our ecological demands have exceeded the productive capacity of our planet (Ewing *et al.*, 2010).

India stands as the second most populous country and fourth largest growing economy with a cosmic growth rate of 7.6% (Shukla, 2017). India is the second largest energy consumer in the world and energy consumption will intensify with the growing population (U.S. Energy Information Administration, 2018). India is vulnerable to climate change as a huge population depends on agriculture and forestry for their livelihood. Any impact on these sectors would negate government initiatives to reduce poverty and sustainable livelihood, because it is hugely dependent on natural resources (Boutabba, 2013) India has a commitment to accomplish the Sustainable Development Goals (SDGs) by 2030. These include quality education for the citizens, access to energy and other resources and ensuring a clean environment. Developing countries like India have the determination to follow the path of economic development. However, this causes immense environmental damage. The significant challenge lies in achieving economic development without stimulating ecological footprints.

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Carbon Footprint

The term carbon footprint refers to the level of greenhouse gases emitted due to an activity. It is often stated as the amount of carbon dioxide generated by functions such as manufacturing and consumption of goods and services. A carbon footprint encompasses coal, oil, natural gas, nuclear power, and renewables in addition to greenhouse gas emissions. “The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product” (Andrews *et al.*, 2013).

An Individual’s Contribution

An individual’s carbon footprint is based on recreation, methods of commuting, styles of work and knowledge about the environment. A consumer can make a responsible choice in their selection of goods and services. Ethical consumption is one possible way to reduce carbon footprints. Individuals could take a variety of steps to reduce their footprint.

Study 1- Income Based Carbon Footprint

Methodology

A survey was conducted among 60 households to calculate their respective carbon footprint. Based on the World Bank classification, these households were classified into three groups-

- X1-Lower Income group (Below Rs. 72,929 annually);
- X2-Middle Income group (Rs. 73,020 to Rs. 880,728 annually);
- X3- High Income group (Above Rs. 880,799 annually).

The survey had 13 questions based on their daily lifestyle such as- type of housing, size of housing, usage of clean energy, mode of transportation, type of regular diet, number of flight trips made and the total number of days stayed in a hotel. Additionally, they were asked a few questions to assess their knowledge on the environment such as- carpooling on a regular basis, bursting of crackers, usage of energy saving devices and awareness on buying environment friendly products. The amount of annual carbon emissions of various households is represented in Table 1.

Table 1: Annual Carbon footprints of the households in tonnes

Number of participants	Lower Income group (X1)	Middle Income group (X2)	High Income group (X3)
1	40.57	47.97	50.73
2	40.80	32.14	37.46
3	18.73	34.3	46.49
4	31.89	36.27	47.54
5	34.96	32.41	39.97
6	14.61	46.50	90.87
7	31.00	54.64	58.95
8	31.88	45.90	36.97
9	28.03	52.28	42.30
10	23.23	43.95	40.52
11	19.16	26.19	43.74
12	21.56	32.39	40.07
13	36.80	43.03	83.40
14	12.73	46.08	29.44
15	21.74	44.10	36.72
16	35.59	39.60	29.44
17	14.60	35.61	36.72
18	12.67	47.78	28.04
19	36.87	45.80	35.60
20	24.64	32.29	44
<i>Arithmetic Mean</i>	26.603	40.9615	44. 9485

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The Arithmetic Mean (shown in Table 1) of each income group was calculated using the following formulae:

Lower Income group: $\sum X1/20$

Middle Income group: $\sum X2/20$

High Income group: $\sum X3/20$

Environmental Kuznets Curve Analysis

Figure 1 is an Environmental Kuznets Curve, representing the average carbon footprints of low, middle- and high-income groups. The upward slope of the graph implies that carbon footprint increases with an increase in income

Environmental Kuznets Curve (EKC) is generally an inverted U-shaped curve representing the relationship between environmental degradation and per-capita income. (Stern *et al.*, 1996) At low levels of development, the quantity and intensity of environmental damage is limited to subsistent economic activity. As the economy develops, urbanization and industrialization accelerate environmental degradation and it exceeds rational levels. At higher levels, structural changes to services coupled with environmental awareness, better regulations, environmental expenditure leads to the gradual decline of environmental degradation (Panayotou, 1993)

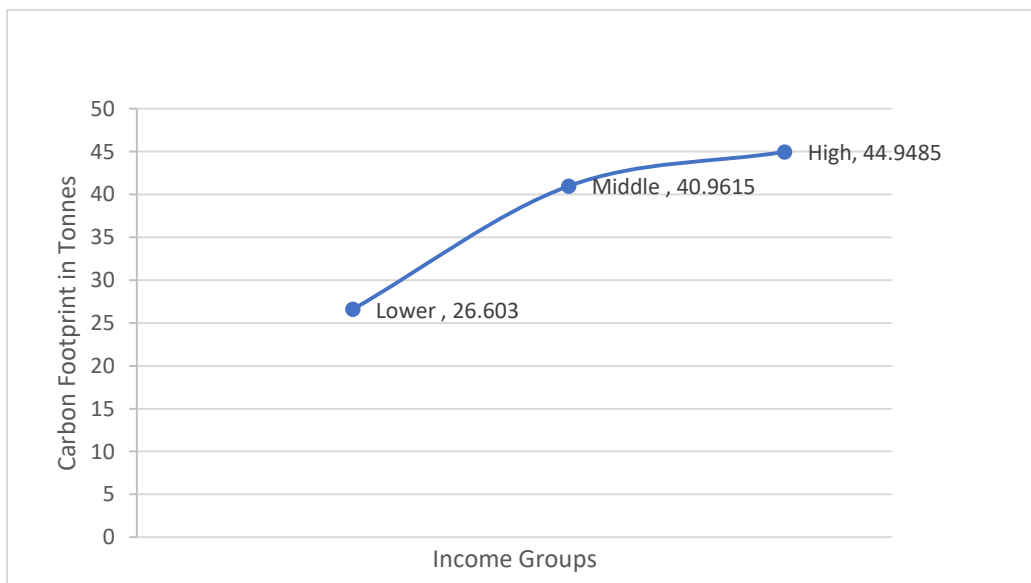


Figure 1: Graphical Representation of Annual Average Carbon Footprint(in tonnes) of the corresponding income group- as per survey results

According to World Development Report 1992, the factors that play an important role in determining the environmental impact per unit of economic activity are: structure of economy, substituting away from products becoming scarce and clean & efficient technology. The analysis of the World development report 1992 shows that economic growth alone is not the solution to all environmental problems. It emphasised on the importance of policies to protect the environment. Major policy adjustments need to be made to move the global economy towards the sustainable development path (Stern *et al.*, 1996).

Interpretation

The carbon footprints of each group is being analysed as follows:

1. Low Income group: Majority of the lower income group participants chose public transport or walking as their method of commuting. They have a small size of housing (under 500 square feet) and do

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not travel by flights. These reasons have considerably reduced their footprint. However, they make these decisions due to the lack of access to these facilities. It was observed that majority of them bursting crackers during Diwali, the festival of light. They do not have adequate knowledge on environmental conservation. They should be educated on the same, so that they could make more conscious decisions.

2. Middle Income group: The participants of this income group alternated between public as well as private transportation. Their size of housing was considerably bigger (around 500-1500 square feet). They made few flight trips in a year (ranging 1-5).

3. High Income group: These participants mostly used only private modes of transportation. Their housing size was comparatively huger (mostly above 1500 square feet). Many flight trips were made by them (while few participants exceeded 20 flight trips annually).

It was observed that the carbon footprints fluctuated even within each of the group due to varied personal decisions. The main reasons being type of diet followed (meat lovers, vegetarian or vegan); family size and habits of recycling. The participants of the survey who chose a vegetarian diet over meat could reduce their annual carbon emissions by 4.8 tonnes. The following decisions could contribute towards reducing personal carbon footprints: having one fewer child by 58.6 tonnes, using green energy by 1.5 tonnes, being car free by 2.4 tonnes and recycling of waste by 0.2125 tonnes.

Study 2-Student Survey

The current generation undeniably plays an important role in deciding the fate of climate change and sustainable development. A student survey was conducted among 115 students from various schools and colleges across different places in India.

The students were questioned about common areas of environmental concern- their mode of transportation, planting of trees, sense of dignity or necessity for travelling in their own vehicles, taking the conscious decision of avoiding bursting crackers.

- The decision regarding bursting of crackers by the students is depicted in *Figure 2* as a pie chart. Diwali is one of the most celebrated festival in the beginning of winter season and a variety of firecrackers are burst for a period of 3 days. India is considered the most polluted country regarding the quality of air. Due to this, acceleration in air pollutants and emissions during Diwali has been a matter of serious concern for policymakers (Shah *et al.*, 2019) 92% of the students restrict themselves from bursting crackers, indicating a positive response towards decreasing carbon emissions.

- *Figure 3* is a pie chart depicting the decision of students regarding afforestation. It is observed that 16% of the students' plant 1 tree, 15% plant 2 trees, only 31% plant more than two trees and the remaining 39% do not plant trees.

However, one tree only absorbs 0.07 tons of carbon emissions which is an exceedingly small fraction of our annual carbon emissions. The main possibilities of reducing greenhouse gases in the atmosphere are reducing emissions (which have direct repercussions to the economy) and carbon dioxide absorption into the soil and vegetation. Hence, forests are an important sink of carbon dioxide, which store huge amounts of carbon in wood. (Dutcă *et al.*, 2009) Conclusively, afforestation must be carried out at a more aggressive pace to dampen the climate change.

- *Figure 4* is a pie chart that depicts the mode of transportation chosen by the students. 57% of the students use public transport to travel. The remaining 43% resort to using personal modes of transportation.

Carbon dioxide constitutes 95% of transportation related greenhouse gas emissions. Cars, SUVs, and pickup trucks running on gasoline, diesel and other fuels are the major emitters of carbon dioxide. Reducing emissions due to transportation will require a broad array of strategies such as: increasing vehicle efficiency, reducing miles travelled and lowering carbon content of fuels. Public transport is a major solution towards reducing emissions due to transportation (Hodges, 2010).

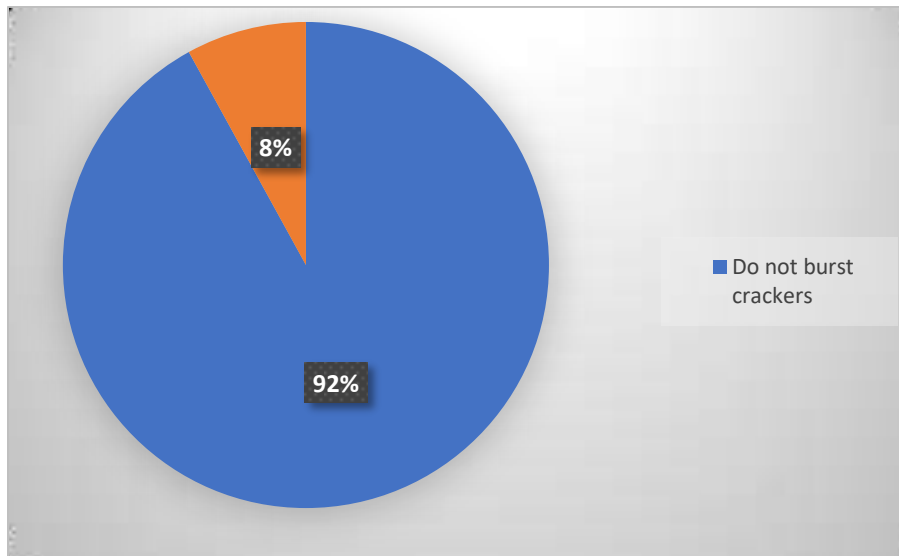


Figure 2: Pie chart representing student's choice of bursting crackers

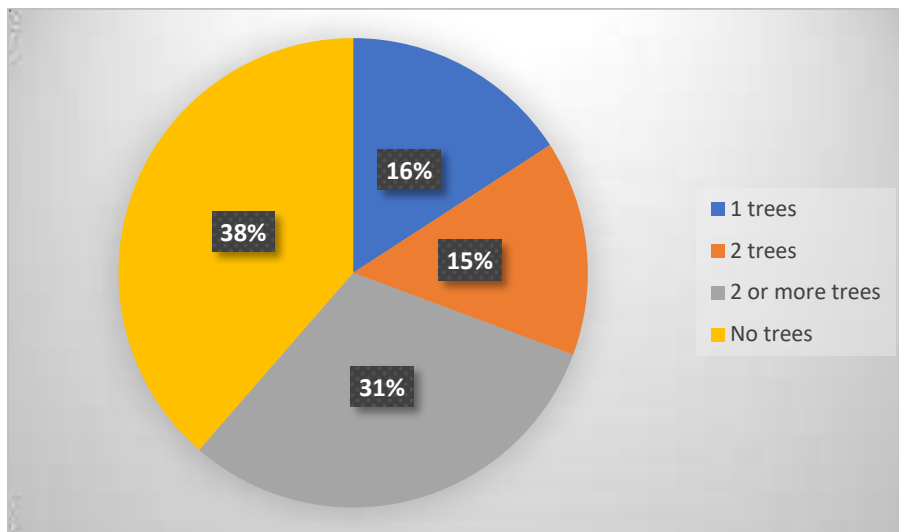


Figure 3: Pie chart representing student's decision regarding afforestation

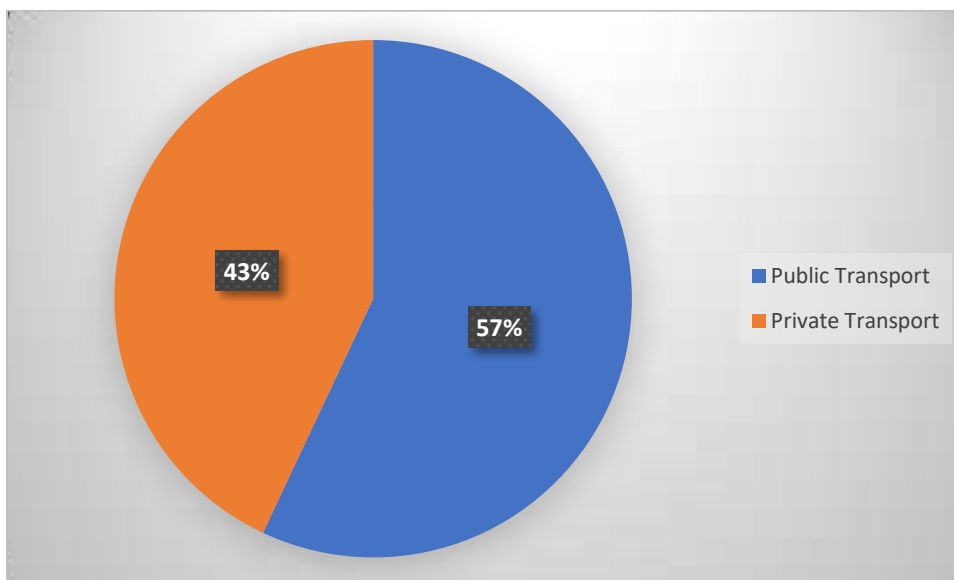


Figure 4: Pie chart depicting student's decisions on mode of transportation

Recent Policy Decisions by the Indian Government

The Indian government has initiated steps towards reducing and controlling the carbon emissions in the nation. The following are the recent initiatives taken by the government (data as of December 2018): India's climate action plans will be taken, known as the nationally determined contributions (NDCs). Three main goals were set under the Paris agreement: reducing the intensity of emissions on the economy by 33-35%, increasing the share of non-fossil fuels to 40% of the total electricity generation capacity and creating a carbon sink of 2.5-3 billion tonnes of carbon-dioxide equivalent. The carbon sink will be created by additional foresting and increasing tree covers. According to independent assessments, India's commitments are keeping up with Paris agreement goal of keeping the temperature increase below 2 degrees Celsius. (Goswami, 2018)

CONCLUSION

It is evident from the sample survey that the average carbon emissions increase with an increase in income. The student survey reveals that students are aware about the climate change and environmental damages. However, they must react to it in a more aggressive pace.

Primarily, our personal decisions can have a huge impact in reducing carbon footprints. Few of these decisions being- using public transport/using a fuel efficient vehicle/carpooling; reducing meat consumption/switching over to a vegan diet; choosing to have only one child-which could also aid population control; choosing to travel by air only when necessary; using clean energy, recycling materials such as glass, metal, paper; using environment friendly products; choosing a size of house appropriate for the family size; choosing not to burst crackers and actively participation in afforestation. However, people need to change their mindset and have access to environment friendly resources.

The government policies and its implementation for industries and households plays a paramount role in transforming the fate of our environment.

According to the Global Risks Report 2017-2018, the fourth biggest risk that will have the biggest impact in the next 10 years is "Failure of climate change mitigation & adaptation" (World Economic Forum, 2018)

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Conclusively, the government and the household must make prompt decisions to save the planet from the perils of climate change by reducing carbon emissions.

REFERENCES

- Clinton J Andrews and Robert H Friis (2013).** Green Living: Reducing the Individual's Carbon Footprint. The Praeger Handbook of Environmental Health **Volume I: Foundations of the Field**, Chapter **23** 455- 473. Available at: <http://rcgb.rutgers.edu/wp-content/uploads/2013/09/AndrewsFriis2012.pdf>
- David I Stern, Michael S Common and Edward B Barbier (1996).** Economic Growth and Environmental Degradation: The Environmental Kuznets Curve and Sustainable Development. *World Development* **Vol 24**(7) 1151-1160. Available at: [https://doi.org/10.1016/0305-750X\(96\)00032-0](https://doi.org/10.1016/0305-750X(96)00032-0)
- Ewing B, D Moore, S Goldfinger, A Ousler, A Reed and M Wackernagel (2010).** Ecological footprint atlas 2010. Oakland: Global Footprint Network. Available at: https://www.footprintnetwork.org/content/images/uploads/Ecological_Footprint_Atlas_2010.pdf
- Hodges Tina (2010).** Public Transportation's Role in Responding to Climate Change. United States. Department of Transportation. Available at: <https://www.hsdl.org/?view&did=772013>
- L.Dutcă, LV Abrudan and V Blujdea (2009).** The impact of afforestation on carbon storage- a review. *Bulletin of the Transilvania University of Braşov* **Vol 2**(51) Series II: 13-18. Available at: <https://pdfs.semanticscholar.org/0e04/94d27d7c094312283566f35aea835459e467.pdf>
- MA Boutabba (2013).** The impact of financial development, income, energy, and trade on carbon emissions: Evidence from the Indian economy. *Economic Modelling* **40** 33-41. Available at: <https://www.researchgate.net/deref/http%3A%2F%2Fdx.doi.org%2F10.1016%2Fj.econmod.2014.03.005>
- N Stern and NH Stern (2007).** The Economics of Climate Change: The Stern Review. Available at: [https://scholar.google.co.in/scholar?q=Stern,+N.H.,\(2007\).+The+Economics+of+Climate+Change:+The+Stern+Review&hl=en&as_sdt=0&as_vis=1&oi=scholart](https://scholar.google.co.in/scholar?q=Stern,+N.H.,(2007).+The+Economics+of+Climate+Change:+The+Stern+Review&hl=en&as_sdt=0&as_vis=1&oi=scholart)
- Panayotou T (1993).** Empirical tests and policy analysis of environmental degradation at different stages of economic development. ILO Working Papers 992927783402676, International Labour Organization. Available at: http://www.ilo.org/public/libdoc/ilo/1993/93B09_31_engl.pdf
- Rohan Shah, Sneha Limaye, Dhammasagar Ujagare, Sapna Madas and Sundeep Salvi (2019).** Personal exposures to particulate matter <2.5 µm in mass median aerodynamic diameter (PM_{2.5}) pollution during the burning of six most commonly used firecrackers in India. *Lung India*. **36**(4) 324-329. Available at: https://dx.doi.org/10.4103%2Flungindia.lungindia_440_18
- Sushma Shukla (2017).** Human capital and economic growth in India. *International Journal of Current Research* **9**(11) 61628-61631. Available at: https://www.researchgate.net/publication/338084619_HUMAN_CAPITAL_AND_ECONOMIC_GROWTH_IN_INDIA
- Urmi Goswami (2018)** India to achieve climate goals before schedule: Environment Minister Harsh Vardhan. [Online] The Economic Times. Available at: <https://economictimes.indiatimes.com/news/politics-and-nation/india-set-to-increase-share-of-renewables-and-reduce-carbo-dioxide-pollution/articleshow/66924213.cms>
- U.S. Energy Information Administration (2018).** International Energy Outlook 2018: Energy implications of faster growth in India with different economic composition. Available at: https://www.eia.gov/outlooks/ieo/india/pdf/india_summary.pdf
- World Economic Forum (2018)** Global Risks Perception Survey 2017-2018. [Online] Available at: <https://www.weforum.org/reports/the-global-risks-report-2018>
- World Development Report (1992).** Development and the Environment. New York: Oxford University Press. World Bank.