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The carbon footprint of household energy use among different income groups in Hisar city

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Abstract

A carbon footprint can be a broad measure or be applied to the actions of an individual, a family, an event, an organization, or even an entire nation. In this research a sample of 40 households each from low, middle and high income groups of Hisar will be selected randomly thus making a total sample of 120 households and data will be collected online on knowledge of homemakers regarding carbon footprints and practices followed by them for reducing household energy consumption and hence reducing the carbon footprints.

Keywords: Carbon footprint, household, energy, consumption

Introduction

A carbon footprint is the total greenhouse gas (GHG) emissions caused by an individual, event, organization, service, or product, expressed as carbon dioxide equivalent. Greenhouse gases, including the carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, land clearance and the production and consumption of food, manufactured goods, materials, wood, roads, buildings, transportation and other services. The total carbon footprint cannot be calculated exactly because of inadequate knowledge of and data about the complex interactions between contributing processes, including the influence of natural processes that store or release carbon dioxide. The concept and name of the carbon footprint derive from the ecological footprint concept while carbon footprints are usually reported in tons of emissions (CO₂-equivalent) per year, ecological footprints are usually reported in comparison to what the planet can renew. This assesses the number of "earths" that would be required if everyone on the planet consumed resources at the same level as the person calculating their ecological footprint. The carbon footprint is one part of the ecological footprint. Carbon footprints are more focused than ecological footprints since they measure merely emissions of gases that cause climate change into the atmosphere.

The amount of carbon emissions trapped in our atmosphere causes global warming, which causes climate change, symptoms of which include melting of the polar ice caps, the rising of sea levels, the disturbance of animals' natural habitats, extreme weather events, and so many more negative side effects that are dangerous. According to National Geographic, carbon dioxide is considered a pollutant, though we may more readily associate "pollution" with things like smoke or plastic floating in a lake. But pollutants are anything that falls under the umbrella of a mix of particles and gases that have the capacity to reach harmful concentrations, according to *National Geographic*. Things like soot, smoke, mold, and pollen are considered pollutants, but greenhouse gases like methane and carbon dioxide are, too. Carbon emissions are one type of greenhouse gas emission that happens when carbon dioxide enters the air after a human activity or process. They are crucial to this conversation because they are the most significant type of emission in terms of quantity.

A July 2017 study published in Environmental Research Letters found that the most significant way individuals could mitigate their own carbon footprint is to have one less child ("an average for developed countries of 58.6 tonnes CO₂-equivalent (tCO₂e) emission reductions per year"), followed by living car-free (2.4 tonnes CO₂-equivalent per year), forgoing air travel (1.6 tonnes CO₂-equivalent per trans-Atlantic trip) and adopting a plant-based diet (0.8 tonnes CO₂-equivalent per year).

Objectives of the experiment

1. To appraise the knowledge and practices of homemakers of different income groups of Hisar regarding carbon footprints (2020-21)
2. To calculate the carbon footprints of households of homemakers of different income groups of Hisar the basis household energy use among different income groups. (2021-22)

Treatment details and replications

A sample of 40 households each low, middle and high income groups of Hisar will be selected randomly thus making a total sample of 120 households and data will be collected online on knowledge of homemakers regarding carbon footprints and practices followed by them for reducing household energy consumption and hence reducing the carbon footprints.

Observations to be recorded

- Knowledge regarding carbon footprints
- Practices followed by homemakers for reducing household energy consumption

Background profile of the respondents

The background profile of the respondents has been presented in table-1 and clearly explained to bring out their characteristic features. Personal, demographic and socio-economic profile of the homemakers included information regarding age, family type, and family size, and education, occupation of respondent and socio-economic profile of the family.

Personal and demographic variables

Age: Personal and demographic attributes of the respondents were studied for proper explanation of the findings. Majority of the respondents i.e. 67.5.0 percent were in age group 36-50 years followed by 28.3.5 per cent in age group of 20-35 years and 4.16 percent in age group of 51-65 year.

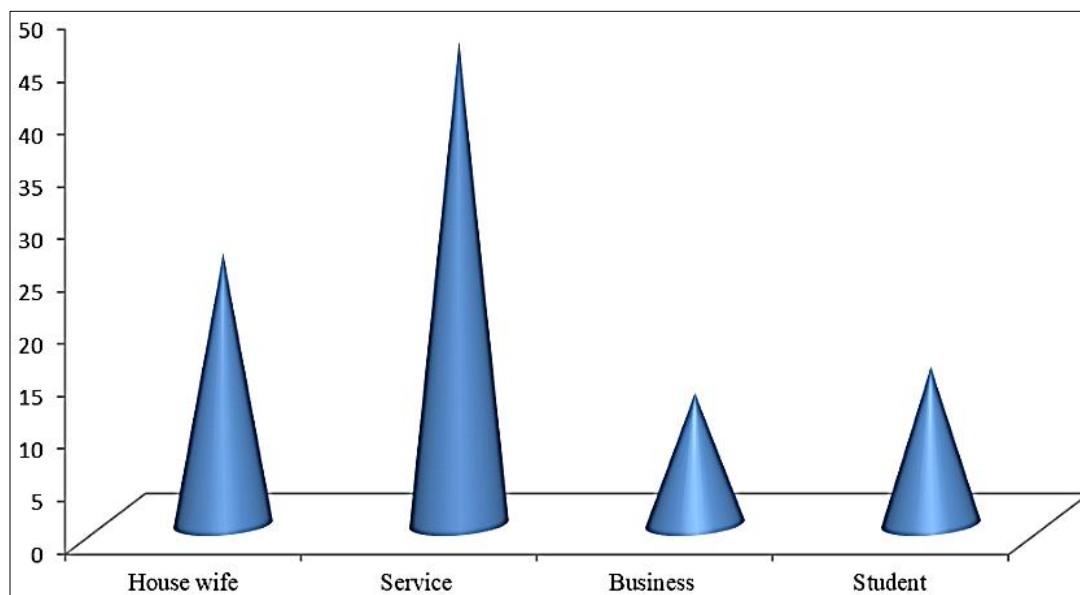
Education: Education status of respondent revealed that maximum number of respondents had education till matric (25.0%) followed by 10+2 (30.0%), primary (12.3%), graduate (22.5.0%) and post graduate (8.3%). Least was illiterate (1.6%).

Table 1: Personal and demographic variables

S. No.	Variables	Category	Frequency (percentage) (n=120)
Personal and demographic variables			
1.	Age (in years)	20-35	34(28.3)
		36-50	81(67.5)
		51-65	5(4.16)
2.	Education of respondent	Illiterate	2(1.6)
		Primary	15(12.5)
		Matric	30(25.0)
		10+2	36(30.0)
		Graduate	27(22.5)
		Post Graduate	10(8.3)
3.	Occupation of the respondent	House wife	31(25.8)
		Service	56(46.0)
		Business	15(12.5)
		Student	18(15.0)
4.	Family type	Nuclear	88(73.3)
		Joint	32(26.6)
5.	Family size	Upto 4 member (Small)	33(27.5)
		5-7 members(Medium)	68(56.6)
		7-9 members and more (Large)	19(15.83)
6.	Socio-economic status	Upper (26-29)	58(48.3)
		Upper Middle (16-25)	38(31.6)
		Lower Middle (11-15)	24(20.0)

Occupation The data showed that the majority of respondent (46.6 %) were doing service followed by 25.5% of

respondents who were housewife and only 12.5% were running their business.



Family type Table 1 revealed that majority of the respondents (73.3%) was living in nuclear families while 26.6 percent had joint families.

Family size Little more than one third of respondents (27.5%) had small family (upto 4 members) followed by 56.0% homemakers with medium size family with 5-7 members and large family size (15.8%) having 7-9 family members.

Socio-economic status of the respondent Socio-economic status of the respondent In order to measure the socio economic status Kuppaswamy Scale (2018) was employed. Majority belonged to upper middle class SES (48.3%) followed by SES of upper (31.6%) and lower middle (20.0%) category.

The data in table showed that the majority of respondent (36 %) were living in terraced house followed by 27.5% of respondents were living in detached house and 17.5% were living their apartment.

Table 2: House type

Form	Frequency	Percent
Detached	33	27.5
Semi-detach	22	18.3
Terraced House	44	36.6
Apartment	21	17.5

1.1 Awareness and knowledge regarding carbon footprint of household energy

The table revealed that the knowledge level of respondents about of carbon footprint and it was found that the majority (43.3%) of the respondent believe that Car was the biggest contributor to a person's carbon footprint followed by trash production (23.3%) and electricity (25.0%)

Biggest contributor to a person's carbon footprint.

Table 3: The biggest contributor to a person's carbon footprint.

Persons carbon footprint	Frequency	Percent
Trash production	28	23.3
Car	52	43.3
electricity use	30	25
gas heating	10	8.3

Table 4: How would you rate the importance assigned to environmental issues in your house.

Components	Frequency/ percent
Not at all	5(4.16)
Slightly	19(15.83)
A little bit	28(23.3)
Fairly	28(23.3)
Very much	40(33.3)

The importance assigned to environmental issues in your house.

The table reveal that 33.3% people were assigned very much to environmental issues in house followed by 23.3% a little bit and fairly and 15.83% were slightly.

The current data reveal that 58.3% household do not aware about environmental management systems and 41.6% were known about environmental management system.

Table 5: Do you know about Environmental Management Systems

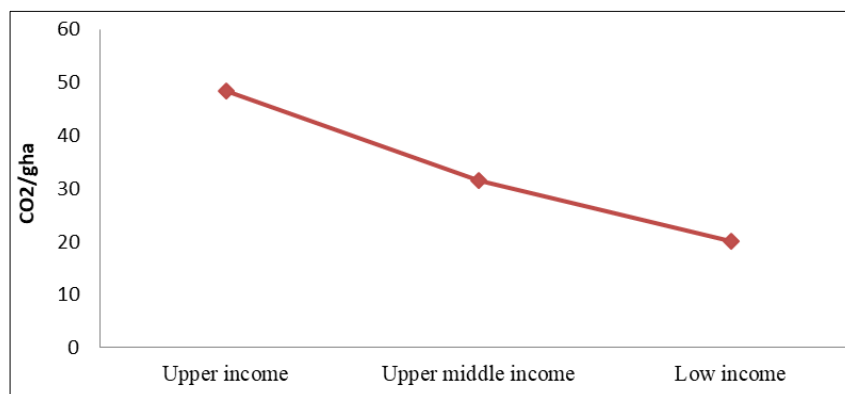
Form	Frequency/ percent
Yes	50(41.6)
NO	70(58.3)

The data reported that 93.5% were not calculated their carbon footprint of their house and 7.5% were calculated their carbon footprint.

Table 6: Calculated the carbon footprint of house.

Components	Frequency/percent
Yes	9(7.5)
NO	111(93.5)

To calculate the carbon footprints of households of homemakers of different income groups of Hisar the basis household energy use among different income groups. (2021-22)



The more money a household has the more average tons of carbon dioxide equivalent it emits per year. Products that they use at home may contribute to the greenhouse gas emissions of other countries. The majority of U.S. households' overseas emissions are produced in China, as well as the other 24 countries. Environment International (2019)

David Roberts 2017- reported wealthier people produce more carbon pollution — even the “green” ones. One's environmental impact is primarily determined by structural

Carbon footprints vary greatly depending on what was the income of an individual, where we live, how wealthy we are, our lifestyle and what energy we have access to. Personal spending on housing, travel, food, products and services pays for two thirds of global greenhouse gas emissions. And people have the power to drastically reduce their own personal footprint if they choose to.

There is a strong correlation between carbon footprint and income level, both domestically and internationally. It showed that the analysis and relationship between income and household energy use.

features of one's life circumstances, especially socioeconomic status. Rich people emit more carbon, even when they recycle and buy canvas tote bags full of organic veggies.

1.2 Personal Carbon Footprint of household energy use

Data regarding expenditure pattern (food, goods, services, energy, waste, transportation, land footprint etc.) of the population of Hisar has been collected through questionnaire survey of the household.

Table 7: Calculation of Personal Carbon Footprint of household energy use

	Footprint Components	Footprint	Footprint (Global Hectare)	Footprint (gha/capita)	Percentage Contribution in the Total Footprint
Carbon Footprint	Energy - Electricity	6314.375	7956.112	0.1850	15.516
	Energy - Natural Gas	11420.989	14390.446	0.3347	28.064
	Water	345.057	434.772	0.0101	0.848
	Transportation- Fuel	2414.978	3042.873	0.0708	5.934
	Transportation- Asphalt	827.024	1042.050	0.0242	2.032
	Transportation- Air Flight	10.622	11.083	0.011	0.700
	Waste	987.969	1244.841	0.0289	2.428
	Food - Meat	1126.78	1419.751	0.0330	2.769
	Food - Dairy	897.756	1131.172	0.026	2.206
	Food- Fruits and Vegetables	1117.078	1407.518	0.0327	2.745
	Food - Cereal	1671.209	2105.723	0.0490	4.106
	Food confiscatory	848.475	1069.079	0.024	2.085
	Food - Drinks	156.492	197.181	0.004	0.385
	Food - Others	1553.502	1957.413	0.045	3.817
	Goods - Furnishing and Equipment	1465.783	1846.886	0.043	3.602
	Goods Housekeeping	473.706	596.870	0.013	1.164
	Goods - Others	1552.407	1956.033	0.045	3.815
	Service - Education	2579.244	3249.847	0.075	6.338
	Service - Health	173.575	218.705	0.005	0.427
	Service Entertainment	741.192	933.902	0.021	1.821
	Service - Technical	937.304	1181.003	0.027	2.303
	Service - Administrative	1413.047	1780.439	0.041	3.472
Land Footprint	Land - Residential	28.956	72.680	0.000	0.071
	Land - Goods	9.906	24.864	0.000	0.024
	Land - Services	84.849	212.96	0.0025	0.208
	Land - Transportation	49.455	124.132	0.001	0.122

Energy: Electricity consumption: Average monthly electricity bill has been inquired during the survey to the respondents, considering the variation during the summer and winter. After achieving the total amount of electricity bill in a year, it has been rehabilitated into unit of electricity consumption – MWh (Mega Watt-hour), Finally amount of carbon dioxide emission for each unit of MWh electricity use has been determined with the standard value consequent from Greenhouse Gas Equivalencies Calculator.

Energy: Natural gas consumption: Respondents have been asked about the type and number of hours Gas Burner use per day on an average. After that, it has been rehabilitated to total amount of (cubic meter) gas usage in a year. Majority of the household uses double burner gas stove.

Transportation: Fuel consumption impact: To determine the total amount of fuel use of different types, respondents have been asked about the number and type of vehicle they have, and per month average fuel cost on each particular vehicle. Following the determination of total annual expenditure for each fuel type, annual quantity has been find out using the unit price of each fuel type.

Transportation: Air travel impact: Respondents have been asked about the number of air travel made by the household members and the number of persons traveled in each particular trip. Multiplying the number of trip by the number of person traveled in each the trip, total Person-Trip traveled in last one year has been determined.

Waste: Determining the impact of waste production of household in GHG emission were recorded through questionnaire, Per capita waste generation rate, total amount of waste generated in a year and the carbon dioxide emission from that amount annually, in Hisar city has been derived from carbon footprint calculator.

Food: To assess the impact of food consumption, expenditure for food consumption has been collected. Total consumption unit has been converted into annual consumption unit, and then using the unit price, yearly cost has been calculated.

Goods: In this research, goods consumption has been categorized under equipment and Furnishing goods and goods used for Housekeeping activities. Subcategory of goods for day to day life use has been determined based on the availability of GHG emission standards

Service- In this research, service activity expenditure has been assessed under four broad categories. They are Education, Health, Entertainment, Technical and Administrative. Sub-categories have been determined based on the availability of carbon emission standard values.

Conclusion

Through this research carbon footprint concept has been introduced for the hisar Residential Area. Natural gas consumption for domestic purpose has been found as the main motive behind the high footprint figure. However this research has great scope in future if conducted on larger extent and can be used as an influential tool during urban policy formulation to enhance the environmental sustainability through utilizing our resources more sensibly.

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