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Carbon Footprint Assessment of College Personnel: A Comparative Analysis

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Abstract:
An awareness of the impact of lifestyle to Carbon Footprint of faculty as well as the university, and sources of carbon footprint could be one way to enable faculty to realize their responsibility in helping to prevent the severity of the problem and help an individual or the university to manage lifestyle with a lesser Carbon Footprint hence contribute to the elimination of greenhouse gas. The study measured the carbon footprint of the College of Numeracy and Applied Sciences personnel including the personnel of the departments under the college. This included the Mathematics, Physics and Statistics Department. Comparison of the CF by department and by sex were likewise done. Result of the study showed that the CF of Mathematics, Physics and Statistics personnel were 1.77 MTCO2e, 1.69 MTCO2e,1.88 MTCO2e, 1.88 MTCO2e, respectively. While the College of Numeracy and Applied Sciences personnel has 1.76 MTCO2e. The personnel's carbon footprints were comparative for both male and female, as well as among the three departments. Goods, services, leisure, transportation and food were the topmost contributor to the college as well as department personnel's carbon footprint.

Keywords: Carbon Footprint (CF); Housing; Food; Transportation; Goods, Services and Leisure; Department, College

INTRODUCTION

The Ecological Footprint is an ecological resource accounting tool that aids countries understand the balance of their ecological state and gives them the needed data to manage their resources. National governments use the Footprint to measure the value of their ecological resources; monitor and manage their assets; identify the problems with ecological deficits; and make policy that protect resources. The world's ecological assets are reaching more the critical level.

Many countries and regions are having ecological deficits, with Footprints larger than their own biological asset. Others depend heavily on resources from other regions, which are under increasing pressure. In some countries or regions of the world, the effect of ecological deficits worsened and leads to global warming deteriorating ecosystem, poverty and conflict.

The Greenhouse gas causing global warming are gases which might be emitted as a result of human activities like carbon dioxide, methane and ozone. Carbon Footprint (FC) is the total amount of greenhouse gases produced in directly and indirectly supporting human, organization, event, city, or state activities. This takes into account the raw materials used, production, distribution, consumption, and disposal of the product at end of its life. The impact of the product on the environment is measured in terms of the volume of carbon dioxide (CO_2). Carbon dioxide (CO_2) is about 75% of all greenhouse gas emissions. Everybody contribute to global warming and to climate change since everyone emit carbon

dioxide through our daily activities. An individual's lifestyle which includes home and work condition; consumption; transportation; clothing; and physical hygiene, shape an individual's carbon footprint.
The higher the footprint, the more carbon dioxide comes from an individual as a result of the choices one makes (EneryStar, 2018).
According to World Resources Institute Climate Analysis Indicators Tool (WRI CAIT) the Philippines total greenhouse gas (GHG) emissions in 2012 were 157.6 million metric tons of carbon dioxide equivalent ($MtCO_{2e}$) which is 0.33 percent of global GHG emissions. Between 1990 to 2012, the GHG emissions of the Philippines increased by 54 $MtCO_{2e}$. The 54 percent came from the energy sector, 33 percent attributed from the agriculture, 8 percent from industrial processes, and 7 percent from waste.
Between 1990 and 2012, the GHG emissions in the Philippines increased by 53 percent while at the same time period. the Philippines' GDP increased by 134 percent. This show that GDP was growing faster than GHG emissions, but despite of this, the Philippines GHG emissions relative to the country's GDP were higher than the world average in 2012.
In 2022, the energy consumption in the Philippines emitted 146.5 million tons of carbon dioxide. This showed an increase from year 2021 total of 135.8 million tons of carbon dioxide. This indicates potential for improvement.
In line with one of the university goal "Challenge Innovation in the four-fold functions of the University with an objective to enhance research productivity contributing to environmental sustainable development, an awareness of the impact of lifestyle to CF of faculty or the university, and sources of carbon footprint could be one way to enable faculty to realize their responsibility in helping to prevent the severity of the problem and help an individual or an organization to manage lifestyle with a lesser CF hence contribute to the elimination of greenhouse gas. In this light, the study was conceptualized.

Objectives Of the Study:

The considered contributor to the CF of College of Numeracy and Applied Sciences (CNAS) personnel are Transportation; Housing; Food; and Goods, Services and Leisure. The general objective of the study is to determine the personnel's carbon footprint of College of Numeracy and Applied Sciences of Benguet State University. The specific objectives of the study are the following:

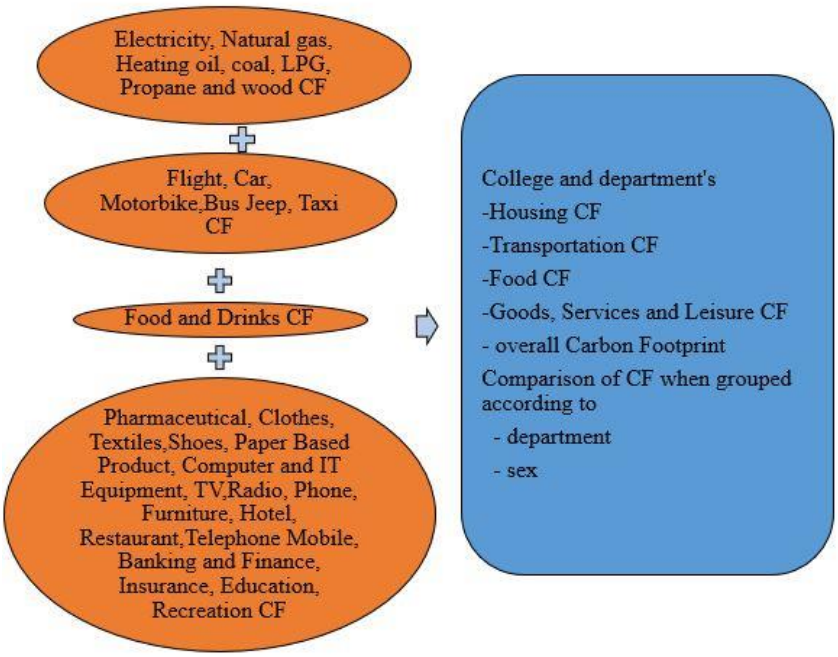
1. To determine carbon footprint on the following aspect and the overall CF of the Mathematics department personnel
   a. Transportation;
   b. Housing;
   c. Food;
   d. Goods, Services and Leisure
2. To determine carbon footprint on the following aspect and the overall CF of the Physics department personnel
   a. Transportation;
   b. Housing;
   c. Food;
   d. Goods, Services and Leisure
3. To determine carbon footprint on the following aspect and the overall CF of the Statistics department personnel
   a. Transportation;

b. Housing;
c. Food;
d. Goods, Services and Leisure

4. To determine carbon footprint on the following aspect and the overall CF of the CNAS personnel
   a. Transportation;
   b. Housing;
   c. Food;
   d. Goods, Services and Leisure
5. To compare the personnel's carbon footprint of the college of Numeracy and Applied Sciences when grouped according
   a. department
   b. sex

Conceptual Framework

The goal of the study was to know which aspects of one's lifestyle weigh more heavily on an individual's carbon footprint and to be able to act appropriately to make individual's carbon footprints as small as possible. The paradigm shows the direction of the study. The independent variables are the carbon footprints on transportation-related, housing related, food related, goods, Services and Leisure related of personnel under the college of Numeracy and Applied Sciences. On transportation CF the following were considered: flights, car, motorcycle, local transportation, bus or trail, tram and taxi. Considered housing related CF were electricity, natural gas, heating oil, coal, LPG, propane and wood pellets. For goods services and leisure, the following were considered: pharmaceutical; clothes, textiles and shoes; paper-based products; computer and IT equipment; television, radio and phone equipment; furniture and other manufacturing goods; hotel, restaurant and pubs; telephone mobile/cellphone call costs; banking and finance; insurance; education; and recreation. From the independent variables, the carbon footprint of the different departments under the college of Numeracy and Applied Science as well as the contribution of the departments' carbon footprints to the college carbon footprint were measured.



Comparison of the carbon footprints of the personnel by departments and by sex under the college of Numeracy and Applied Sciences were likewise evaluated.

Hypotheses of the Study

1. The carbon footprint on the following area and the CF of Mathematics department personnel is zero.
    a. Transportation;
    b. Housing;
    c. Food;
    d. Goods, Services and Leisure
2. The carbon footprint on the following area and the overall CF of Physics department personnel is zero.
    a. Transportation;
    b. Housing;
    c. Food;
    d. Goods, Services and Leisure
3. The carbon footprint on the following area and the overall CF of Statistics department personnel is zero.
    a. Transportation;
    b. Housing;
    c. Food;
    d. Goods, Services and Leisure
4. The carbon footprint on the following area and the overall CF of the college of Numeracy and Applied Sciences personnel is zero.
. a. Transportation;
    b. Housing;
    c. Food;
    d. Goods, Services and Leisure
5. There is no significant difference of the carbon footprint of personnel under the College of Arts and Sciences when grouped according to
    a. department
    b. sex

LITERATURE REVIEW

Amoncio, Hannah Joyce and etal (2012) researched on Correlation Between The Philippine Science Students' Annual Family Income And Carbon Footprint. The study aimed to identify the activities that greatly contribute to the carbon footprint of students belonging to different scholarship categories and family income. The scholarship category used was based on the socioeconomic bracket as determined from the parents' income tax returns and other indicators. Result showed that the special scholars contribute the most to climate change among the all scholarship categories because of the largest overall income, scholars acquire more gadgets and appliances that emit more carbon dioxide.

The research entitled "Carbon Footprint of Academic Activities: A Case Study in Diponegoro University" by Syafrudin etal (2019) computed the carbon footprints at Diponegoro University, the researcher determined how much of the activities conducted in the campus contributed to the emission and analyzed applied scenarios that could minimizing them. The study covered clean water treatment activities, electricity usage, transportation, wastewater, and solid waste treatment activities in the campus. The

carbon footprint emissions were calculated based on methods from the International Panel on Climate Change (IPCC). Result of the study showed that the Emissions calculated are CO2, CH4, and N2O expressed in TonCO2-eq. The carbon footprint resulting from campus activities at Undip is 16,345.83 TonCO2-eq. Electricity and transportation activities were the first and second largest carbon footprint contributor with a total carbon footprint of 13,953.22 TonCO2-eq and 1,449.99465 TonCO2-eq, respectively.

Li etal (2015) also made a study entitled "Carbon footprint analysis of student behavior for a sustainable university campus in China" and developed a novel methodology for estimating an average student's personal carbon footprint and deployed it at a university in Shanghai. Data was gathered through survey responses with additional data and emissions calculations. Result indicated that the average annual carbon footprint per student was 3.84 tonCO_{2e}. 65% from daily life, 20% from transportation, and 15% from academic activities. The three topmost source of individual activity were dining (34%), showering (18%), and dorm electricity loads (14%). Higher footprints were observed in men, graduate students, and metropolitan area students compared to women, undergraduates, and students from rural areas and small towns.

Serino (2016) estimated the Philippine households' carbon footprint from consuming various goods and services. The carbon intensities of different economic sectors were determined using data from the Philippine Input-Output Table and Global Trade Analysis Project's carbon emission coefficients. The total household carbon footprint was determined by summing up the carbon emission from each consumption category estimated by tracing the associated emission from its intermediate inputs used in the production. Results showed that households related to expenditure on fuel, light and transportation had the highest carbon emitting goods consumed while the least carbon intensive were nondurable and recreation goods. Also, a strong positive relationship between household carbon footprint and income was observed but the effect varies across the distribution. This indicates that increases in carbon footprint are to be expected as households get richer.

Utaraskul (2015) measured the CF of Environmental Science Students at Science and Technology, Suan Sunandha Rajabhat University (SSRU) using the web base Thai carbon footprint calculator program of Thailand Greenhouse Gas Management Organization (TGO). The CF was evaluated through the use of electric appliances and using the 3 criteria: transportation, food consumption and energy consumption. Result of the study showed that generate greenhouse gas emissions by students were between 0.39 – 8.25 tC02e/yr with an average GHG emission of approximately 2.16 t C02e/yr. The use of electric appliance was the main activity of students that generated greenhouse gas with 1.05 tC02e/yr. This is followed by food consumption with 0.7 tC02e/yr and transportation with 0.4 tC02e/yr.

The Carbon Footprint of the School of Forestry Engineering (Technical University of Madrid) was determined by Alvarez et al. (2014) using Organization-Product-Based-Life-Cycle Assessment Compound Method based on Financial Accounts. The measured total Carbon Footprint of the School of Forestry Engineering in 2010 was 2147 t CO_2eq.

Jiang et al. (2013) explored the individual behaviour change and engagement in building low carbon communities in China through a case study looking at the building of a low carbon campus at Fudan University. Study showed that individual behavior directly influences the overall energy consumption and CO_2 emissions on Fudan University's campus. The research further analyzed the promotion of individual engagement in building a low carbon campus through behaviour change based on awareness raising and behavior forming; approaches to encourage behavior change; beyond the barriers

and the constraints; and systems and mechanisms for the long-term engagement. A low carbon management system was proposed.

Güereca et al. (2013) conducted a GHG emission study for the Universidad Nacional Autonoma de Mexico. The result was generated according to the Greenhouse Gas Protocol and under a consumption based methodology integrating life-cycle assessment that considered the activity categories: electric energy generation, vehicle fleet, purchased electricity, commuting, air travels, courier shipments, paper consumption and solid waste. It was calculated that in 2010, the total CF of the Institute of Engineering was calculated to be 1577 tCO_2e. This was accounted by 42% from Greenhouse Gas emissions generated by the use of electricity, 50% from transportation which included fleet and commuting vehicles, 5% from air travel, 1% from shipments, 1% from paper use and 1% associated from to the final disposal of solid waste.

Larsen et al. (2013) analyzed the carbon footprint of students from different departments of Norwegian University of Technology and Science using Environmental Extended Input–Output (EEIO) model. Result of the study showed the CF to be very significant with an average contribution of 4.6 tonnes per student. This was particularly contributed by the purchase of large amounts of equipment and consumables for scientific use. It was likewise observed that the CF per student of Social Science and Humanities is significantly lower compared to that of Natural Science, Engineering, and the Faculty of Medicine. However, the most important contributing input to the university CF is allocated to the property department.

In higher education, the study of Ozawa-Meida et.al., (2013) at De Montfort University determined the consumption-based carbon footprint combining a top-down supply-chain economic input-output estimation of emission factors and a bottom-up lifecycle assessment (LCA) inspired accounting of activity intensities. Three emissions included were emission from production upstream; emissions from downstream due to the organization's product usage and disposal: and transportation of purchased goods. Result showed that the university has around 79% of the total greenhouse gas emission. They found that the university's total carbon footprint was roughly evenly divided among building energy use, travel, and procurement.

Aroonsrimorakot et al., 2013. Measured the amount of CFbased on Mahindol University Environment and Resource Studies faculty activities. Included in the data collected were the greenhouse gases sources such as consumption on electricity and water supply, wastewater and garbage quality, and amount of fuels used. It was observed that the Environment and Resource Studies Faculty emission has a GHGs equal to 1,091.85 tonCO_{2e}. The electric energy usage and produced solid waste were the sources that emitted the most greenhouse gases.

Luis (2013) measured the carbon footprint of from paper consumption of Lyceum of the Philippines University Batangas. Five paper consumption sources were considered and these were the supply office, students publication office, university bookstore, classrooms and library. Result showed that the total CF on paper consumption was 65.23 MT CO_2. The largest contributor was books sold at the university bookstore.

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METHODOLOGY

Respondent And Place Of Study

The respondents of the study were personnel of the different departments of the College of Arts and Numeracy Benguet State University during the school year 2023-2024.This includes the personnel of the Physics department, Mathematics department, Statistics department and the College. There were nine (9) respondents out of seventeen (17) Mathematics department personnel with five (5) males and four (4) females, thirteen (13) respondents out of 13 Physics department personnel with six (6) male and seven (7) females, and six (6) respondents out of seven (7) of the statistics personnel of which five (5) are females while only one (1) is male. Overall there were twenty eight (28) respondents out of thirty seven (37) CNAS personnel with twelve (12) male respondents and sixteen (16) female respondents.

Research Method and Instrumentation:

The study used a quantitative-descriptive survey design with comparative approach. comparison Carbon footprint was measured using the free carbon footprint calculator at carbonfootprint.com since it is the site where local settings could be incorporated in the computation. This includes the country setting and country CO_2e conversion per kWH of energy consumption with Philippine setting of 0.512 kg CO_2e conversion per kWH of energy consumption as approved by Implementing Guidelines Of The Philippine Energy Labeling Program Of The Department Of Energy. The computation coverage was from September 1 2022 to September 31, 2023 with dollar conversion of 1 Dollar = 55 Pesos. The overall carbon footprint included carbon footprints on Transportation; Housing; Food; and Goods, Services and Leisure. Housing carbon footprint includes carbon footprints on electricity, natural gas, heating oil, coal, LPG and propane. Included in the transportation aspect are carbon footprint on flights, car, motorbike, local transportation, bus, tram and taxi. The carbon footprint on goods, services and leisure included pharmaceutical; clothes, textiles and shoes; paper based products; computer and IT equipment; television, radio, phone equipment; banking and finance; insurance; education and leisure.

In the comparison done by department, department was categorized based on the departments under the College of Numeracy and Applied Sciences which are the Mathematics department, Physics department and Statistics department. The comparison by sex was done categorizing sex as binary sex (male/female) usually designated at birth.

Statistical Analysis

Weighted mean was used to categorize the department and college personnel's CF. Percentage and rank was used to categorize the contribution of the CF variables: Transportation, Housing; Food; Goods, Services and Leisure; One sample Wilcoxon Signed rank test was used to compare the CF with the targeted CF of 0. The Mann-Whitney U test was used to compare CF when respondents were grouped according to sex. The Kruskal-Wallis test was used to compare the carbon footprint of college personnel when grouped according to department. All were tested at 0.05 level of significance.

RESULTS AND DISCUSSIONS

Tables 1 to 4 present the CF of the Mathematics, Physics, Statistics departments and CNAS personnel showing the minimum, maximum and mean CF; and the percent contribution to the department CF as well as its comparison to the targeted CF of zero CF.

In table 1, the CF of the Mathematics department personnel are presented. Under the Housing, the CF ranges from 0.03 to 0.68 $MTCO_{2e}$, transportation CF ranges from 0 to 2.91 $MTCO_{2e}$, Food CF ranges from 0.08 to 0.65 $MTCO_{2e}$, while the Goods, Services and Leisure CF ranges from 0.26 to 1.06 $MTCO_{2e}$.Based on the mean values, highest contributor to the Mathematics department personnel CF is transportation (46.33%) with car CF as the main contributor, followed by Goods, Services and Leisure (27.12%) with clothes CF as the main contributor, Food (16.95%) with respondents classified as moderate meat eaters, and the least contributor is housing (6.60%). Only transportation CF is not significantly different with the target CF of 0, the rest of CF's were significantly different from the target CF.

The result of the study is supported by the studies of Guereca, etal(2013), Serino (2016), Li (2015) and Syafrudin, etal.(2019) where transportation was one of the highest contributor of students and university CF.

Table 1. Carbon Footprint of Mathematics Department Personnel

Carbon Footprint	Mathematics Department Personnel CF in $MTCO_{2e}$					sig
	Minimum	Maximum	Mean	%	Rank	
a. Housing	0.03	0.68	0.17	9.60	4	0.007
b. Transportation	0.00	2.91	.82	46.33	1	0.12
c. Food	0.08	0.65	.30	16.95	3	0.008
d. Goods, Services and Leisure	0.26	1.06	.48	27.12	2	0.008
OVERALL	0.45	4.23	1.77			0.008

The Mathematics Department CF ranges from 0.45 to 4.23 $MTCO_{2e}$ with a mean value of 1.77 $MTCO_{2e}$. This was significantly higher than the target CF.

The CF of Physics department personnel can be seen in table 2. The top contributor to Physics department personnel CF is goods, services and leisure (33.73%) with CF range value of 0.04 to 2.98 $MTCO_{2e}$ and an average value of 0.57 $MTCO_{2e}$. This is followed by food (25.44%) with CF range of 0.05 to 0.93 with respondents being moderate meat eaters, and transportation (20.71%) with CF range of 0.01 to 0.99. The least contributor is housing (20.12%) with a CF ranging from 0.02 to 1.66 $MTCO_{2e}$ and an average value of 0.34 $MTCO_{2e}$. All contributors were significantly larger than the target CF. CF on clothes was the main contributor of CF on good, services and leisure. Luis (2013) found paper consumption under good, services and leisure specifically on paper consumption has high CF. Utaraskul (2015) and Amoncio, etal (2012) had a similar result where food and electric appliances were the greatest contributor of student CF.

Table 2. Carbon Footprint of Physics Department Personnel

Carbon Footprint	Physics Department Personnel CF in $MTCO_{2e}$					sig
	Minimum	Maximum	Mean	%	Rank	
a. Housing	0.02	1.66	0.34	20.12	4	0.001
b. Transportation	0.01	0.99	0.35	20.71	3	0.001

c. Food	0.05	0.93	0.43	25.44	2	0.001
d. Goods, Services and Leisure	0.04	2.98	0.57	33.73	1	0.001
OVERALL	0.12	4.59	1.69			0.001

Overall, the CF Physics department personnel ranges from 0.12 to 4.59 $MTCO_{2e}$ and an average value of 1.69 $MTCO_{2e}$. This is significantly larger compared to the target CF.

Table 3 shows the CF of Statistics department personnel. CF from housing ranges from 0.01 to 0.37 $MTCO_{2e}$ with a mean value of 0.14 $MTCO_{2e}$ and contributed the least (7.45%) to the department personnel's CF. Goods, services and leisure (38.83%) contributed the most with CF ranges from 0.20 to 2.07 and a mean value of 0.73 $MTCO_{2e}$. This is followed by Transportation (26.06%) with CF ranging from 0.02 to 1.77 $MTCO_{2e}$, and food (27.66%) with a mean value of 0.52 $MTCO_{2e}$ with a range value of 0.08 to 1.23 $MTCO_{2e}$. Though the contribution ranking is similar with that of the Physics department presented at table 2, only transportation has no significantly different value with the target CF. This implies that personnel's CF on food, goods, services and leisure had significantly higher value than the target CF. On Goods, services and leisure, clothes and motorbike were the main contributor. On transportation, the main contributor is CF on cars. Utaraskul (2015) likewise support the result where food and electric appliances were the greatest contributor of student CF.

Table 3. Carbon Footprint of Statistics Department Personnel

Carbon Footprint	Statistics Department Personnel CF in $MTCO_{2e}$					sig
	Minimum	Maximum	Mean	%	Rank	
a. Housing	0.01	0.37	0.14	7.45	4	0.018
b. Transportation	0.02	1.77	0.49	26.06	3	0.018
c. Food	0.08	1.23	0.52	27.66	2	0.018
d. Goods, Services and Leisure	0.20	2.07	0.73	38.83	1	0.018
OVERALL	0.66	3.66	1.88			0.018

Overall, the Statistics department personnel has CF mean value of 1.88 $MTCO_{2e}$ with values ranging from 0.66 to 3.66 $MTCO_{2e}$. This is significantly higher than the target CF similar to that of the Mathematics and Physics department personnel as presented in tables 1 and 2.

CNAS personnel's CF is presented at table 4. The college CF ranges from 0.12 to 4.59 $MTCO_{2e}$ with a mean value of 1.76 $MTCO_{2e}$. The main contributor to the college personnel's CF is goods, services and leisure (32.95%) with a range value of 0.04 to 2.93 $MTCO_{2e}$ and a mean value of 0.58 $MTCO_{2e}$. This is followed by transportation 30.11%) with CF ranging from 0 to 2.91 and a mean value of 0.53 $MTCO_{2e}$. Food (23.30%) is the third contributor to the college personnel's CF with a mean value of 0.41 $MTCO_{2e}$ with values range of 0.05 to 1.23 $MTCO_{2e}$. The least contributor is housing (13.64%) with value ranging from 0.01 to 1.66 $MTCO_{2e}$ and a mean value of 13.64%. CF on goods, services and leisure was greatly contributed by the CF on clothes, while transportation CF was greatly contributed by car CF.

Again, this is supported by the studies of Guereca, etal (2013), Serino (2016), Li (2015) and Syafrudin, etal (2019) and Utaraskul (2015) where transportation was one of the highest contributor of students and university CF.

Table 4. Carbon Footprint of College of Numeracy and Applied Science Personnel

Carbon Footprint	CNAS Personnel CF in $MTCO_{2e}$					Sig
	Minimum	Maximum	Mean	%	Rank	
a. Housing	0.01	1.66	0.24	13.64	4	0.000
b. Transportation	0.00	2.91	0.53	30.11	2	0.000
c. Food	0.05	1.23	0.41	23.30	3	0.000
d. Goods, Services and Leisure	0.04	2.98	0.58	32.95	1	0.000
OVERALL	0.12	4.59	1.76			0.000

The CF of the college personnel together with the specific contributors has a significantly higher values compared to the target CF.

Table 5.a shows the comparison of the different department personnel's CF. Based on computed significance level higher than 0.05 level of significance, there is no significant difference in the CF values of the Mathematics, Physics and Statistics personnel. Though there were difference in the CF values, ranges and percent contribution as seen on tables 1 to 3, the data presented on table 5 implies that the personnel CF values from the three department were comparable.

Table 5.a. Comparison Of Carbon Footprint By Department

Carbon Footprint	Math CF	Physics CF	Stat CF	sig
a. Housing	0.17	0.34	0.14	0.447
b. Transportation	.82	0.35	0.49	0.944
c. Food	.30	0.43	0.52	0.557
d. Goods, Services and Leisure	.48	0.57	0.73	0.433
OVERALL	1.77	1.69	1.88	0.814

Table 5.b presents the comparison of the departments and college personnel's CF when grouped according to sex. Based on the computed level of significance which are all higher that 0.05 level of significance except for the college CF on transportation, there is no significant difference in the CF of Mathematics, Physics and Statistic department personnel when grouped according to sex. This implies that both males and females from the three departments have comparable CF's.

Table 5.b. Comparison Of Carbon Footprint By Sex

Carbon Footprint	Sig			
	Math	Physics	Stat	College
a. Housing	0.779	1.000	0.857	1.000
b. Transportation	0.110	0.534	1.000	0.016
c. Food	0.374	0.181	0.571	0.730
d. Goods, Services and Leisure	0.983	0.445	1.000	0.190
OVERALL	0.249	0.836	0.857	0.190

This is likewise observed with the college CF except for the CF on transportation where male respondents have significantly higher CF on transportation compared to that of the female respondents. This is supported by the study of Li where result of the study showed higher CF of male students compared to

female students. The CF on housing, food, goods, services and leisure as well as the overall CF of both male and female are comparable.

CONCLUSION

Based on the results the following are concluded:

1. The CF on housing, transportation, food, goods, services and leisure as well as that of the overall department CF of personnel under the Mathematics department were significantly higher than the target CF. Highest contributor of the department CF are transportation, goods, services and leisure.
2. Physics department personnel have overall CF as well as CF on housing, transportation, food, goods, services and leisure significantly higher than the target CF. Highest CF contributor is food, goods, services and leisure.
3. The personnel under the Statistics department have CF on housing, transportation, food, goods, services and leisure significantly higher than the target CF. The department overall CF is likewise significantly higher than the target CF.CF on food, goods, services and leisure is the highest CF contributor.
4. The overall CF and the CF on housing, transportation, food, goods, services and leisure of personnel under the College of Numeracy and Applied Sciences is significantly higher than the target CF. CF on transportation, goods, services and leisure is the highest CF contributor.
5. The CF of the personnel under the Mathematics, Physics and Statistics department have comparable CF on housing, transportation, food, goods, services and leisure as well as that of the overall CF.
6. Male and female personnel of the Mathematics, Physics and Statistics departments have comparable overall CF as well as CF on housing, transportation, food, goods, services and leisure. This is with the exception of CF on transportation of Mathematics department personnel where male CF on transportation are significantly higher compared to that of females.

Based on the conclusions cited, measures to lessen CF on goods, services and leisure by lessen expenses on clothing, shoes, motor vehicles and furniture through recycling is suggested. Mitigating measure is suggested to lessen CF on food by consuming lesser meat products and consume more on fish or vegetables. College personnel could limit use of car instead, use public utility vehicle or bus. It is likewise recommended to conduct related research using other CF calculators which could cover more parameters that could be contribute to individual's CF. Also, similar research on the CF computation within the university premises and personnel in other college is recommended.

LITERATURE CITED:

1. Alvarez, S., Blanquer, M., Rubio, A., 2014. Carbon footprint using the compound method based on financial accounts. The case of the school of forestry engineering, technical University of Madrid. J. Clean. Prod. 66, 224e232.
2. Amoncio, Hannah Joyce Batulan, Trenah Dyne Josol, Geremy Fe A. Langahid, Kathy Claire Ong, Dorothy Ann S. Pique, Kenny Taula, Japhet Yu, Marian Isabel D. Michael A. (2012) Casas Philippine Science High School- Southern Mindanao Campus Davao City, Philippines. Correlation Between The Philippine Science Students' Annual Family Income And Carbon Footprint.
3. Aroonsrimorakot, S., Yuwaree, C., Arunlertaree, C., Hutajaroen, R., and Buadit, T. (2013). Carbon Footprint of Faculty of Environment and Resource Studies, Madidol University, Salaya Campus, Thailand. APCBEE Procedia (5). 175-180.

4. ENERGYSTAR 2018. How big is your carbon footprint? GoGreen_Activities 508_compliant_small.pdf,1.
5. Güereca, L.P., Torres, N., Noyola, A., 2013. Carbon footprint as a basis for a cleaner research institute in Mexico. J. Clean. Prod. 47, 396e403. Hesselbarth, C., Schaltegger, S., 2014. Educating change agents for sustainability e learnings from the first sustainability management master of business administration. J. Clean. Prod. 62, 24-36
6. http://www.aag.org/galleries/mycoegeoportal2012files/mcasas3_r.pdf
7. https://iopscience.iop.org/article/10.1088/1755-1315/448/1/012008/pdf
8. https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-philippines#:~:text=In%20the%20Philippines%2C%2054%20percent,percent%20respectively%20to%20GHG%20emissions.
9. International Energy Agency Statistics: Philippines Electricity and Heat 1990 and 2012
10. IOP Conf. Ser.: Earth Environ. Sci. 448
11. Jiang, P., Chen, Y., Xu, B., Dong, W., Kennedy, E., 2013. Building low carbon communities in China: the role of individual's behaviour change and engagement. Energy Policy 60, 611- 620.
12. Larsen, H.N., Pettersen, J., Solli, C., Hertwich, E.G., 2013. Investigating the carbon footprint of a University e the case of NTNU. J. Clean. Prod. 48, 39-47.
13. Li, X., Tan, H., and Rackes, A. (2015). Carbon footprint analysis of student behavior for a sustainable university campus in China, Journal of Cleaner Production (2015), http://dx.doi.org/10.1016/j.jclepro.2014.11.084
14. Reyes, J. A. (2013). The Carbon Footprint Of Education A Case Study On Indirect Co2 Emissions From Paper Consumption. International Journal of Advanced Research in Management and Social Sciences. Vol. 2 | No. 10, pp 54-64
15. https://garph.co.uk/ijarmss/oct2013/6.pdf
16. Ozawa-Meida. L., Brockway, P., Letten, K., Davices, J., and Fleming, P. (2013). Measuring carbon performance in a UK University through a consumption-based carbon footprint: De Montfort University case study. Journal of Cleaner Production (56). 185-198
17. Serino, M, 2016. The Rising Carbon Footprint of Philippine Households: An Estimation Using Consumption Expenditure and Input-Output Analysis. Annals of Tropical Researches. 38[2]:1-16.
18. Syafrudin , B Zaman, M A Budihardjo, S Yumaroh, D I Gita and D S Lantip 2020 Carbon Footprint of Academic Activities: A Case Study in Diponegoro University
19. Tatsanawalai Utaraskul. 2015. Procedia - Social and Behavioral Sciences. 197, 1156 – 1160
20. World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 2.0, 2016). Global https://www.climatelinks.org/sites/default/files/asset/document/2016_USAID_Philippines%20GHG%20Emissions%20Fact%20Sheet.pdf