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A Comparative Study on Carbon Footprint knowledge of Rural andUrban Women of Bhilwara, Rajasthan

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ABSTRACT

Over the past few decades carbon emissions have experienced a fourfold increase. If this trend continues it won't be long before the Earth's condition becomes severely affected leading to dire consequences for our planet. The present study was conducted in the Bhilwara district of Rajasthan to determine the knowledge level of respondents regarding carbon footprints. A total of 480 rural and urban women were selected for the present study and data was collected through the interview method using a standardized knowledge test. For the analysis of data frequency, percentage and mean percent score were used to calculate the knowledge level of respondents and a z-test was administered to find out the difference in knowledge level between rural and urban respondents. The results revealed that none of the rural respondents possessed a good understanding of carbon footprints, while a small percentage (10%) of urban respondents demonstrated a good level of knowledge regarding carbon footprint. A significant difference in knowledge was observed between both respondents. Rural respondents had an average knowledge score of 2.96, while urban respondents scored significantly higher at 9.15 with a z-score of -8.57 at the 1% level of significance.

Keywords: Carbon footprint, Carbon emission, Rural women, Greenhouse emission, Comparative study, Carbon, Urban women

INTRODUTION

Pollution is not merely a term it constitutes an undeniable facet of contemporary human existence (Naidu *et al.*, 2021). It has emerged as a widespread and pressing issue in the modern world (Mittiga, 2022). Presently, India ranks as the second most polluted country globally. Pollution is characterized as the introduction of pollutants or contaminants into the environment resulting in adverse changes (Mehmoode*et al*., 2022). The most recent report from the Intergovernmental Panel on Climate Change (IPCC) released in April 2022, underscores the imperative to limit global warming to 1.5°C emphasizing that if this action is not taken promptly it may never materialize (Chowdhuri *et al.,* 2022). Notably the climate crisis is rapidly intensifying driven by factors such as deforestation, drought, pollution and plastic waste with the consequences visible worldwide (Lin *et al.,* 2022).The concentration of greenhouse gases has been steadily increasing over the past few decades leading to a rise in the global average temperature. Many human activities including household electricity consumption for heating and cooling, power generation and the production of food and goods result in greenhouse gas emissions further hastening global warming and

climate change. Projections indicate that India's waste generation will surge from 62 million tons to 165 million tons by 2030 (Kumar *et. al* 2017). In India there are variations in the average annual per capita carbon emissions between rural and urban areas with urban areas averaging 2.5 tons of CO_2e and rural areas at 0.85 tons of CO_2e (Alhashmi, 2021). On a global scale, India stands as the third-largest contributor to carbon emissions accounting for 2.46 billion metric tons equivalent to 6.8 per cent of total global emissions. Nevertheless, India's per capita carbon emissions remain comparatively low at 1.84 tons a stark contrast to the United States 16 tons. In recent years the pollution issue in Rajasthan has grown increasingly alarming. Recognizing the gravity of the situation, it became imperative to investigate public awareness with a specific focus on environmental pollution and the carbon footprint. Thus, the present study was undertaken to find out the knowledge of rural and urban women regarding their carbon footprint.

MATERIALS AND METHODS

The study was undertaken in Bhilwara district, Rajasthan. Out of the 12 panchayat samities four were randomly selected from each direction which was namely Kotri, Mandal, Hurda and Suwana. To obtain a representative sample of Bhilwara district a list of villages was prepared for each selected Panchayat Samiti. From each list two villages were randomly selected *i.e*. total of eight villages namely Jawal, Kanti, Mandal, Meja, Dantra, Dhanpura, Suwana and Kodukota were selected for data collection. From each village a sample of 30 rural women was selected from the list prepared with the help of anganwadi workers. Thus, the total sample size for rural women was 240. For urban households, a list of colonies was compiled and eight colonies (two from each direction) were randomly selected namely Aayam, Gokuldham, Swastik enclave, Dwarika, Manglam, ShyamVihar, KamlaVihar and KesarKunj. From each colony, a sample of 30 urban women was selected. Thus, the total sample size for urban women was 240. In this study, data on the knowledge of carbon footprints at the household level were collected through door-to-door interviews. To know the existing knowledge of carbon footprints, an interview schedule consisting of 28 closed-ended and open ended questions was developed. Questions were structured to determine the knowledge of rural and urban women regarding the environment, environment pollution and carbon footprint. The knowledge test was formulated based on the available literature and was evaluated by subject matter specialists to ascertain the clarity of questions and also to know whether all the selected aspects are covered adequately or not. The reliability of the tool was also measured. The necessary modifications were made as per the suggestions given by experts. For analysis of data frequency, percentage and mean percent score were used to calculate the knowledge level of respondents and a z-test was administered to find out the difference in knowledge level of rural and urban respondents.

RESULTS AND DISCUSSION

Demographic profile of the respondents

Majority of the rural and urban respondents were between the age group of 20 to 45 years who were educated upto primary education. In rural areas, more than half of the respondents (55.83%) were of medium socio-economic status, whereas nearly one-third of respondents (30.42%) belonged to high socio-economic status

and only 13.75 percent of respondents were found in the category of low socio-economic status. In urban areas the majority of respondents (85%) belonged to high socio-economic status and only 15 percent of respondents belonged to medium socio-economic status. None of the respondents were in the low socio-economic category.

Knowledge of the respondents about carbon footprint

An in-depth inquiry into the knowledge of the respondents in four components was made to find out the knowledge of rural and urban women regarding their carbon

Table 1: Component-wise knowledge of the rural and urban respondents about carbon footprint n= 480

S.No.	Components	Rural (240) MPS	Urban (240) MPS
1.	Knowledge about Environment	22.17	45.17
2.	Knowledge about household activities responsible for environment pollution	8.96	24.90
3.	Knowledge about carbon emission and carbon footprint	0	10.42
4.	Knowledge about rules and regulations about environment cleanliness	2.78	13.89
	Overall mean per cent of knowledge	8.48	3.60

Table 1 presents the component-wise overall knowledge of the urban and rural respondents. Knowledge about the carbon footprint of urban and rural respondents was measured with MPS of 3.60 and 8.48, respectively.The critical examination of the knowledge score highlights that urban respondents possessed average knowledge about the environment with MPS 45.17 and poor knowledge of other components, viz., household activities responsible for environmental pollution (MPS 24.90), rules and regulations about environmental cleanliness (MPS 13.89), and carbon emissions and carbon footprints (MPS 10.42). Rural respondents exhibited limited awareness regarding the four aspects of the carbon footprint. Their knowledge scores for environmental awareness, understanding household activities contributing to environmental pollution, familiarity with environmental cleanliness regulations, comprehension of carbon emissions and the carbon footprint were notably low with MPS of 22.17, 8.96, 2.78 and zero, respectively. These findings underscore the need for targeted educational and awareness-building efforts particularly in rural areas to enhance understanding and knowledge about environmental issues and the carbon footprint.

Table 2 presents noteworthy findings regarding the knowledge of respondents in urban and rural areas. In the urban area, approximately two-thirds of the respondents (62.50%) were aware of the importance of cleanliness in their surroundings. On the other hand, in rural areas, less than half of the respondents (45%) possessed this knowledge. Regarding the understanding of the term "environment," more than half of the urban respondents (53.33%) were familiar with its meaning whereas less than one-fourth of the rural respondents (20.83%) could provide a definition. In terms of knowledge about different types of pollution, such as air

Table 2: Distribution of rural and urban respondents according to their knowledge about environment n=480

S. No.	Aspects	Rural (240)		Urban (240)	
		f	%	f	%
1.	Cleanliness of surrounding	108	45	150	62.50
2.	Meaning of environment	50	20.83	128	53.33
3.	Meaning of Environment pollution	40	16.67	72	30
4.	Personal problems due to pollution	32	13.33	78	32.50
5.	Types of pollution	36	15	114	47.50

pollution, water pollution and noise pollution nearly half of the urban respondents (47.50%) had this awareness while only 15% of the rural respondents demonstrated knowledge in this area.

When it comes to personal problems caused by pollution around one-third of urban respondents (32.50%) were knowledgeable about such issues compared to only 13.33% of rural respondents who possessed this knowledge. Additionally, approximately one-third of urban respondents (30%) were familiar with the concept of environmental pollution while only 16.67 per cent of rural respondents had knowledge in this domain. A study conducted by Levist on 2011 and Mortoja *et al*. 2022 also reported similar findings, indicating that the majority of people exhibited moderate concern about climate conditions and did not perceive them as posing significant personal harm. These findings highlight the disparities in knowledge between urban and rural areas, with urban respondents generally exhibiting higher levels of awareness regarding cleanliness, environmental concepts, pollution types, personal problems caused by pollution and the meaning of environmental pollution.

Table 3: Distribution of rural and urban respondents according to their knowledge about household activities responsible for environment pollution n=480

S. No.	Aspects	Rural (240)		Urban (240)	
		f	%	f	%
1.	Daily household activities are responsible to pollute the environment	20	8.33	70	29.17
2.	Cooking fuels and electrical appliances used in the house are cause of pollution	10	4.17	56	23.33
3.	Kitchen waste and plastic materials used in the house are reason for environment pollution	16	6.67	52	21.67
4.	Continuous environment pollution will lead to life in danger	112	46.67	158	65.83
5.	Listened about reuse, refuse, recycle or reduce in terms of environment	14	5.83	90	37.50
6.	Sanitary napkins are also made from a kind of plastic material	0	0	32	13.33
7.	Separate dustbin arrangement are there dispose of sanitary napkins	0	0	10	4.17
8.	Sanitary napkin is also cause of pollution	0	0	10	4.17

Table 3 provides insightful information about the respondents awareness levels regarding pollution and related factors. In both urban and rural areas, nearly two-thirds of the respondents (65.83% urban and 46.67% rural) were aware of the current state of pollution and recognized that continuous environmental pollution poses a threat to human life. This finding aligns with a study conducted by Yu and Wang (2013), which reported that 78 per cent of respondents agreed that climate change harms residents and society, while only 4 per cent disagreed.

Regarding knowledge about environmentally-friendly practices such as reuse, refuse, recycle or reduce more than one-third of urban respondents (37.50%) were familiar with these terms, whereas only 5.83 per cent of rural respondents had knowledge in this area.

In terms of awareness about daily household activities contributing to pollution 29.17 per cent of urban respondents possessed this knowledge, while in the rural area only 8.33 per cent of respondents were aware of such activities. This finding is supported by the study by Ge *et al*. (2021), which reported that 85 per cent of respondents fairly or strongly agreed that human activities are a cause of climate change.

Regarding the understanding of the role of cooking fuels and electrical appliances in causing pollution 23.33 per cent of urban respondents and 4.17 per cent of rural respondents had this knowledge, respectively. Similar findings were mentioned by Dida (2022), who found that respondents in Sub-Saharan Africa had limited knowledge about the health effects and predisposing factors associated with the use of kerosene and fuel wood as energy sources. In terms of knowledge about kitchen waste and plastic materials as contributors to environmental pollution, 21.67 per cent of urban respondents and 6.67 per cent of rural respondents were aware of this connection. Yusuf and Fajri (2022) also found in their study that a significant proportion of respondents (65.9%) lacked knowledge about waste management. Regarding knowledge about sanitary napkins, 13.33 per cent of urban respondents were aware that they are made from a type of plastic material and only 4.17 per cent of urban respondents knew about the availability of separate dustbins for disposing of sanitary napkins and the potential pollution caused by improper disposal. None of the rural respondents had knowledge in this area. Garg (2012) and Sinha and Paul (2018) reported in their study that the Indian government proposed a subsidized sanitary napkin scheme for rural adolescent girls, but several challenges, including awareness, availability, quality, regular supply, privacy, water supply, disposal and reproductive health education and family support, need simultaneous attention for the promotion of menstrual hygiene.

Overall these findings indicate disparities in knowledge levels between urban and rural areas highlighting the need for targeted awareness campaigns and educational interventions to enhance understanding of pollution-related issues and promote environmentally-friendly practices among the population.

The findings presented in Table 4 are concerning as they reveal a lack of awareness and knowledge about carbon footprints among the respondents. In the urban area, slightly over half of the respondents (54.17%) had heard about carbon emissions and only 21.67 per cent had heard about carbon footprints.

Table 4: Distribution of respondents according to their knowledge about carbon footprint n=480

S. No.	Aspects	Rural (240)		Urban(240)	
		f	%	f	%
1.	Heard about Carbon emission	0	0	130	54.17
2.	Sources of carbon emission	0	0	46	19.17
3.	Heard about Carbon footprint	0	0	52	21.67
4.	Meaning of carbon footprint	0	0	24	10
5.	Sources of Carbon footprint	0	0	18	7.5
6.	Disadvantages of Carbon Footprint	0	0	20	8.33
7.	Effects of Carbon Footprint	0	0	10	4.17
8.	Carbon emission can be increased or decreased even by human activities	0	0	0	0
9.	Contributors of Carbon footprint	0	0	0	0
10.	Food consumption, transportation and household energy are also a contributor of carbon footprint	0	0	0	0
11.	Calculate one's own carbon footprint	0	0	0	0
12.	Various ways of reduction of carbon footprint	0	0	0	0

Similarly, Rahman *et al*. (2019) found in their study that 54.2 per cent of respondents had acquired knowledge about climate change from some source while 45.8 per cent had not heard of climate change at all. Furthermore, only 19.17 per cent of urban respondents in the present study knew the sources of carbon emissions and a mere 10 per cent knew the meaning of the carbon footprint. Additionally, less than 10 per cent of urban respondents were aware of the disadvantages, sources and effects of carbon footprints.

None of the rural respondents had any knowledge about these aspects. This lack of knowledge is alarming, especially in the current age where people are heavily engaged in social media but remain unaware of important environmental concepts. It is particularly concerning that the rural respondents scored zero in terms of knowledge about carbon emission contributors to carbon footprints, food consumption and transportation as contributors to carbon footprints, calculating one's own carbon footprint and various ways to reduce carbon footprints. Tobler (2012) and Hoppe *et al*. (2018) also found in their study that people still hold several misconceptions regarding carbon emissions and climate change indicating a need for better education and awareness campaigns. These findings highlight the urgent need for comprehensive education and awareness programs to bridge the knowledge gap and enhance understanding of carbon footprints and their implications. By increasing knowledge and awareness individuals can be empowered to make informed decisions and take actions that contribute to the reduction of carbon emissions and the mitigation of climate change impacts.

The findings presented in Table 5 shed light on the knowledge of respondents regarding rules and regulations related to environmental cleanliness. In the urban area, 41.67 per cent of respondents were aware that the Government of Rajasthan had banned the manufacturing, sale and use of identified single-use plastic items as of July 1, 2022. However, in rural areas, only

Table 5: Distribution of rural and urban respondents according to their knowledge about rules and regulations about environment cleanliness n=480

S. No.	Aspects	Rural (240)		Urban (240)	
		f	%	f	%
1.	Government of Rajasthan banned the manufacture, sale and use of identified single - use plastic items like plates, cups, straws, trays and polystyrene from July 1, 2022	20	8.33	100	41.67
2.	Environment protection act (1986) to prevent environment and life of human being	0	0	20	8.33
3.	Cleanliness complaint can be made on Rajasthan Sampark Portal by dialing 181	0	0	0	0

8.33 per cent of respondents had knowledge about this ban. Furthermore, only 8.33 per cent of urban respondents were aware of the Environment Protection Act (1986), which is aimed at preventing environmental damage and safeguarding human life. In contrast, none of the rural respondents had any knowledge about this legislation. It is concerning to note that neither the rural nor urban respondents had any information about the Rajasthan Sampark Portal, which serves as a platform for registering information related to cleanliness by dialing 181. This lack of awareness about such platforms and initiatives hinders the effective communication and reporting of cleanliness-related issues. The limited knowledge exhibited by the respondents regarding environmental control measures and prevention criteria is a sensitive issue. In the face of constant environmental changes and the serious problems they pose, it is essential for individuals to be informed about measures that can help mitigate and prevent environmental damage. As mentioned by Wang and Zhou (2020), the majority of respondents in China believed that the government should take a leading role in responding to climate change. This highlights the importance of government action and the need for public awareness and support for environmental initiatives. Addressing this knowledge gap requires comprehensive awareness campaigns and educational programs that focus on informing individuals about environmental regulations, government initiatives and platforms for reporting environmental concerns. By enhancing knowledge and understanding individuals can actively participate in environmental protection and contribute to a more sustainable future.

Overall knowledge of the rural and urban respondent about carbon footprint

To know the level of knowledge of the respondents about carbon footprints, they were grouped into three categories of knowledge namely poor, average and good on the basis of their mean percent scores.

Figure 1 provides an overview of the distribution of rural and urban respondents across different categories of knowledge regarding carbon footprints. The majority of rural respondents (86.67%) exhibited poor knowledge, indicating a lack of understanding in this area. Only 13.33 per cent of rural respondents had average knowledge, while none of them had good knowledge regarding carbon footprints.

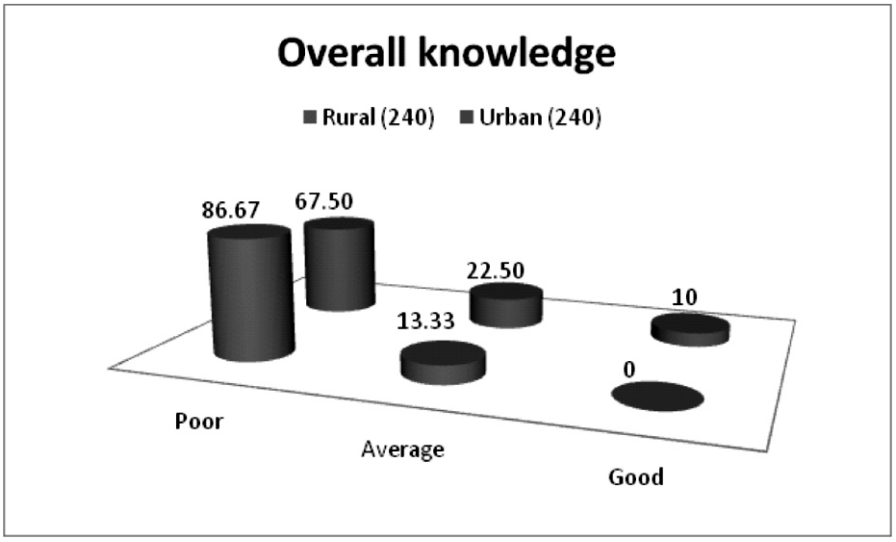


Fig.1: Distribution of rural and urban respondents by their overall knowledge about carbon footprint

Among urban respondents more than two-thirds (67.50%) fell into the poor knowledge category, suggesting a similar lack of awareness compared to the rural respondents. Around one-fourth (22.50%) of urban respondents had average knowledge and only 10 per cent demonstrated good knowledge about carbon footprints.

These findings underscore a significant disparity between rural and urban respondents in terms of their knowledge about carbon footprints. The majority of both rural and urban participants exhibited limited understanding in this domain, with rural respondents showing a slightly higher proportion of poor knowledge. This suggests a need for targeted educational interventions and awareness campaigns to enhance the knowledge and awareness of individuals both in rural and urban areas regarding carbon footprints and their implications for the environment.

Upon examining Table 6, it becomes evident that a significant difference exists in the knowledge levels regarding carbon footprints between rural and urban respondents. The data presented in Table 7 demonstrates that the mean knowledge value of rural respondents is 2.96, while the mean knowledge value of urban respondents is 9.15. By conducting a statistical analysis at a 1 per cent level of significance, a Z score of -8.57 was obtained, indicating a substantial difference between the knowledge levels of rural and urban respondents. This finding suggests that urban respondents possess a significantly higher level of knowledge about carbon footprints compared to their

Table 6: Significance of difference in rural and urban respondent's knowledge about carbon footprint

S.No.	Particular	Mean value	Z score
1.	Knowledge of Rural respondents	2.96	-8.57*
2.	Knowledge of urban respondents	9.15	

*Significant at 1% level of significance

rural counterparts. The results highlight the disparity in knowledge between rural and urban areas emphasizing the need for targeted interventions to enhance awareness and knowledge regarding carbon footprint particularly in rural communities.

CONCLUSION

The findings of the study indicate that there is a significant lack of knowledge among both rural and urban respondents when it comes to understanding the concept of carbon footprint. This lack of knowledge is particularly pronounced in rural areas where none of the respondents demonstrated good knowledge about carbon footprints. In urban areas although a small percentage of respondents showed good knowledge the majority still fell into the poor knowledge category. The disparities in knowledge levels between rural and urban respondents can be attributed to various factors. Urban respondents may have better access to education including formal education and exposure to information through social media and other sources. Their engagement in discussions related to environmental issues might contribute to a higher level of awareness and understanding of carbon footprints. On the other hand rural respondents may have limited access to educational resources and may be less exposed to information about environmental topics.

The study highlights the concerning fact that both rural and urban women lack knowledge regarding the proper use of technologies and often engage in negligent household activities that contribute to increased carbon emissions. This emphasizes the urgent need for educational interventions and awareness campaigns targeting women in both rural and urban areas. By enhancing their knowledge and awareness about carbon footprints and their implications for the environment, individuals can be empowered to adopt more sustainable practices and reduce their carbon emissions. By promoting green and sustainable behaviors such as adopting renewable energy sources, practicing waste reduction and recycling and using eco-friendly products, individuals can actively contribute to mitigating the negative effects of their carbon footprint. Ultimately, the goal is to create a more environmentally conscious society that understands the importance of reducing carbon emissions and works towards a sustainable future.

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