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Gender Empowerment Through Greenhouse Gas Inventory in Barangay Sto. Tomas, San Jose City, Nueva Ecija

Edmark P. Bulaong[1*]; Gella Patria L. Abella[1]; Roberto D. Pelayo[1]; Lea S. Caguiat[1]; Daryl A. Juganas[1]
Teodora A. Polo[1]; Neal Vincent Fernando[1]
[1]Institute for Climate Change & Environmental Management, Central Luzon State University,
Science City of Muñoz, Nueva Ecija, 3120, Philippines

Corresponding Author:- Edmark P. Bulaong[1*]

Abstract:- Developing a greenhouse gas emissions inventory is a key step toward understanding and managing local emissions. With this, a household emission calculator was developed to provide a local greenhouse gas inventory (GHGI) tool to monitor and identify emission sources and serve as a basis for the mitigation strategies. Post hoc comparisons using the Tukey HSD test indicated that the carbon emissions of households living inside a subdivision (M=4.9, SD=1.41) is significantly higher than households living outside subdivisions (M=4.26, SD=0.62). In terms of income, the higher the income, the more tendency for households to buy equipment and recreational appliances (73%) which directly influenced the carbon footprint output (r 0.129*). In transportation, old model vehicles (r 0.425*) and having no itinerary plan (r 0.375*) correlated with the emissions coming from the transport sector. In food, meat preference (0.401*) and reheating of food (r 0.312*) strongly affects the overall emissions. Using the greenhouse gas inventory, the respondents had a lower monthly carbon footprint in July 2022 (M=3.71, SD=1.12) compared to the previous months (M=4.56, SD=1.82). The study suggests that awareness of actions and the presence of quantifiable instruments result in more accurate measures to mitigate carbon emissions.

Keywords:- *Calculator, Carbon Emission, Greenhouse Gas Inventory, Household.*

I. INTRODUCTION

The Philippines contributed 0.31 percent and 0.39 percent, respectively, of the total world greenhouse gas (GHG) emissions in 2010 and 2015, respectively. As the economy expands, emissions in the nation are rising. The energy, industrial processes, agriculture, and waste generation sectors are the four (4) that contribute the most to GHG emissions, according to the Philippines' greenhouse gas inventory from 2010. The country's total greenhouse gas (GHG) emissions increased by 41.8 percent in 2010 due to the usage of coal and fuel oil for electricity generation, and that percentage is increasing at a rate of 3.7 percent yearly. With 35% of all emissions, transportation came in second.

The developed country parties, or so-called Annex I countries, are primarily responsible for adopting policies and steps to reduce their anthropogenic emissions of GHGs under the United Nations Framework Convention on Climate Change (UNFCCC). Even though it is a developing nation, the Philippines is nevertheless required to enact laws and regulations to reduce its anthropogenic GHG emissions.

A significant portion of the total amount of greenhouse gases in the atmosphere came from anthropogenic emissions. By lowering the concentrations of greenhouse gases (carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6) in the atmosphere to a level that would prevent dangerous anthropogenic interference with the climate system, the Kyoto Protocol implemented the UNFCCC's goal to delay the onset of global warming.

The National Climate Change Action Plan: Knowledge and Capacity Development mandates that the Philippines develop methods for reducing GHG emissions, anthropogenic sources, and enhancing removals by sinks. This is in accordance with Republic Act No. 9729, also known as the Climate Change Act (amended RA 10174). The Climate Change Commission is the project's leading organization. Executive orders pertaining to the GHG inventory may be issued or released by the Climate Change Commission.

Today's weather is incredibly unpredictable, and the world's climate is shifting and changing constantly, inflicting tremendous anguish, pain, and death for millions of people. Families started to become destitute, unproductive, and homeless. Environmental challenges are more essential than ever and have a significant impact on people's daily routines, so there must be a solution. Human actions can cut back on the sources of GHG emissions. As an illustration, in the transportation sector, mitigation can be accomplished by enhancing sinks of GHGs like planting trees and vegetables, promoting biodiversity, and by being aware of our emissions and conservation/mitigation strategies. It can also be accomplished by improving driving practices, reducing demand for travel, and advancing vehicle design and materials technologies.

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In order to identify and pinpoint the sources of emissions, the study measured and tracked greenhouse gas emissions. Scientific research has shown that greenhouse gas emissions increase the global heat that causes climate change. The greenhouse gas inventory, or GHGI, assists in tracking and cataloging emission sources and carbon footprints in order to provide awareness and guidelines for conducting mitigation initiatives. With the use of the GHGI, the community was able to manage the risks brought on by excessive greenhouse gas emissions, and measures for their reduction were developed to lessen their harmful impacts, such as global warming.

Global warming is a result of too much greenhouse gases in the atmosphere. The national economy and local governments frequently take several years to recover from the effects of extreme weather events, which affect human lives, ecosystems, and infrastructure loss.

Everyone has emissions and every activity generate a carbon footprint and everyone is responsible for conducting the inventory and accounting. Sto. Tomas is one of the 38 barangays of San Jose City, Nueva Ecija. It is categorized as a rural community with vast plains of rice fields and emerging micro-businesses scattered in the area, with a fast-pace developing community, the Barangay pose to increase its energy usage and emission output, moreover, as one of the main crossroads, the Barangay also continuously increase its traffic contributing to emissions by transport sector.

The more we are aware of what we do, the more accurate we can target for reduction and the more alternatives we can do that can help us adapt to or mitigate the GHG emissions. The general goal of the study is to have quantitative measurement that will offer insights on how we can specifically target our reduction and what mitigation strategies will be applied and be effective for every household and for the whole community.

The study estimated the carbon emissions of households in Barangay Sto. Tomas, San Jose City, Nueva Ecija. The inventory of greenhouse gases enabled quantifiable measures for mitigation strategies to be developed. The study firsthand established a household-level greenhouse gas inventory in Barangay, Sto. Tomas, San Jose City using a novelty-standardize household accounting calculator software (available and specifically developed for household use) which projected annual carbon footprint. Specifically, the study:

- *Established partnership with City and Barangay LGUs, City GAD FPS and Management Offices;*
- *Raised the level of awareness and preparedness of the constituents of the barangay on Greenhouse Gases;*
- *Capacitated the household of the barangay on GHGI and Reporting;*
- *Determined adaptation and mitigation strategies towards carbon emissions*
- *Generated sex-disaggregated data for carbon emissions*

II. MATERIALS AND METHODS

A. Community Involvement: Brgy. Sto. Tomas

Sto. Tomas is one of the 38 Barangays in San Jose City Nueva Ecija. It is categorized as a rural community with vast plains of rice fields and emerging micro-businesses scattered in the area. Everyone has emissions and every activity we do generate our own carbon footprint and everyone is responsible for conducting the inventory and accounting. The more we are aware of what we do, the more accurate we can target for reduction and the more alternatives we can do that can help us adapt to or mitigate the GHG emissions. The study focused on household-level GHGI of Brgy Sto. Tomas, San Jose City, Nueva Ecija. Organizational and Operational Boundary from Household emissions included Household GHGI of Direct and Indirect Emissions from Sector 1, 2 and 3 that creates the baseline of GHG emissions.

Table 1 Scope of Data Collection for the GHGI Calculator

Carbon Emission	Household Level Scope
SCOPE 1: Direct Emissions	• Household Size • Family Vehicles ○ Diesel ○ Gasoline • Stationary Combustion (LPG, Coal, Wood)
SCOPE 2: Indirect Emissions	• Electricity Bill
SCOPE 3: Indirect Emissions	• Solid Waste Generated • Public Transportation • Food Consumption (Frequency)

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B. Timeline and Beneficiary

The study was conducted in the time frame from April 2022 to March 2023 at Barangay Sto. Tomas, San Jose City, Nueva Ecija. The women specifically the mothers of each household are well-known to account for the everyday expenditures and everyday activity of each family member, as such they are also the one responsible and the one monitoring every household use, electricity/water bills, energy and food consumption, and waste accumulated. In this premise, it is common knowledge that most households, the women are more into the mental load in terms of managing and planning as a parenting role in their family (Pew Research Center, 2012). The men that also serve as household heads can also lead in creating the inventory as such they are generally more

involved in the transportation sector and other relevant activities that generate emissions.

C. Abbreviations and Acronyms

During the Pandemic (Dec 2019-Dec 2021), the Brgy. Sto. Tomas community observed an abundant increase in their electric bills. Based on their records, the monthly bills were consistent throughout the year. Even the electric consumption during summer were the same with other months wherein the weather is much cooler. The community has about every appliance needed at home and are all subscribed to an internet and cable connection. The residents generally would like to lower their consumption of electricity with minimal impact on their daily activity, and this project proposed a method in how the community can monitor their consumption and devised a way to optimized their usage, create a power usage pattern, lower their monthly bills in electricity and together, help in lowering carbon emissions for the sake of the environment.

Appliances use electricity, and this power comes from coal-fired thermal power plants which are operated by SAJELCO. The coal-fired thermal power plant use fossil fuel which produce large amount of carbon emissions, and this carbon emission are stored in the atmosphere which can increased the greenhouse effect of the earth to its limit which results to global warming.

➢ *Specifically, Other issues were Identified in the Area which Includes:*

- Un-monitored power usage in the area
- The absence of an assigned street lights switcher
- Ineffective minimization of electric bills in the community
- Lack of awareness and planning of electric usage
- Monthly expense increase in food consumption
- Monthly expense increase in transportation
- Monthly increase in waste generation.

D. Technology use

The effectiveness of various emission reduction techniques can be evaluated using the software used to calculate emissions. For example, they can be used to determine how many carbon dioxide equivalents can be avoided if a particular action is taken, such as enhancing building insulation as opposed to another action, such as adding more heating and cooling systems. Such comparisons aid in making well-informed choices regarding more significant and affordable reduction initiatives. The type of fuel your power plant uses to produce the energy and the amount you use will determine how many greenhouse gas emissions are produced by the electricity you use at home. The efficiency of your appliances, the size of your home, and the quantity and kind of fuel used all affect how many greenhouse gases they generate. The amount of emissions produced by a vehicle depends on its fuel economy, the distance traveled, and the driving style used. Additionally, the more recycling you perform, the less garbage will be dumped in landfills and the less greenhouse gas emissions will be produced during the processing of raw materials.

E. Conceptual Framework

The research incorporated the IPCC 2021 Greenhouse Gas Emission Assessment Protocol and estimate carbon emissions from household level data.

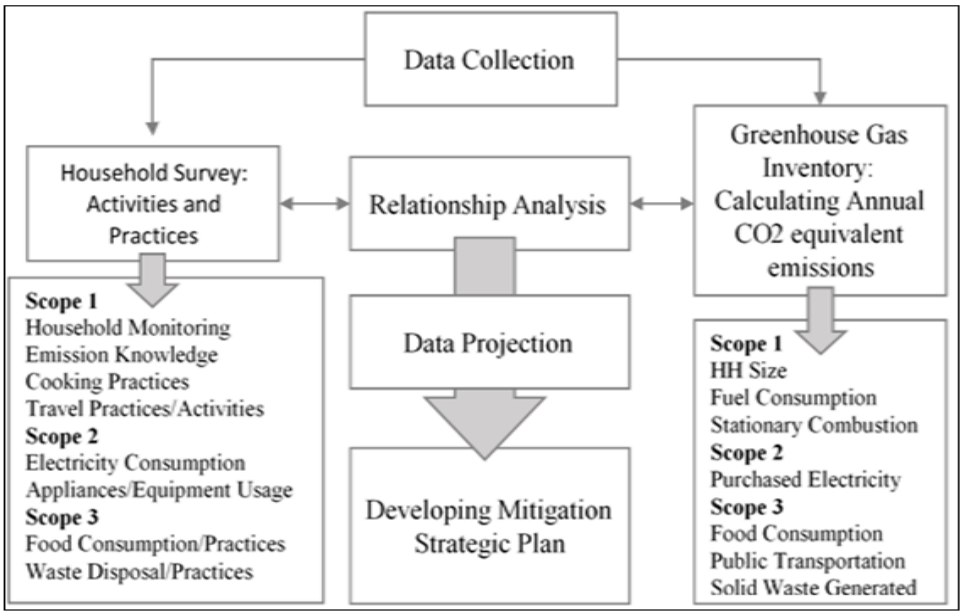

Fig 1 Conceptual Framework for the Study

The conceptual framework (Figure 1) involved data gathering of greenhouse gas emissions through survey that enumerates household carbon equivalent emissions. A separate questionnaire was also constructed to gather household practices and activities that may identify possible sources of emissions that can be subject for mitigation strategies. The study correlated the household activities with the household emissions and project if there's a strong relationship between the two. Mitigation strategies were developed based on the data gathered from the study.

III. RESULTS AND DISCUSSION

A. Respondents Profile

Frequency analysis shows the distribution and the times the selection from the questionnaire occurred. The frequency in sex, age, income bracket distribution determined the range of categories where the population belong to.

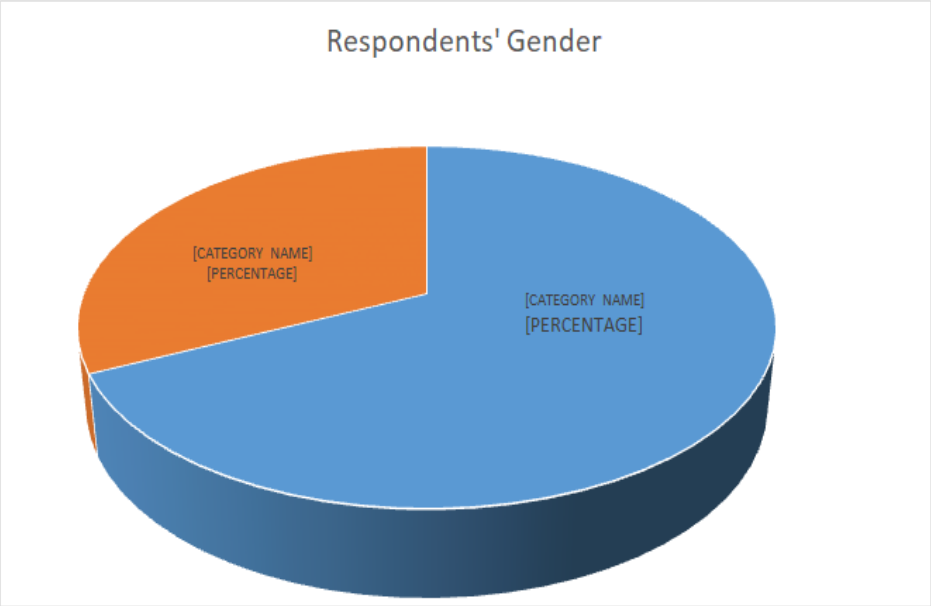

Fig 2 Frequency Analysis: Distribution of Respondents' Gender

The total respondents were 144 randomly selected household heads, with 12 respondents distributed from the 12 zones of the Barangay. Out of the total participants, 98 were Female household heads and 46 household heads were Male.

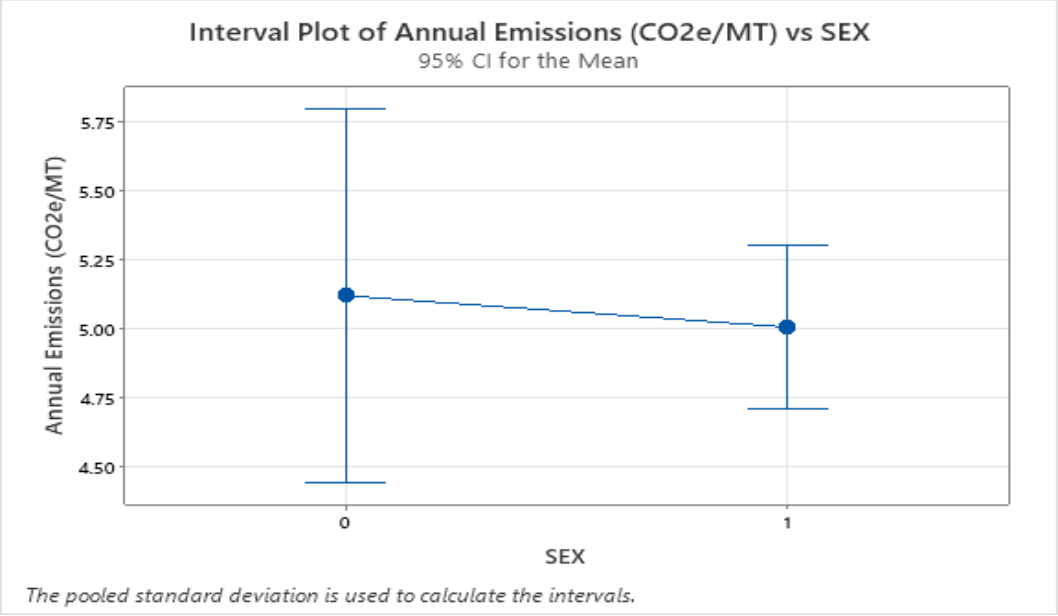

Fig 3 Emission Comparison in Terms of Sex

Table 2 Emission Comparison in Terms of Sex

SEX	N	Mean	St Dev	95% CI	Source	DF	Adj SS	Adj MS	F-Value	P-Value
Male (0)	23	5.118	1.572	(4.443, 5.793)	SEX	1	0.250	0.2496	0.09	0.761
Female (1)	121	5.004	1.650	(4.710, 5.299)	Error	142	380.980	2.6830		
					Total	143	381.229			

Pooled St Dev = 1.63797

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Results in sex-disaggregated data showed a significant difference of emissions between male and female household heads. A male household head has significantly higher carbon emissions (5.118) compared to females (5.004). This data is comparable to the national trend of gender differentiated data (CCC-National Climate Change Action Plan, 2011) on carbon emissions with Males having their increase appetite for meat, and with males being a major user of vehicles specifically four wheeled cars. Men also have spent more time in gas-intensive item such as cooking and fuel. Entertainment on the other hand also was more inclined to men (92%) based on the household-activities and practices survey. These energy intensive materials and properties may have a big factor in making men having higher carbon footprint compared to women. Recent studies (Xi-LiuYUE and Qing-XianGAO. 2018) also showed that despite having relatively similar monthly incomes, male consumption of products contributes 16% more to global warming emissions than that of women.

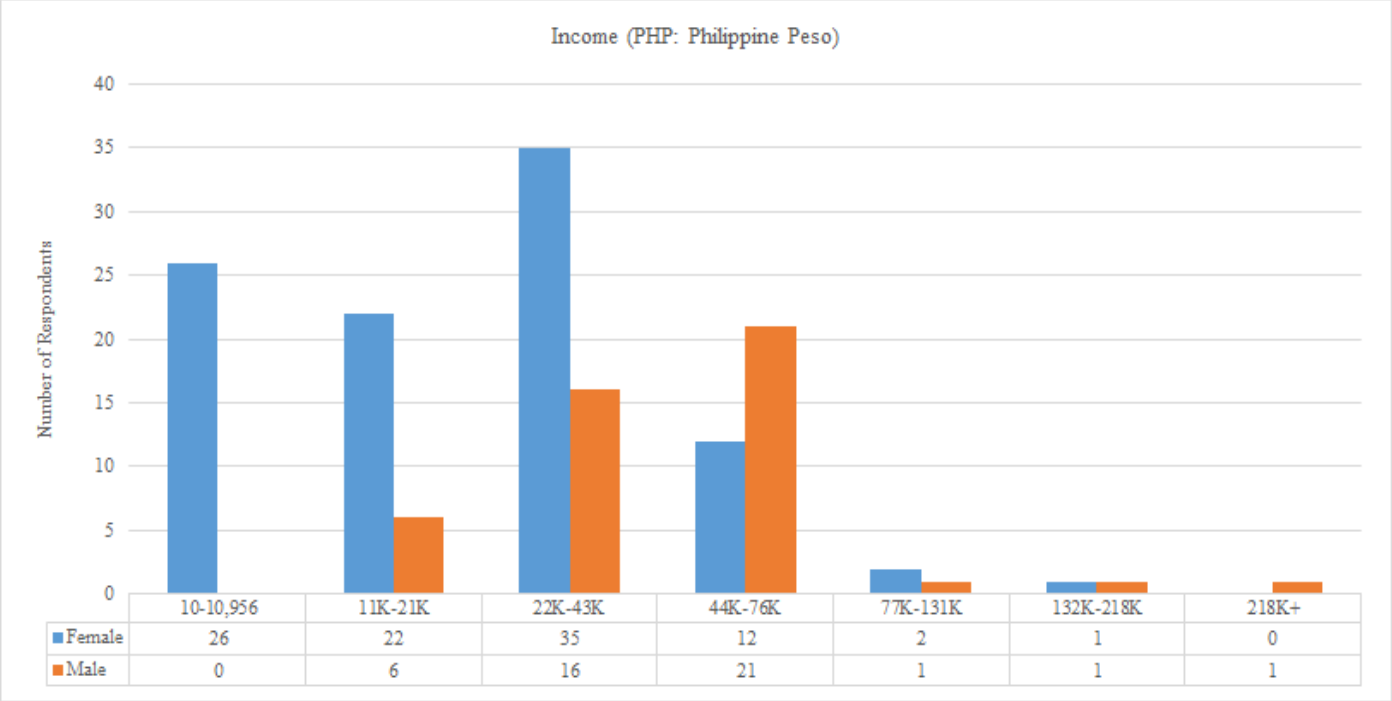


Fig 4 Frequency Analysis: Income Bracket

There were a majority of respondents belonging to the middle aged working class group (age 30-50). Based on the preliminary survey of occupations, most respondents were farmers and business owners, while the minority were government or private employees. The age group of 61 and above were also well represented with 24 participants in total, while the age group of 15-20 were also represented by the young household heads with 14 respondents. Male household heads were the highest earners based on the survey with 3 male respondents exceeding the PHP 130,000.00 monthly income. 26 participants (female) responded that they earn around PHP 10,000.00 monthly which is considered as the lowest base pay on provinces.

Table 3 Household Criteria

Location Type and Household Size	Households	Total
Subdivision (Lexber Subdivision, Twin Hearts Subdivision and Roseville Subdivision)	18	144
Rural Area	126	
One Person Household	8	144
Two Person Household	31	
Three Person Household	32	
Four Person Household	41	
Five or more Person Household	32	

The distribution of participants based on area type and household were also accounted. The geographic classification of Barangay Sto. Tomas is rural, and the type of rural area in the study were assigned as rural-subdivision type and rural area. This classification was useful in determining whether practices, activities, usage and emissions have a significant difference between households residing inside the subdivision and those that are outside subdivisions which were mostly situated in agricultural lands. Household size were also accounted for to determine 5 household size classifications. The household size ranging from 2 to 5+ were well represented in the survey with only 8 households representing only one individual.

B. Carbon Footprint

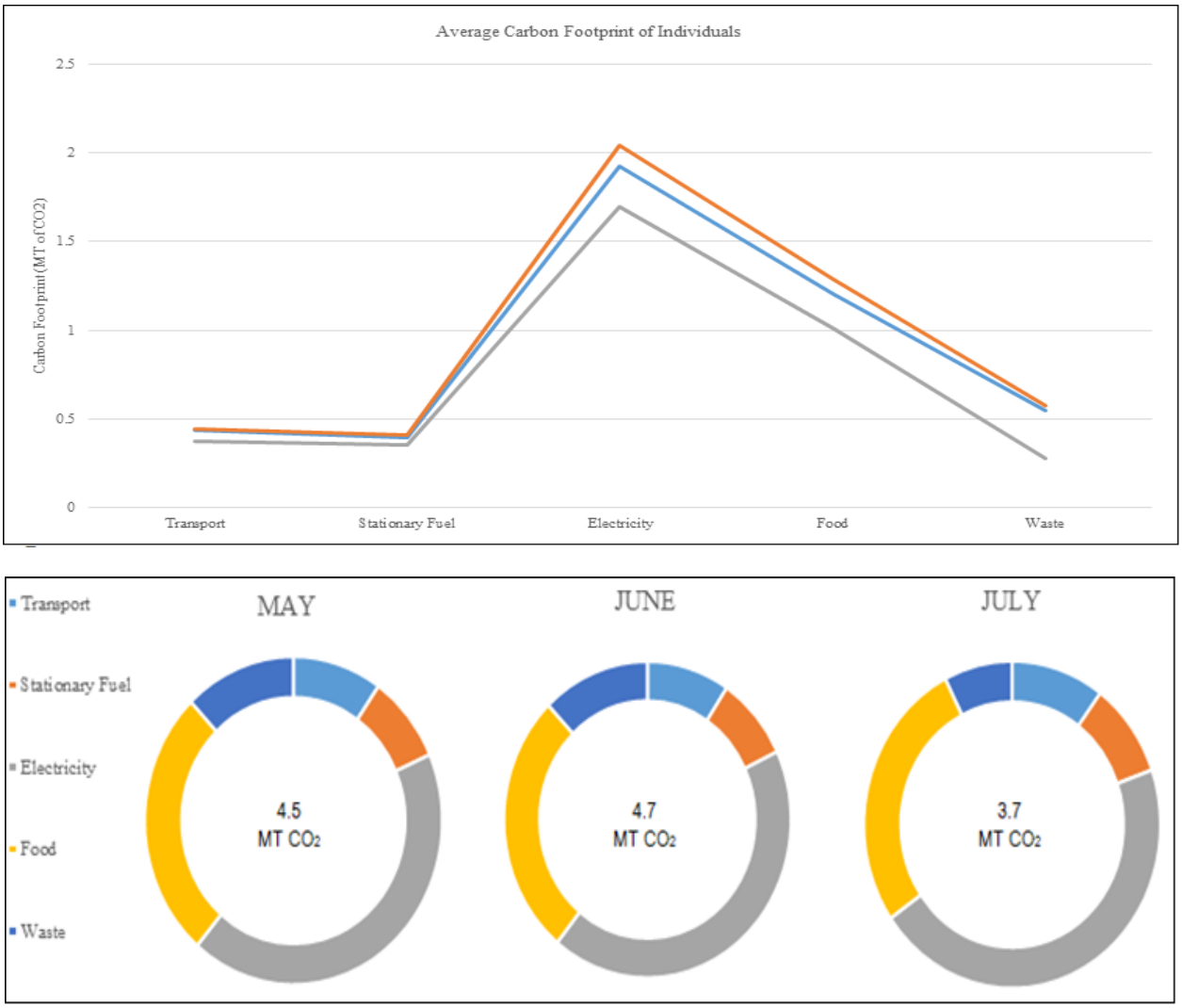


Fig 5 Average Carbon Footprint of Individuals

The trend of emissions of the different sectors (Transport, Stationary Fuel, Energy, Food, Waste) follow the same path for the month of May, June and July 2022. The energy sector (Electricity Bill/Consumption) was attributed as the main contributor to the overall carbon emissions with an average of 1.9 MT of CO2 equivalent (e) for 3 months. Energy demands in the Philippines are continuously on the rise with a projected energy demand rising up to 20% on 2022 (PSA 2022), this can be a precursor on the trend of the same fate in terms of an increased in energy emissions. Purchased goods categorized as indirect emissions represented by the food consumption of the family attributed the second most contributor of emissions with an average of 1.2 MT of CO2e for 3 months. Food consumption by a household can be a great contributor to greenhouse gases (IPCC, 2014), producing meat usually consumed more resources such as water and energy in terms of per kilogram net produced (Rippin HL, Cade JE, Berrang-Ford L, Benton TG, Hancock N, et al. 2021). This data can powerfully project how individuals or households can help lessen carbon emissions in terms of changing preference to a more sustainable food sources. Transportation on the other hand was a minor contributor of emissions, based on the calculated data, households travel only when the need arises and workplaces ranges only to a distance of 1-12 km of travel per day. This is in line with the current trend of transport emissions nationwide due to the COVID-19 pandemic that lessens the overall used of vehicles (Grépin KA, Ho T, Liu Z, et al. 2022). The data of transport emissions was different before the pandemic, and it usually was one of the main contributors of emissions in the Philippines (Kristhel Anne M. Caynila, Katherine T. Luna, and Sarah Amabelle A. Milla. 2022). Waste generated by a household were also accounted for which includes solid wastes they produce per day that usually go on trash bins and go to landfill waste. Based on the data, 0.4 MT of CO2e are released in the air by waste ranging from 1-3 kg per day. These emissions were widely accounted to contribute also to pollution and land toxicity (Christine Wiedinmyer, Robert J. Yokelson, and Brian K. Gullett. 201). Based on recent studies, waste handling is very important in order to lessen emissions, waste that are properly stored and incubated can slowly decomposed and be absorbed by soil, water and air which is in contrast to wastes burned or exposed openly that releases emissions in the air increasing the greenhouse gas (David G. Streets et al. 2017).

The stationary fuel comprises of using fuels for cooking, heating and/or other activities by using Liquid Petroleum Gas (LPG), Coal and wood. 6 household members were identified to continually use coal and wood for cooking, studies have shown that using coal or wood release carbon captured in the air and stored in a tree thus releasing again the greenhouse gas into the atmosphere, some studies (Susan A. Shaheen and Timothy E. Lipman. 2007) suggest that using sustainable fuels from farm produce can be a carbon neutral alternative which can benefit both the environment and the consumer compared to using processed fuels.

The overall emissions of households were also accounted, the month of May 2022 has a total of 4.5 MT of CO2e, June 2022 has 4.7 MT of CO2e while the Month of July 2022 has a sudden drop of only 3.7 MT of CO2e. This can be due to the decrease of emissions from food consumption, electricity and waste. Temperatures in the area of San Jose City, Nueva Ecija, significantly decrease in the month of July 2022, with June being the start of rainy season in the country, early heavy rainfalls (248 mm) were recorded on July 6, 2022 with an average of 26.7°C for the month of July lower compared to the month of May (29.7°C) and June (28.6°) (PAGASA 2022). The weather can be an indicator to the decrease of emissions based on energy sector, respondents also noted that there was less time of operation for their cooling equipment due to the rainy season. The seminar-workshop may also help in lowering the overall carbon emissions of Barangay Sto. Tomas, on July 6, 2022, a training on GHGI was conducted in order to capacitate household heads in inventory and accounting of their household activities and practices together in monitoring their bills, travels, consumption and usage. The workshop also included information dissemination on how the household can mitigate carbon emissions by reducing sources of emissions and adapting change in order to lessen also their carbon footprint.

C. Difference on Carbon Footprint per Month

Table 4 Analysis of total carbon emissions per month

Result Details				
Source	*SS*	*df*	*MS*	
Between-treatments	86.6209	2	43.3104	$F = 14.4921$
Within-treatments	1282.09	429	2.9886	
Total	1368.7109	431		

The f-ratio value is 14.4921. The p-value is < .00001. The result is significant at p < .05.

Pairwise Comparisons		$HSD_{.05} = 0.4792$ $HSD_{.01} = 0.5967$	$Q_{.05} = 3.3261$ $Q_{.01} = 4.1423$
T_1:T_2	$M_1 = 5.19$ $M_2 = 5.46$	0.26	$Q = 1.83$ ($p = .39968$)
T_1:T_3	$M_1 = 5.19$ $M_3 = 4.40$	0.79	$Q = 5.49$ ($p = .00036$)
T_2:T_3	$M_2 = 5.46$ $M_3 = 4.40$	1.05	$Q = 7.31$ ($p = .00000$)

Legend: T1=May, T2=June, T3=July

There were significant differences between the total carbon footprint per month. The total carbon footprint of May was significantly different to the total carbon of July (Q=5.49, p = 0.00036) and also with the total carbon footprint of June to the total carbon footprint of July (Q=7.31, p = 0.000) based on F-test one-way ANOVA. The data showed that in the month of July, there is a significant decrease of the total carbon footprint of households in Barangay Sto. Tomas, this may be due to change in weather and the decrease in demand on electricity supply especially during rainy season, this is also evident on previous studies by Iain Staffell, Stefan Pfenninger, (2018) wherein electricity consumption is becoming increasingly weather-dependent and cold weathers could see decrease of energy demand.

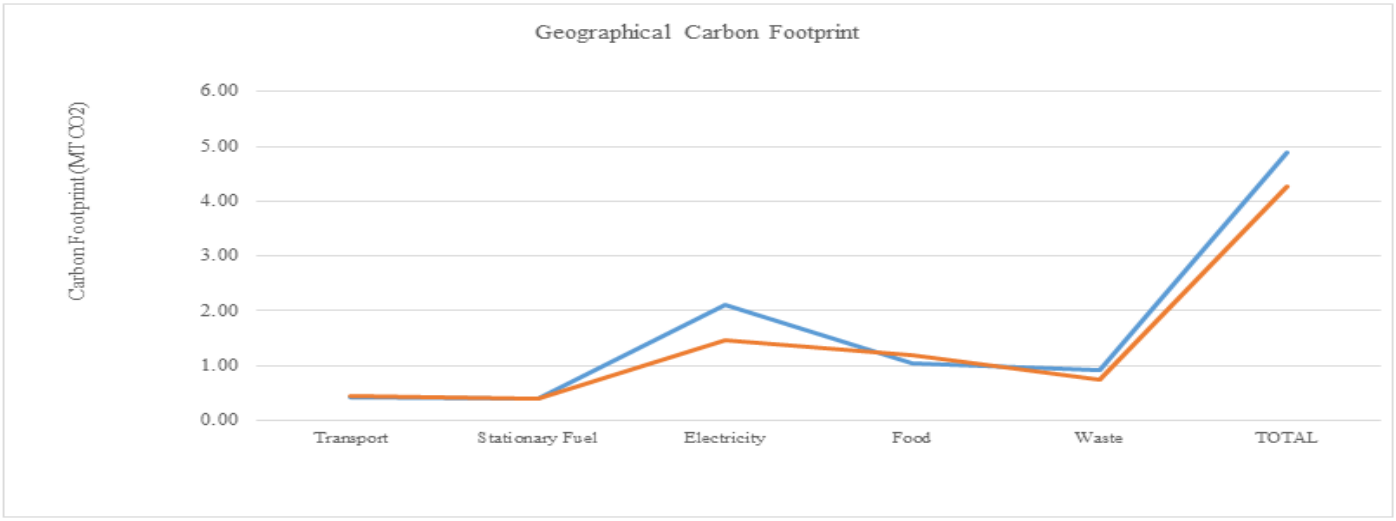
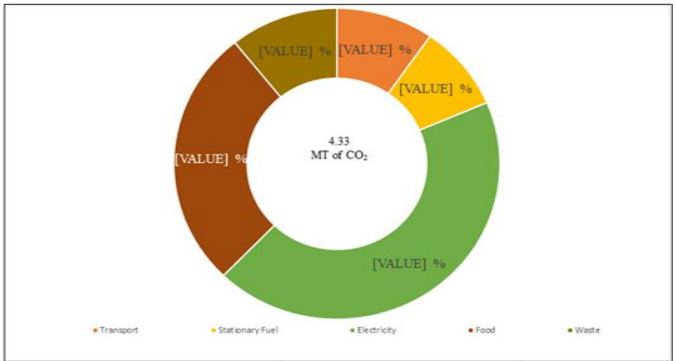


Fig 6 Carbon Footprint from Rural areas and Subdivisions

The data showed that energy usage (Electricity) was higher in households residing in subdivisions compared to other households. This indicates that carbon emissions inside the subdivision are also higher. Studies have shown that having a complete concrete paved road with less vegetation and/or trees increased the overall temperature of an area, having infrastructures situated densely in an area also increased absorption of heat and heat stored in such areas slowly release the energy overtime making subdivision hotter day and night which create an urban heat island effect (Alberto, A.M.P., Camaso, E.E., Bulaong, E. et al. 2020). This difference in temperature may have been a great factor in the usage of cooling facilities in subdivisions, hooter day and night may prompt a household to turn on electric fans and air-conditioning unit increasing their overall energy usage. In terms of transportation, there's a slight increase of carbon footprint in rural areas compared to residents in a subdivision, based on preliminary data, residents were mostly situated in barrios or farm lock lands with further distances away from highway roads, this increased their mileage used of their vehicles therefore increasing their transportation emissions.



SECTOR	Tons of CO2	Percent
Transport	0.42	10 %
Stationary Fuel	0.38	9 %
Electricity	1.89	44 %
Food	1.17	27 %
Waste	0.47	11 %
TOTAL	4.33	100 %

Fig 7 Average Carbon Footprint of Households

The annual carbon footprint of Barangay Santo Tomas was projected based on the accumulated data from 144 household heads distributed equally in population and area (12 zones). Sectors identified were the Transport Sector, Stationary Fuel (LPG, Wood, Coal), Energy (Electricity), Food and Waste. Based on the results, the top contributors of emissions per sector were the Energy Sector (44%), and Food Consumption (27%).

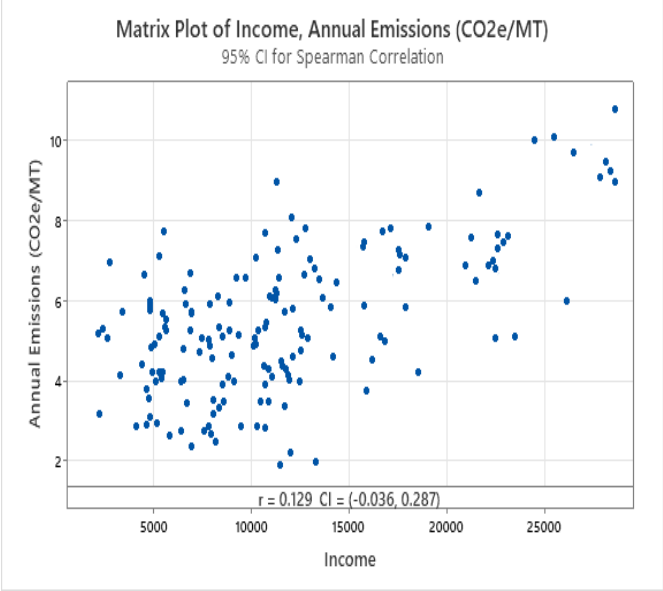


Fig 8 Correlation: Income and Emissions

The matrix plot of a household's carbon footprint generally increases with its income (Wier et al. 2001; Dey et al. 2003; Weber and Matthews 2008; Buchs and Schnepf 2013; Baiocchi et al. 2010; Gough et al. 2011; Kerkhof et al. 2009; Chitnis et al. 2014). The relationship between income and carbon emission has a very weak association (0.129) although studies have shown that in developing countries, as incomes increase households tend to shift their expenditures into equipment and recreational appliances which are generally more carbon intensive. According to the research, lower income households typically generate a larger share of their carbon emissions from basic needs like food and energy,

and specifically, emissions from electricity use typically result from direct energy use. Additionally, compared to lower income households, high income households generate a larger percentage of their carbon footprint through leisure and culture. Additionally, Weber and Mathews (2008) note that households with higher incomes and overall household expenses typically have a more diverse carbon footprint.

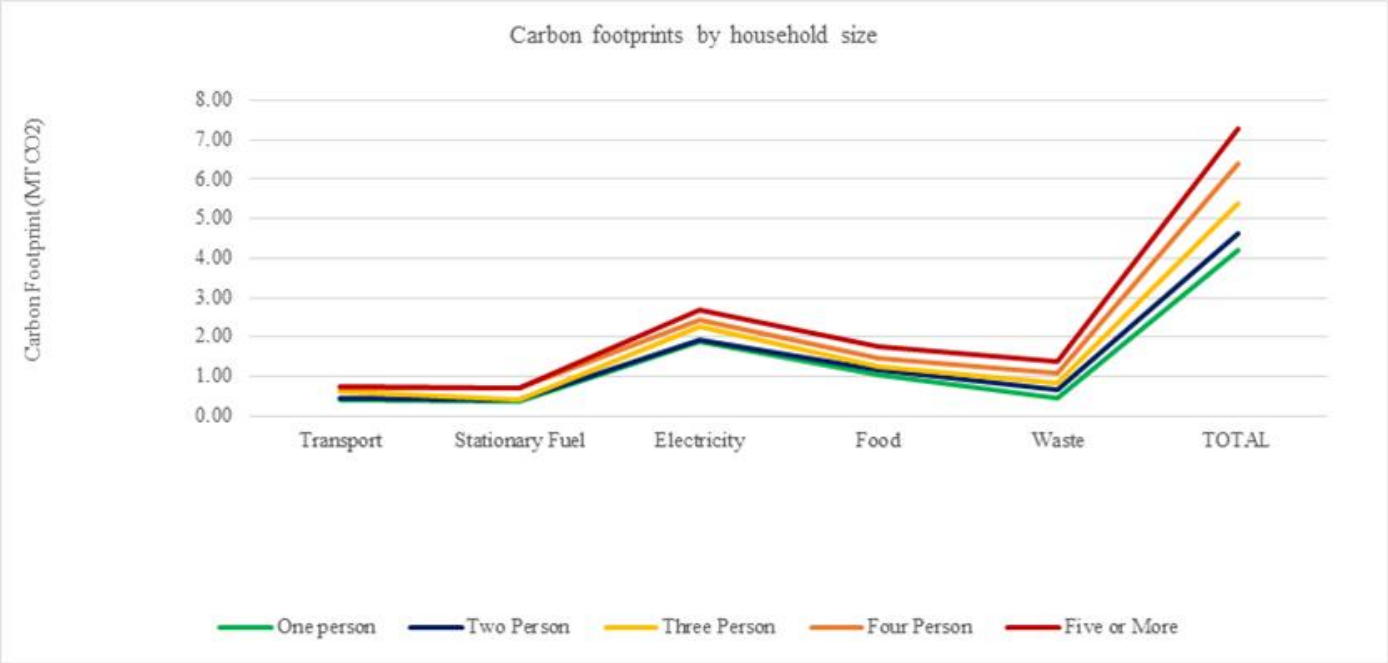


Fig 9 Carbon Footprints by Household Size

Household carbon emissions are typically found to be significantly influenced by household size, based on the figure, as more people are in a household, the more emissions are produced but also when it comes to other factors, household size (Dey et al. 2003; Baiocchi et al. 2010; Jones and Kammen 2011; Weber and Matthews 2008; Tukker et al. 2010; Gough et al. 2011) tends to profit from economies of scale. This is due to the fact that cohabitants often require less living space than single occupants do, which lowers the energy needed for heating and cooling, as explained by Tukker et al. (2010). Additionally, people who share a home also tend to share energy-consuming appliances. In their analysis of various household types, Gough et al. (2011) found that younger single person households tend to emit relatively high amounts due to transportation and personal services, and Buchs and Schnepf (2013) point out that economies of scale are less important for transport and indirect emissions.

D. Emissions Incurred from Household Practices & Activities

Households dwelling in extreme climates generally incur higher carbon emissions due to energy use for space heating and/or air conditioning (Tukker et al. 2010); however, this effect is moderated by other factors, such as the type of energy supply and housing construction. The carbon intensity of the electricity supply also effects household carbon footprints even if it is only used for powering lights, appliances and gadgets and not for heating, as intensities vary widely. This can be analyzed by determining key factors of sources of emission in terms of household practices and activities.

- *Driving Practices:*

The use of old model vehicles has a moderate degree of positive correlation (0.425*) with the transport emissions indicating that the older vehicles is used correlates to the increase of emissions in transportation sector. While travelling without plan or itinerary also indicates a moderate degree of positive correlation (0.375*) with transport emissions. The export of outmoded, polluting vehicles from affluent nations has increased over the years as demand for affordable used cars in poorer nations has expanded. Most automobiles emit greenhouse gases from their tailpipes when they are driven. Creating and transporting the fuel that powers your car emits greenhouse gases as well. For instance, to produce gasoline, oil must be extracted from the ground, transported to a refinery, refined into gasoline, and then transported to gas stations. These actions all have the potential to increase greenhouse gas emissions. The total carbon footprint of an individual increases when they travel without a set itinerary and use a car for even small trips that they could frequently make on foot or by bicycle. According to several research, people in industrialized nations also tend to drive short distances. For instance, in England, almost 60% of trips under two miles are performed by car (Nurzawani Md Sofwana, Mohd Talib Latif. 2020).

- *Cooking Practices:*

Reheating food has a moderate degree of positive correlation (0.312*) with the food emissions indicating that eating more meat correlates to increase of emissions from the food sector. Home cooking and re-heating accounts for 61% of total emissions associated with food preparation a study by Frankowska, A., Rivera, X.S., Bridle, S. et al. (2020). Reheating practices was strongly related to the increase of

stationary fuel emissions. Most studies project the emission impact of food only up to the purchase stages of the food supply chain (Frankowska, A., Rivera, X.S., Bridle, S. et al. 2020), thus excluding preparation, re-heating and cooking. The preparation of family meals can contribute up to 20% (Vegetable) and 36% (Meat) of total product emissions (Scarborough P, Appleby PN, Mizdrak A, Briggs AD, Travis RC, Bradbury KE, Key TJ. 2014). Consumer product purchases alone account for a significant portion of emissions, and utilizing electricity for heating further increases a household's carbon footprint.

➢ *Food Consumption:*

Preference on meat has a moderate positive correlation (0.402*) with the stationary fuel emissions indicating that the practice of reheating foods correlates in the increase of emissions of stationary fuel sector. When a carbon footprint is examined in terms of greenhouse gas emissions rather than carbon dioxide alone, the carbon emissions buried in food items typically make up a sizeable amount of it (Dey et al. 2003; Nijdam et al. 2005; Tukker and Jansen 2006; Druckman and Jackson 2009, 2010). The type of diet greatly affects this. In comparison to people who follow more conventional diets, vegetarians and consumers of locally obtained seasonal food typically have lower per capita environmental consequences from food consumption (Garnett 2013; Tukker et al. 2010).

➢ *Capacity Building, Monitoring Emissions:*

Participating in the capacity building for GHGI has a moderate negative correlation (-0.302*) with the overall emissions from the month of July 2022. This indicates that the training seminar may help in reducing the overall greenhouse gas emissions especially in the later part of data collection (July 2022). Developing a greenhouse gas emissions inventory is a key first step toward understanding and managing local emissions (UNFCCC, 2022). This was evident in the emission output for the month of July wherein respondents accumulated lower annual carbon footprint after conducting the capacity building of greenhouse gas inventory. The more we are aware of what we do, the more accurate we can target for reduction and the more alternatives we can do that can help us adapt to or mitigate the GHG emissions.

E. Determinant of Household Carbon Emissions

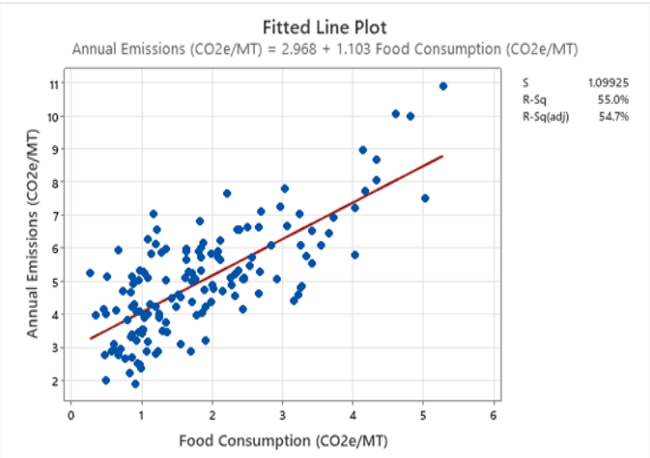


Fig 10 Food Consumption and the Total Household Emissions

The standard error of regression (S=1.099) falls below 2.5 which produce a sufficiently narrow 95% prediction interval. This showed that annual emissions increased on an average coefficient of 1.103 per food consumption emissions. The R-squared also indicates that 55% of data falls closer on the regression model. Food is essential for human survival, and the carbon footprint of food refers to the greenhouse gas emissions caused by the production, processing, transport, storage, cooking, and disposal of the food we consume. According to Song F, Reardon T, Tian X, et al. (2019), the greenhouse gas (GHG) emissions associated with food consumption make up 19%–29% of all GHG emissions globally. The consumption of processed foods and animal products is responsible for the large increase in GHG emissions (Xu, Y., Geng, Y., Gao, Z. et al. 2022). Despite the fact that GHG emissions rose from both urban and rural inhabitants, the distance between them is widening. Food consumption is primarily influenced by the agricultural, food processing and manufacturing, chemical manufacturing, transportation, storage, and post services industries. According to FAO-UN (2018), packaging, processing, transport and waste disposal generate additional carbon footprint on top of the emission from the type of food we eat.

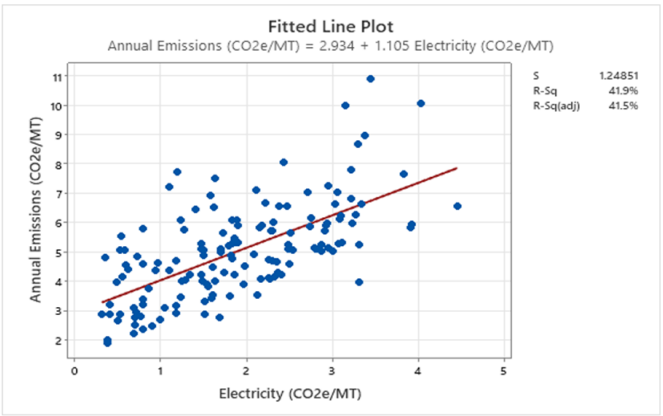


Fig 11 Energy Emissions and the Total Household Emissions

The standard error of regression (S=1.249) falls below 2.5 which produce a sufficiently narrow 95% prediction interval. This indicated that the average annual increase in emissions was 1.105 per emission of energy, specifically electricity. Additionally, the R-squared shows that 41.9% of the data fits the regression model more closely. There is a great of causality with the emissions from the energy sector specifically the electricity consumption which drives the increase of the total carbon footprint of a household. Electric power plant type and efficiency, as well as the fuel or energy source used, all affect emissions. Depending on the sources of electricity supplied to the electric power grid at any given time, the amount of CO2 created per kWh will change. 164.4 million metric tons of carbon dioxide equivalent (MtCO2e) or 0.39 percent of the world's GHG emissions were produced by the Philippines in 2019 (OurWorldinData, 2022). According to Lamiaa Abdalla and Tarek El-Shennawy (2013), the energy sector in the Philippines accounted for 52% of greenhouse gas emissions, specifically electricity consumption, which accounts for 40% of all global CO2 emissions. Electricity is produced by burning fossil fuels to produce heat that powers steam turbines.

IV. CONCLUSION

Analysis of Carbon Emissions also showed that households living in subdivisions or villas contributes more on carbon emissions compared to households living in the rural setup although the population sampled in a subdivision only comprises of 18 households compared to 126 households in the rural area. This shows that in terms of carbon emissions, the sources of emissions from the subdivisions comes from the energy sector and comprises of 34% of the total emissions of households. This attributed to an increase of 20% more of the emissions compared to the rural areas. Subdivisions often have higher temperatures due to a more urbanized setup and having a lot of carbon sinks such as concrete and infrastructures, the heat accumulates faster and affects the community thus the increase of energy usage such as electricity specifically cooling systems contributed to a lot of carbon emissions in the area.

Developing a greenhouse gas emissions inventory is a key first step toward understanding and managing local emissions. This was evident in the emission output for the month of July wherein respondents accumulated lower annual carbon footprint after conducting the capacity building of greenhouse gas inventory. The more we are aware of what we do, the more accurate we can target for reduction and the more alternatives we can do that can help us adapt to or mitigate the GHG emissions.

RECOMMENDATIONS

The results showed significant differences of carbon emissions per month. On this basis, future research should also examine carbon emissions from different months or from different season to expand the coverage of projection and have comparisons of data per timeline. The data projection can also be widen based on comparison between geographical data or between area types or classes.

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