

Carbon Footprint of Students and Personnel of Nakhon Ratchasima Rajabhat University: Correlations and Relevant Factors

Nirun Kongritti
Nakhon Ratchasima Rajabhat University

— *Review of* —
**Integrative
Business &
Economics**
— *Research* —

ABSTRACT

This study aims to analyze relevant factors considering to carbon footprint from activities in the daily life of students and personnel in Nakhon Ratchasima Rajabhat University and the correlation of carbon footprint in relevant factors. In term of quantity study of carbon dioxide emissions from activities (e.g. commutation, study and work, supply/consumption and recreation of students and personnel) apparently showed carbon footprint between 0.023 – 2.363 kgCO₂e /person/day of average between 0.058 – 2.260 kgCO₂e/person/days. Consequently, the highly amount of carbon footprint of student activities was supply/consumption and commutation activities with an average of carbon between footprint of 2.363-1.868 kgCO₂e/person/days and 0.469 kgCO₂e – 1.045/person/day, respectively.

While the activity contains the highly amount of carbon footprint as commutation activities and the next activity as supply and consumption with carbon footprint /person/day 2.206 – 2.234 kgCO₂e/person/day and 1.426 – 1.857 kgCO₂e /person/day, respectively. Additionally, the correlation of carbon footprint in relevant factors of students and personnel indicated all activities relating to carbon footprint in the same direction. Providing that activities generated more carbon dioxide emissions, it increased carbon footprint of students and personnel for commutation, recreation and supply/consumption. Consequently, carbon footprint of students and personnel showed statistical significant levels of correlation coefficient at 0.01 to 0.933 0.290 and 0.396, respectively.

In addition, the correlation coefficient of the variables has a correlation or carbon footprint of students and personnel. Subsequently, all activities were related to carbon footprint in the same direction provided that activities generated more carbon dioxide emissions, it correspondingly increased carbon footprint in relevant factors of students and personnel. Furthermore, commutation, recreation activities and supply/consumption were in related to carbon footprint of students and personnel significantly at 0.01 level by statistical correlation coefficient at 0.933 0.290 and 0.396, respectively.

Keywords: Carbon footprint, Correlation

1. Introduction

Environmental problems are issues for consideration of humanity widely as it is likely to impact more violence. Nowadays, the attention problem is global warming, variance problems and climate change to the entire earth system. Consequently, an international conference organized measurement, prevention and resolution. According to United Nations Environmental Programme: UNEP, in cooperation with the World Meteorology organization and World Meteorological Organization: WMO has established a committee concerning the government on Intergovernmental Panel on Climate: IPCC. For the analysis of climate change, measurement and strategies are provided in organizations related to climate change, which the United Nations Convention on

climate change has subsequently signed (United Nations Framework Convention on Climate Change: UNFCCC). Many various countries signed the ratification during United Nations Conference on Environment and Development UNCED (1) the agreement is the source of measurements and guidelines to solve the problem as the solution to promote cooperation from parties to nation for carbon footprint

Everyday human activities have caused environmental impacts. Particularly, carbon dioxide emissions formed quantity of CO₂ emissions of British people on Christmas day at 650 kg. By means of activities, shopping showed at 310 kg., light collecting at 218 kg., commutation by car at 96 kg., and cooking at 26 kg., etc. (2) therefore, reducing greenhouse gas emissions has reflected the responsibility of all concerned sectors. Principally, the public sector as a consumer reduces greenhouse gas emissions of the countries in the world.

This research aims to analyze factors of carbon footprint and carbon footprint of students and personnel of Nakhorn Ratchasima Rajabhat University using the Correlation and Relevant Factors method, technique to study environmental impacts arising from daily life activities such as fuel combustion from transportation, consumption of food and beverages, electric power from electrical appliances and water supply of students and personnel of Nakhon Ratchasima Rajabhat University.

2. Methods

2.1 Data collection

To determine the sample size for this research consists of regular students from 5 Faculties of Education, Science and Technology, Human and Social Sciences, Management Sciences and Industrial Technology including personnel of Nakhon Ratchasima Rajabhat University, in an academic and supporting section in the entire population, 21,021 people working determined sample sizes using Taro Yamane's formula (3) it determined the sample size in a number of 400 people divided into comparable proportion of students were 5 faculties in academic and practice in number of 58 people. In this study, it regulated the size of the sample group in number of 60 people as well as the working age group of all samples in a number of 420 people.

Tolerance scope at 0.05 in number of 400 people was defined in population survey response data consisting of questions about commutation, study/work, and supply/consumption due to direct greenhouse gas emissions from fuel combustion owing to transportation, consumption of food and beverages, electric power from electrical appliances and water supply.

2.2 Analysis and environmental accounting

Collecting data by the use of resources from activities in the daily life of students and academic personnel as follows:

2.2.1 Commutation consists of fuel combustion from the vehicle.

2.2.2 Study/work consists of electrical power from the equipment, electrical appliances, and water supply.

2.2.3. Supply/consumption consists of using water for washing, food and drink, electric power from electrical appliances

2.2.4 Vacation consists of electrical power from the equipment, electrical appliances, and water supply.

2.3 Environmental impact assessment

Activity Data was multiplied by the values of emission factors. The carbon dioxide output was in the form of tons or kilograms carbon dioxide equivalent (CO₂ equivalent).

$$\text{CO}_2 \text{ eq emission} = [\text{Activity data}] \times [\text{Emissions factors}]$$

2.4 Descriptive statistics

Descriptive statistics showed carbon footprint and data collection of students and personnel of Nakhon Ratchasima Rajabhat University for environmental accounting with the carbon calculations.

Carbon footprint as tons or kilograms of CO₂ equivalent for the analysis of descriptive statistics as follows: average, minimum, maximum, range, standard deviation and statistical distribution by Normality Test with Kolmogorvo-Smirnov (K-S) test.

Study on the correlation coefficient between various activities with the student and carbon footprints of students and personnel based on the direction of the correlation of a single dependent variable and independent variable. Consequently, independent variables contained the correlation coefficient in a high level showing in the predictive variables in a high level. While independent variables were the correlation coefficient in a low level showing the predicted variables in a low level respectively.

3. Results

3.1 Descriptive statistics

3.1.1 In case of students, it showed the average of 4 activities: commutation, vacation, and study/work. There was the average between 0.029 – 2.121 kilograms of carbon dioxide equivalent/person/day (kgCO₂e/person/day). The highest carbon footprint activity was supply/consumption and the second activities were commutation and study/work with average carbon footprint equal to 2.121 0.731 and 0.063 kgCO₂e/person/day and standard deviation equal to 1.162 0.865 and 0.026, respectively. Accordingly, the test of normality test by kolmogorvo-Smirnov (K-S) test showed owing to supply/consumption in a normal distribution, while other activities showed no a normal distribution in table 1.

3.1.2 In case of personnel, it showed the average of 4 activities: commutation, recreation, supply/consumption and study/work in the average values were between 0.060 - 2.247 kgCO₂e/person/day. The highest carbon footprint activity was commutation and the second activities were supply/consumption and study/work in average carbon footprint equal to 2.247 1.642 and 0.090 kgCO₂e/person/day and a standard deviation of 3.346, 1.210 and 0.029 respectively and the Test of Normality by Kolmogorvo-Smirnov (KS) test showed that the 4 activities showed no a normal distribution in Table 1.

Table1. Descriptive statistics of the carbon footprint of the students and personnel

population	CO ₂ of activities	\bar{x}	S.D.	Min	Max	Range	K-S test (P-value)
Students	Commutation	0.731	0.865	0.000	6.260	6.260	0.000
	Recreation	0.029	0.033	0.000	0.310	0.310	0.000
	supply/consumption	2.121	1.162	0.100	6.600	6.500	0.200
	study/work	0.063	0.026	0.000	0.110	0.110	0.000
Personnel	Commutation	2.247	3.346	0.000	18.820	18.820	0.000
	Recreation	0.060	0.051	0.000	0.310	0.310	0.000
	supply/consumption	1.642	1.210	0.070	7.410	7.340	0.012
	study/work	0.090	0.029	0.000	0.110	0.110	0.000

3.2 Carbon Footprint Analysis

In the analysis and environmental accounting for data collection showing the use of resources from activities in the daily life of students and academic personnel with data collection, commutation ,study/work, supply/consumption and recreation as follows.

3.2.1 The carbon footprint analysis owing to travel activities found that the students and personnel of Nakhon Ratchasima Rajabhat University were average carbon footprint of travel at 1.165 kgCO₂e/person/day. According to personnel as academic personnel, the highest carbon footprint on traveling to 2.261 kgCO₂e/person/days and the subsequence from supporting personnel and students of Faculty of industrial technology was at 2.234 and kgCO₂e/1.045/person/day, respectively. Figure1: the proportion of carbon footprint on commutation was at 28 percent /person of average. The subsequence from supporting and students of Faculty of Humanities and Social Sciences in the proportion of carbon footprint on commutation was at 27 percent/person of average and 10 percent of average, respectively in Figure 2

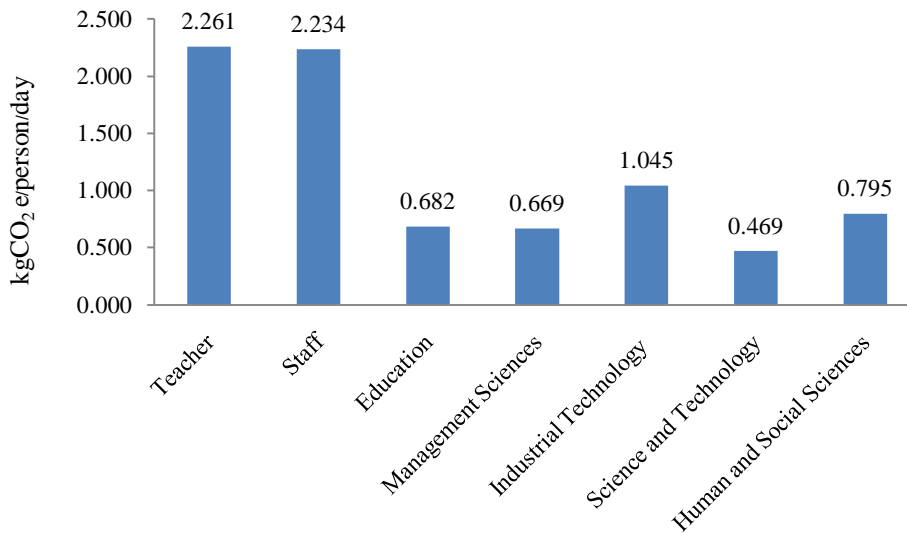


Figure 1 The proportion of carbon footprint on commutation of students and personnel

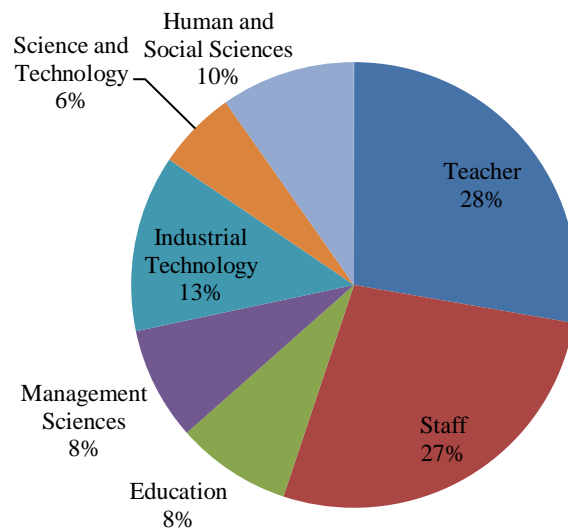


Figure 2 The proportion of travel carbon footprint per person of students and personnel

3.2.2 The analysis of carbon footprint of recreation found students and personnel of Nakhon Ratchasima Rajabhat University at 0.038 kgCO₂e/person/day. The highest carbon footprint showed in recreation of personnel at 0.062 kgCO₂e/person/day and students of Faculty of Industrial Technology was at 0.058 and 0.039 kgCO₂e/person/day, respectively. In Figure 3, the carbon footprint of recreation/person found carbon footprint personnel at 23 percent/person of average. The sequence of recreation in supporting personnel and students of Faculty of Industrial Technology was 22 and 14 percent/person of average, respectively in Figure 4.

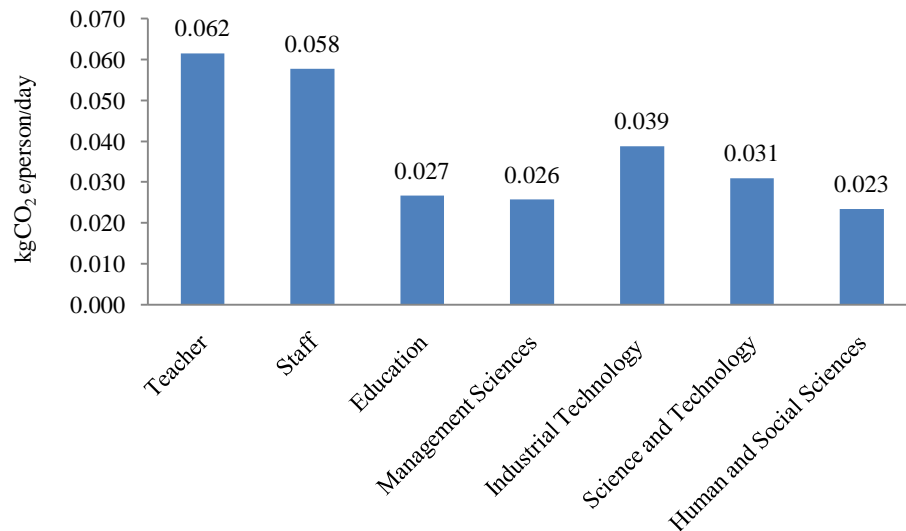


Figure 3 Carbon footprint of recreation of students and personnel

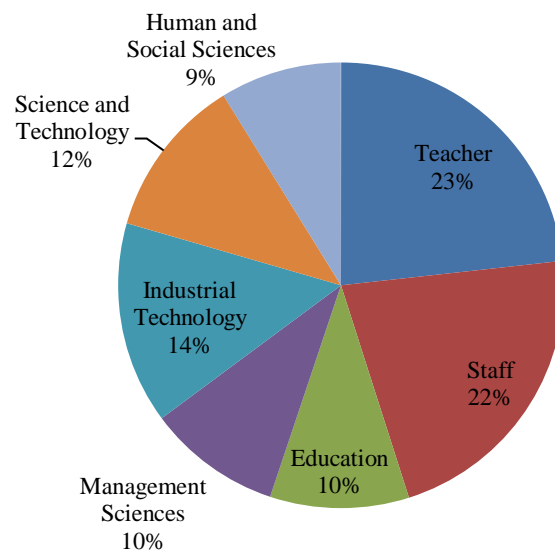


Figure 4 Proportion Carbon Footprint of rest per head of students and personnel

3.2.3 The analysis of carbon footprint owing to supply/consumption found that the students and personnel of the university has a carbon footprint of supply/consumption at 1.984 kgCO₂e/person/day of average. According to students of faculty of Industrial technology, the highest carbon footprint owing to supply/consumption was at 2.363 kgCO₂e/person/day. The sequence of students of Faculty of Humanities and Social Sciences and the Faculty of Education at 2.175 and 2.146

kgCO₂e/person/day, respectively. Figure 5 representing the carbon footprint of commutation per person of average found that students of Faculty of Industrial Technology showing carbon footprint due to supply/consumption per person of average was at 17 percent. Consequently, it found students of Faculty of Education and Humanities and Social Sciences showing carbon footprint of supply/consumption per person at 16 percent complete in Figure 6.

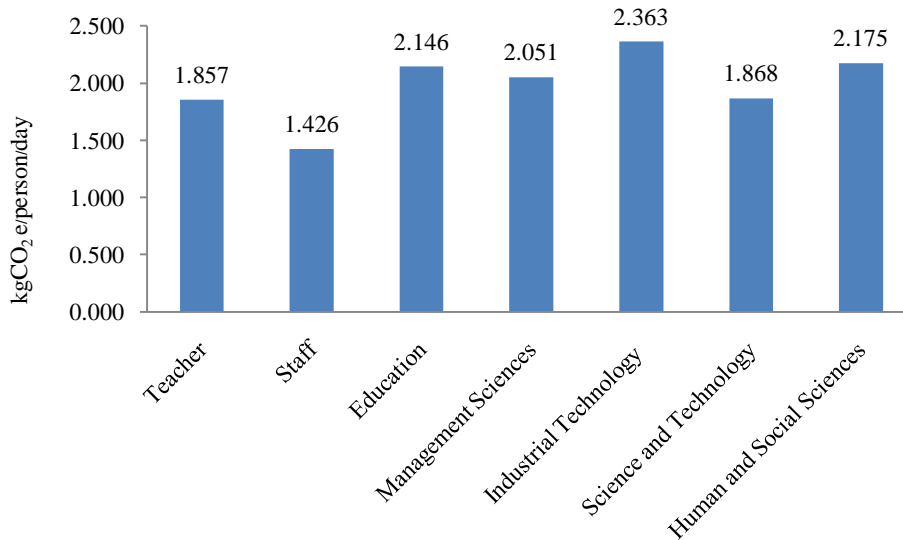


Figure 5 Carbon footprint of supply / consumption of students and personnel

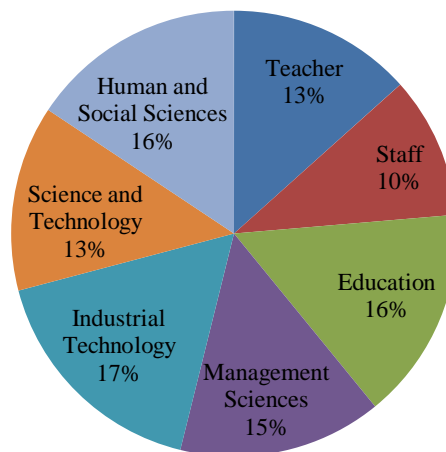


Figure 6 Proportion of carbon footprint of supply/consumption per person of students and personnel

3.2.4 The analysis of carbon footprint owing to study/work found that the students and personnel of Nakhon Ratchasima Rajabhat University showing carbon footprint of study/work at 0.071 kgCO₂e/person/day of average. According to personnel, the highest carbon footprint of study /work found 0.093 kgCO₂e/person day of average. The sequence of students of Faculty of Science and Technology was at 0.086 and 0.074 kgCO₂e/person /day, respectively. As Figure 7, carbon footprint of commutation per person found that personnel owing to study/work were 19 percent/person of average. The sequence from supporting personnel and students of Faculty of

Science and Technology found carbon footprint owing to study work at 17 and 15 percent/person of average respectively as shown in Figure 8.

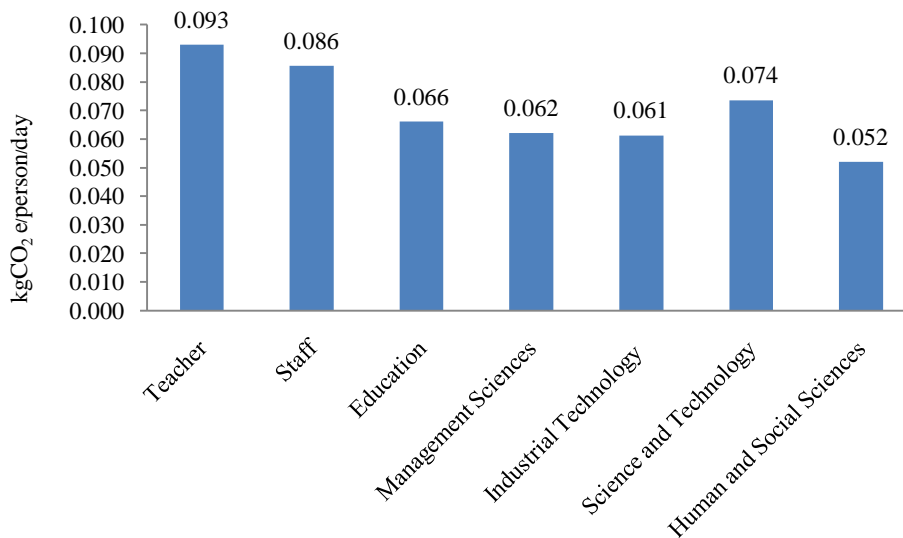


Figure 7 Carbon footprint of study/work of students and personnel

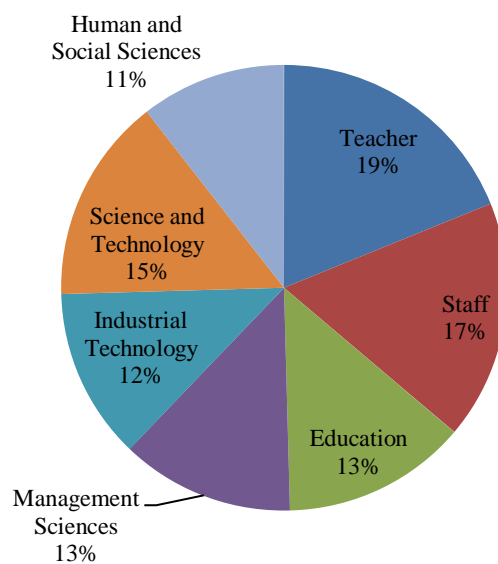


Figure 8 Proportion of carbon footprint of study/work per person of students and personnel

3.3 The Correlation Coefficient

3.3.1 The correlation coefficient with predictor factors was related to carbon footprint of students that all the activities were correlated to the carbon footprint in the same direction. Provided that all activities increase carbon dioxide emissions, it correspondingly affected carbon footprint of students. Owing to commutation and supply/consumption relating to carbon footprint of the students, it was statistically significant at the 0.01 level with a correlation coefficient of 0.66 and 0.831 respectively in Table 2.

Table 2: The correlation coefficient of students

Variable	statistics	Carbon footprint	Commutation	Recreation	Supply/Consumption	Study/Work
Carbon footprint	r (P-Value)	1				
Commutation	r (P-Value)	0.663**	1			
Recreation	r (P-Value)	0.027	0.012	1		
Supply/	r (P-Value)	0.831**	0.137*	0.015	1	
Work/Study	r (P-Value)	0.024	0.055	0.068	0.015	1
		0.683	0.339	0.241	0.798	

Note ** statistical significance at the 0.01 level.

** statistical significance at the 0.05 level.

3.3.2 The correlation coefficient on predictor factors was related to the carbon footprint of personnel that all activities were carbon footprint in the same direction. Provided that all activities increased carbon dioxide emissions, it correspondingly affected the carbon footprint of students. Owing to commutation, recreation, supply/consumption relating to carbon footprint of personnel, it was statistically significant at the 0.01 level with a correlation coefficient of 0.977, 0.368 and 0.337 respectively in Table 3.

Table 3: The correlation coefficient of personnel

Variable	Statistics	Carbon Footprint	Commutation	Recreation	Supply/Consumption	Study/Work
Carbon Footprint	r (P-Value)	1				
Commutation	r (P-Value)	0.977**	1			
Recreation	r (P-Value)	0.368**	0.586**	1		
supply/consumption	r (P-Value)	0.337**	0.126	0.026	1	
Study/Work	r (P-Value)	0.063	0.062	0.088	0.041	1
		0.494	0.502	0.341	0.655	

Note ** statistical significance at the 0.01 level.

** statistical significance at the 0.05 level.

4. Conclusion

The study examined carbon footprint of students and personnel at 3.492 kgCO₂e/person/day of average. According to personnel, it was at 4.039 kgCO₂e/ person/day and students showing carbon footprint at 2.944 kgCO₂e/ person/day. Carbon footprint calculation of student population and personnel found carbon footprint of students and personnel Nakhon Ratchasima Rajabhat University at 78.687 kgCO₂e/ day or 28,721 kgCO₂e/year. In addition, the students found carbon footprint of the students at 75.907 kgCO₂e/day or 27,706 kgCO₂e/year. Furthermore, carbon footprint of personnel was 2.780 kgCO₂e/day or 1,015 kgCO₂e/year. Considerably, each activity found carbon footprint of supply/consumption and commutation of both students and personnel showing the highest values at 56.80 and 20.79 kgCO₂e/day or 20,731, and 57 kgCO₂e/year. Significant factors of carbon footprint of students and Personnel were commutation followed by supply/consumption. This was consistent with studies of the campaign (4) the study of carbon

dioxide emissions from human activities at Saen Suk in Chon Buri found activities with power and fuel showing the highest carbon emissions at 4.42 billion metric tons of carbon/year. Consequently, consumption was 0.58 billion metric tons of carbon dioxide events/year. Owing to the database inspection of commutation, students and personnel found that most students commutation by motorcycle and personnel cars. As a result, there were in a larger number of carbon dioxide than other activities. The correlation coefficient on the variable of predictor factors was related to carbon footprint of the students and personnel that all activities were correlated carbon footprint in the same direction. Provided that activities increased carbon dioxide emissions, it correspondingly affected the carbon footprint of the students and personnel. Owing to commutation, recreation and supply / consumption, it was related to carbon footprint of students and personnel at a statistically significant level at 0.01 with a correlation coefficient at 0.290, 0.933 and 0.396 respectively.

5. Acknowledgements

The author would like to thank Research and Development Institute of Nakhon Ratchasima Rajabhat University for research funding.

6. References

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