Climate Change

Carbon footprint analysis of rural households with respect to fuel and energy consumption in village Chak Chua of district Jammu, J & K

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To Cite:
Kalgapurkar Anita, Gurunadharao VVS. Ground Water Modeling for Evaluation of Effect of Water Harvesting Structures on Groundwater Recharge. *Climate Change* 2023; 9: e2cc1004
doi: https://doi.org/10.54905/disssi.v9i26.e2cc1004

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Peer-Review History
Received: 27 July 2023
Reviewed & Revised: 02/August/2023 to 17/September/2023
Accepted: 21 September 2023
Published: 25 September 2023

Peer-Review Model
External peer-review was done through double-blind method.

Climate Change
pISSN 2394-8558; eISSN 2394-8566

URL: http://www.discoveryjournals.org/climate_change

ABSTRACT

The household is a basic micro unit of the nation which can play an important role in protecting environment by curbing the emission of carbon footprints. The present study was carried out to analyze the carbon footprints of rural households with respect to fuel and energy consumption at household level in village Chak Chua of Jammu district, J&K. The study comprised of 85 households and data was collected by using a pre structured questionnaire and personal interviewing the members of the households. We also take in to account the socio-economic status and lifestyle along with fuel and energy consumption pattern of households. Major fuel and energy source fulfilling the demand of local people in study area are petrol, diesel, kerosene, LPG, wood and electricity. Petrol and electricity constituted the major share of consumption which is 30 liter/month/house and 145kwh/house/month, respectively. Results of this study showed that the total carbon foot print among the households of study area is 0.6618 kgCO2e/capita/month. The major share in carbon foot print is observed for petrol which is 27.8 % and lowest for wood i.e., 0.1% of total carbon footprint. The findings of the present research would assist the households to become aware about their activities that contribute carbon dioxide necessitating needed changes in their lifestyle in protecting the mother earth.

Keywords: carbon footprint, rural household, fuel, energy.

Abbreviations: DEFRA - Department for Environment, Food and Rural Affairs, INCCA- Indian Network for Climate Change Assessment, IPCC- Intergovernmental Panel on Climate Change

1. INTRODUCTION

Carbon footprint is a measure of emission of greenhouse gases expressed in carbon dioxide equivalents. This has been used as an environmental indicator to understand and quantify the main emission sources and it constitutes as an

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effective tool for energy and environment management (Ramachandra and Shwetmala, 2012). There is a broad scientific consensus that greenhouse gases resulting from human activity as the major culprits of global climatic change. Virtually all human activities cause carbon dioxide emissions by using electricity generated from fossil fuel power stations, burning gas for heating or driving a petrol or diesel car, every that lead to climate change. Increasing greenhouse gaseous concentration in the atmosphere is perturbing the environment to cause grievous global warming and associated consequences (Pandey et al., 2010).

At global level, seventy two percent of greenhouse gases emission is consequences of household activities, which is influenced by lifestyle (Majid et al., 2014). It is expected that rural households emit more carbon dioxide into the atmosphere. The rural households tend to use more energy and more carbon intensive solid fuels than urban households. Similarly, in the countryside distances are longer and more transport action cause more emission (Jaiswal and Shah, 2013). Micro-level carbon dioxide emissions, which are connected to household consumption and affected by lifestyle, are receiving more and more attention. Research on household's carbon emission has become one of the most popular areas of climate change mitigation. As a consequence of climate change issue, increasing attentions are attracted to topics like energy consumption and carbon emissions.

Carbon footprint has become a widely used term and concept in the public debate on responsibility and abatement action against the threat of global climate change (Wiedmann and Minx, 2008). The common baseline is that the carbon footprint stands for a certain amount of gaseous emissions that are relevant to climate change and associated with human production or consumption activities. Thus, the main objectives of this study therefore are, to measure the carbon footprint at household level due to emission from fuel and energy consumption in study area which would help in implementing carbon capture strategies.

2. MATERIAL AND METHODS

The study area i.e., village 'Chak Chua' lies in district Jammu of J&K state which is located at 32° 36' North latitude and 74° 54' East longitude at an altitude of 300m above mean sea level. The village is 11.7 Km away from the district Jammu. Climate of the area was found to be humid subtropical the study area is very hot and can reach up to 40 ^{0}C whilst in July and August, heavy though erratic rainfall occurs with monthly extremes of up to 50mm. In September, rainfalls declines, and by October conditions are extremely dry with minimal rainfall and temperatures of around 29 ^{0}C. The area is plain and rain fed and depends partially on rainwater for irrigation because most of the water is received from perennial streams. The whole area is irrigated by the perennial streams with the help of canals to the adjoining agricultural fields. The population of the area meets its fodder and fuel wood requirements mainly by lopping and cutting of trees from the agricultural fields and homestead areas. Besides fuel wood, other fuels used include LPG and kerosene. The present study was carried out in the rural area of Jammu district. A thorough questionnaire was prepared to calculate individual carbon footprint of the respondents selected randomly. Data were collected from eighty two households. The data was collected personally, and the respondents were requested to thoroughly fill the details in the questionnaire, to the best of their knowledge. Data regarding fuel and electricity consumption was calculated per house/month and per capita/month (Kumar and Sharma, 2014). Carbon footprints have been calculated following Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), Indian Network for Climate Change Assessment (INCCA, 2010) and (DEFRA, 2012-13). Carbon footprint in kgCO_2e was calculated by multiplying quantity of fuel or electricity unit consumed by household with conversion factor (Ramachandra and Shwetmala, 2012). The conversion factors used for Kerosene = 2.5382 kgCO_2e (IPCC, 1997), Coal =3.26 kgCO_2e (DEFR, 2012) and conversion factors used for petrol, diesel, electricity, wood and LPG are 2.2144, 2.6008, 0.44548, 0.1 and 1.4929, respectively (Carbon Trust, 2013).

3. RESULTS AND DISCUSSIONS

Demographic status of the study area revealed that highest representation was from age groups fifteen-thirty years and thirty-sixty years while the lowest representation was by the age group above sixty years. The sex ratio of the study area showed an increasing trend with higher age group. However, lowest sex ratio of females per thousand males was observed to be in the age group below fifteen years. Literacy status of study area reveals that literacy status of males and females in the area was 48 percent and 29 percent, respectively. Population of the area was categorized in four income classes viz. Very low, Low, Medium and High on the basis of their monthly income classes (Table 1). The percentage representation of medium income class was found to be highest (45%), followed by high income class group (35%). The highest percentage representation of high- and medium-income class was due to the reason that they had large land holdings, agriculture, employment and dairy farming.

Average values of petrol, diesel, kerosene, LPG, coal, wood and electricity consumption has been provided in the table 1. In study area, average consumption of petrol was recorded highest which is 30 liter/house/month and followed by diesel, LPG and Kerosene having consumption of 16 liter/house/month, 15.4 liter/house/month and 15 liter/house/month, respectively (Table 2). Per

capita consumption of fuel was also observed highest for petrol, which is calculated as 0.083 liter/capita/month followed by diesel having per capita consumption value of 0.044 liter/month. In general, the average consumption of various fuels in study area are in following pattern; Petrol (P) > Diesel (D) > LPG (L) > Kerosene (K) > Wood (W) > Coal(C). Average electricity consumption in study area is 145 Kwh per house per month and average per capita energy consumption is 0.401Kwh (Table 2).

Carbon foot print is one of the humanities greatest challenge and one of the important indicators that the people are in ecological overshoot. Since the carbon footprint is 50 per cent of humanity's overall ecological footprint, reducing carbon footprint is essential to end ecological overshoot (Dev, 2009). Carbon footprint values for households of study area are presented in table 3. The total calculated carbon footprint among households of study area is 238.91 $kgCO_2e$/month. It varied from 0.25 to 66.43 $kgCO_2e$ per house per month for wood and petrol, respectively.

Per captia carbon footprint among the households of village Chak Chua from various fuel and energy source is also calculated and it is observed highest for petrol (0.184 $kgCO_2e$/month) and lowest for wood (0.0007 $kgCO_2e$/month).

Table 1

Representation of various income classes in the study area

S. No	Income class	Families (%)
1	Very low	05
2	Low	15
3	Medium	45
4	High	35

Table 2

Average fuel and energy consumption pattern of households in study area

Fuel	Energy	house/month	capita/month
Coal	---	1.52 kg	0.0042 kg
Petrol	---	30 liter	0.083 liter
Diesel	---	16 liter	0.044 liter
---	Electricity	145 kwh	0.401 kwh
Wood	---	2.53 kg	0.007 kg
LPG	---	15.4 liter	0.043 liter
Kerosene	---	15 liter	0.042 liter

Table 3

Average carbon footprints of households in village Chak Chua

Source	$kgCO_2e$ per house/month	$kgCO_2e$ per capita/month
Coal	4.9552	0.013726
Petrol	66.432	0.184022
Diesel	41.613	0.115271
Electricity	64.590	0.178932
Wood	0.2530	0.000701
LPG	22.990	0.063686
Kerosene	38.073	0.105465
Total	238.91	0.661804

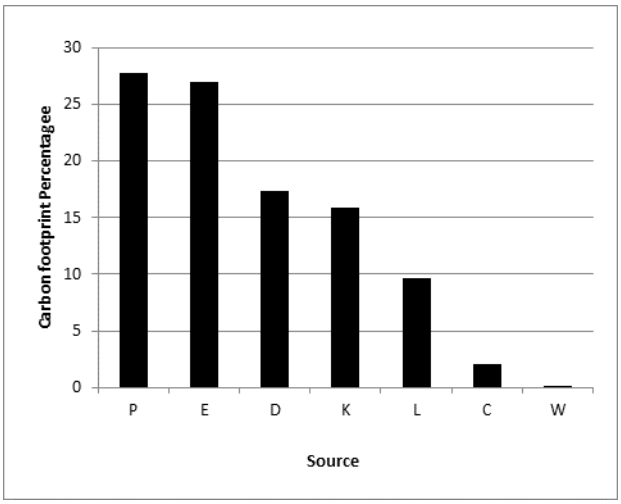

Figure 1

Percentage of Carbon Footprint per household per month in study area

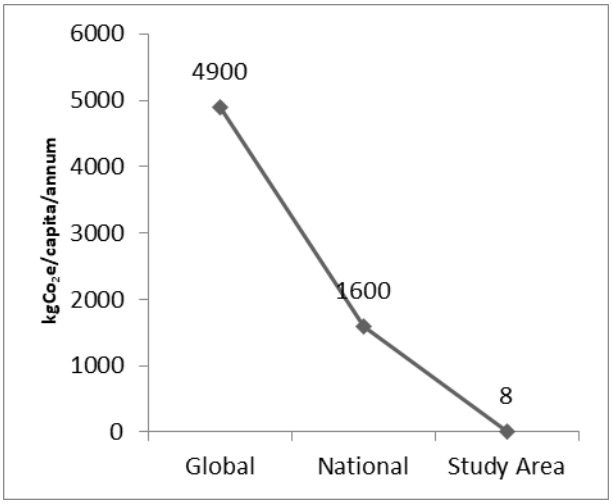

Figure 2

Carbon Footprint of study area with respect to global and national average

Percentage values of carbon foot print for different fuel and energy sources among the household of study area is also calculated and presented in Figure 1. It has been observed that out of total carbon footprint, the maximum share is of petrol and electricity. In general, the percentage share of carbon footprint for various fuel and energy source follows the trend: P (27.8%) >E (27.03%) > D (17.41%) > K (15.93%)> L (9.62%)> C (2.07%) > W (0.1%). These results show that, average per capita carbon footprint for household of study area is considerable lower than the global and national average carbon footprint (Figure 2).

4. CONCLUSION

The study revealed that the main contribution in the carbon footprint of households is of petrol which is mainly due to the use of personal vehicles for transportation. Electricity is the main source of energy in the study area which is also second highest contributor of carbon footprint among the household. Income is a key factor to household's lifestyle, as income increases, people try to improve their living standards by buying better appliances, new vehicle. Since the various household actions command to perform various roles in the house by different family members, their correct and proper practices will reduce the emission of

carbon dioxide, if the households are made aware about it. The awareness should be created among the households to chose energy efficient home appliances, carpool or take public transport, plant tree etc.

Acknowledgement

The authors are thankful Head Department of Environmental Sciences, University of Jammu for facilities and encouragement.

Ethical approval

Not applicable.

Informed consent

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

Funding

The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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