

## Investigating Personal Carbon Emissions of Students and Lecturers of UIN Sunan Ampel Surabaya During New Normal Covid-19 Transition Period

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**Abstract :** The main driver of global warming is the greenhouse gases emission. The most important greenhouse gas is Carbon Dioxide (CO<sub>2</sub>). Greenhouse gases can be generated from daily human activities such as the use of electrical energy, the use of motor vehicles, and food consumption. The higher education of UIN Sunan Ampel Surabaya, plays an important role in improving the quality of human resources and the environment. In addition, the role of students and lecturers as agents of change requires them to be able to recognize and calculate their carbon emissions as part of efforts to reduce greenhouse gas emissions. The objective of this study was to investigate personal carbon emissions of students and lecturers of UIN Sunan Ampel Surabaya during new normal Covid-19 transition period. We used a quantitative descriptive approach as the method of study. Daily students and lecturers' activities were obtained by questioner. The carbon emission calculation based on the Intergovernmental Panel on Climate Change (IPCC). The study revealed that the total personal students and lecturers carbon emission were 1.416,17 Kg CO<sub>2</sub>-eq/year and 2.491, 19 Kg CO<sub>2</sub>-eq/year respectively. UIN Sunan Ampel Surabaya as higher education institutions should be proposed carbon management in order to reduce personal carbon emission.

### INTRODUCTION

Global warming can cause the phenomenon of increasing greenhouse gases. There is an increase in the concentration of greenhouse gases on earth, which is dominated by carbon dioxide. Indonesia has committed to participating in reducing greenhouse gas emissions with a national reduction target of 26% and an international reduction target of 41% (Bappenas, 2012).

Various human activities produce greenhouse gas emissions that are released into the atmosphere. Daily activities carried out using energy will certainly produce carbon dioxide emissions. One of the most significant sources of greenhouse gas emissions is carbon dioxide (CO<sub>2</sub>). Greenhouse gas emissions are the largest contributor to greenhouse gas emissions released

into the ambient air. Increasing carbon emissions will accumulate and affect the environment. This is due to the increasing intensity and variety of human activities so that they can produce carbon footprints.

Carbon footprint analysis is a measurement of greenhouse gas emissions that is sourced from the composition of the gas and the amount of gas (Franchetti & Apul, 2012). The carbon footprint is obtained from the accumulation of greenhouse gas emissions produced by individual and group activities, which can be calculated and expressed as equivalent to carbon dioxide. One of the activities that can produce a carbon footprint is all forms of lecture activity on campus, one of which is the UIN Sunan Ampel Surabaya campus. All activities that take place on campus affect the amount of carbon emissions produced.

When viewed from the existing conditions of the campus, the minimum number of trees or green open space (RTH) affects the large amount of carbon released into the atmosphere. Due to the role of trees or green open space as gas absorbers, carbon cannot function properly due to the large amount of carbon released into the air. Green open space is needed to increase the availability of air and clean air for the community and to create urban aesthetics (Joga. N, 2011).

The State Islamic Institute of Sunan Ampel Surabaya was founded in 1965 and, since 2013 has changed its name to UIN Sunan Ampel University Surabaya. UIN Sunan Ampel Surabaya University is a state university located in the city of Surabaya and consists of nine faculties, namely the Faculty of Science and Technology, the Faculty of Adab and Humanities, the Faculty of Tarbiyah and Teacher Training, the Faculty of Psychology and Health, the Faculty of Sharia and Law, the Faculty of Da'wah and Communication Studies, the Faculty of Usluhudin and Philosophy, the Faculty of Social and Political Sciences, and the Faculty of Economics and Business. The total student population of UIN Sunan Ampel is 20.390 (PdDikti, 2022). The UIN Sunan Ampel Surabaya campus has 2 campuses located in the city area of Surabaya, and researchers studied the carbon footprint produced by campus 1 which is located on JL. Ahmad Yani No. 117, Jemur Wonosari, Kec. Wonocolo, City of SBY, East Java 60237, and consists of 7 faculties, including the Faculty of Science and Technology, the Faculty of Adab and Humanities, the Faculty of Tarbiyah and Teacher Training, the Faculty of Sharia and Law, the Faculty of Da'wah and Communication Science, the Faculty of Usluhudin and Philosophy, and the Faculty of Economics and Business, with a population of 18.262 students.

Activities on Campus 1 of UIN Sunan Ampel Surabaya produce personal carbon emissions, both primary and secondary. Primary activities include student transportation activities, which cause carbon emissions due to burning vehicle fuel. While secondary activities

include the use of electrical equipment during activities on campus, these emissions appear indirectly.

This study aims to analyze the number of individual carbon emissions resulting from activities carried out on campus and compare the total percentage of individual carbon emissions produced by each emission. The amount of carbon emissions taken into account in this study consists of four scopes, including the scope of transportation use, the scope of electricity use, the scope of food, and the scope of waste.

## METHOD

### Location and Research Sample

The research location used in data collection is located on campus 1 at UIN Sunan Ampel Surabaya, precisely at JL. Ahmad Yani No. 117, Jemur Wonosari, Kec. Wonocolo, Surabaya City, East Java 60237. UIN Sunan Ampel Surabaya has a variety of campus activities, namely teaching and learning activities and other activities supported by complete and adequate facilities, including sports centers, mosques, libraries, canteens, laboratories, and so on. The time for data collection and analysis was May–June 2022. An overview of the research locations can be seen in Figure 1.



Figure 1: Map Campus I Area of UIN Sunan Ampel Surabaya. (Modified Google Earth, 2022)

### Population and Research Sample

The study used samples from the student population of Campus I UIN Sunan Ampel

Suarabaya, with a total student population of 18,262 people. The number of samples used to determine the number of respondents is calculated using the Slovin formula (Sugiyono, 2011) with an error degree of 10%. The following calculations are used in determining the number of samples:

$$n = \frac{N}{1+N \alpha^2} \quad (1)$$

Notes:

n = Number of samples (people)  
N = Number of population (people)  
a = Degree of error (10%)

Table 1: Number samples

Population	Samples		EF/GWP	HV
	Student	Lecturer		
18.262	100	-		
761	-	48		

Source: analysis results, 2022

This type of research is descriptive quantitative research, which describes the research results in the form of an analysis of the calculations obtained. Data collection consisted of two parts, namely primary and secondary, which were obtained from reviewing literature, observations, interviews, and questionnaires.

The processing of the data used in the research is based on an analysis of the calculation of carbon dioxide (CO<sub>2</sub>) emissions referring to the guidelines of the International Panel On Climate Change (IPCC) 2006. This research focuses on calculating individual carbon footprints produced by students at UIN Sunan Ampel Surabaya. The calculation of an individual's carbon footprint focuses on four areas, including the following:

### Scope 1 Transportation Activities

The calculation of student carbon footprints in scope 1 is calculated using the following formula:

$$\text{BB Consumption} = \text{Fuel consumption (L/year)} \times \text{HV} \quad (2)$$

$$\text{Emissions} = \text{BB Consumption} \times \text{EF} \times \text{GWP} \quad (3)$$

Information:

HV = Heating value (HV /L)

EF = Emission factor (kg/TJ)

GWP = Value of global warming potential (CO<sub>2</sub>-eq)

Table 2: EF, GWP and HV

Fuel Type	EF/GWP			HV			
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O				
Premium	69.300	1	33	21	3,2	310	33x10-6
Solar	74.100	1	3,9	21	3,9	310	36x10-6

Source: IPCC,2006

### Scope 2 Use of electricity

Calculation of student carbon footprints in scope 2 is calculated using the following formula:

$$\text{Emissions} = \text{Power consumption} \times \text{EF} \quad (4)$$

Information:

Electricity consumption = Electricity usage (KWh)

EF = Emission factor (0.87 kg CO<sub>2</sub>/KWh) (Directorate General of Electricity, 2019)

### Scope 3 Food Consumption

The calculation of the student's carbon footprint in scope 3 is calculated using the following formula:

$$\text{Emissions} = \text{Food consumption} \times \text{FE} \quad (5)$$

Information:

Food consumption = food consumed (kg)

EF= Emission factor (kg CO<sub>2</sub>-eq/kg)

Table 3: FE types of food

Types of Food	EF (kg CO <sub>2</sub> -eq/kg)
Carbohydrate	3,92
Meat	68,8
Chicken	35,6
Chicken offal	35,9
Fish	5,4

Types of Food	EF (kg CO <sub>2</sub> -eq/kg)
Vegetable	1,6
Fruit	0,9
Egg	4,9
Coffee	10,1
Milk	1,8

Source: Scarborough P.dkk, 2014

#### Scope 4 Waste Production

The calculation of the carbon footprint of students in scope 4 is calculated using the following formula:

$$\text{Emissions} = \text{Accumulation of waste} \times \text{FE} \quad (6)$$

Information:

Waste = Accumulation of waste (kg)  
 EF = Emission factor for waste (0.427 kg CO<sub>2</sub>-eq) (Technical Instructions for Monitoring, Evaluation and Reporting (PEP) of RAD-GRK Implementation; IPCC 2006)

## DISCUSSION

The results of the number of student carbon footprints resulting from various activities which are divided into 4 scopes on Campus I UIN Sunan Ampel Surabaya are as follows:

#### Scope 1 Transportation Activities

In scope 1 of the transportation activity, personal students and lecturers get carbon emissions from using motorbikes and cars while on campus, the activities carried out include using motorbikes and cars when going from building to building. The resulting carbon emissions come from motorized vehicle fuel. Transportation activities become a source of high dependence on energy sources because almost all vehicle products used in the transportation sector use motor vehicle fuel. The results of calculating personal student and lecturer carbon footprints obtained in the scope of transportation activities based on Table 4 are 10.73 kg CO<sub>2</sub>-eq/year and 28,39 kg CO<sub>2</sub>-eq/year, respectively. The results of carbon

emissions from transportation activities on campus are small compared to activities at other distances because the distance traveled by vehicles in carrying out activities on the nearest campus is less than 1 km.

#### Scope 2 Activity of using electricity

In scope 2 of the activity of using electricity, student and lecturer personal carbon emissions are obtained from the activity of using electronic equipment personally when on campus. Most of the electronic equipment used is laptops, smartphones, and power banks. The results of calculating personal student and lecturer carbon footprints obtained in the scope of electricity use based on table 4 are 30,49 kg CO<sub>2</sub>-eq/year and 43,89 kg CO<sub>2</sub>-eq/year, respectively. The results of carbon emissions from the activity of using electricity on campus are the second-smallest compared to other activities due to the use of electrical devices that are taken into account, including the personal electrical equipment of students and lecturers.

#### Scope 3 Food Consumption

In scope 3 of food consumption activities, personal student and lecturer carbon emissions are obtained from consuming food while in the area of government agencies at UIN Sunan Ampel Surabaya. The results of calculating the carbon footprint of students and lecturers obtained in the scope of food consumption based on table 4 are 1352,59 kg CO<sub>2</sub>-eq/year and 2416,69 kg CO<sub>2</sub>-eq/year. The results of carbon emissions from food consumption on campus are the largest compared to other activities because food consumption mostly comes from types of food that have high emission factors.

#### Scope 4 Waste Production

In scope 4 of waste production, personal students and lecturers carbon emissions are obtained from activities that result in waste while in the area of government agencies at UIN Sunan Ampel Surabaya. The results of calculating the personal student and lecturer carbon footprint obtained in the scope of waste based on table 4 are 22,36 kg CO<sub>2</sub>-eq/year and 2,22 kg CO<sub>2</sub>-eq/year.

eq/year. The results of carbon emissions from activities that result in waste on campus are the second largest compared to other activities due to the large use of paper by each student.

So that the total carbon footprint of personal students and lecturers from 4 areas, including transportation activities, electricity use, food consumption, and waste, is 1416,17 kg CO<sub>2</sub>-eq/year and 2491,19 kg CO<sub>2</sub>-eq/year.

Table 4: The results of carbon emissions from various activities

Activity	Results Carbon emissions (kg CO <sub>2</sub> -eq/year.)	
	Students	Lecturers
Transportation	10,73	28,39
Using electricity	30,49	43,89
Food Consumption	1352,59	2416,69
Wasate production	22,36	2,22
Total Carbon emissions	1416,17	2491,19

In table 4 it can be seen that the activity that produces the highest carbon footprint comes from scope 3, namely the activity of consuming food with individual student and lecturer carbon emissions of 1352.59 kg CO<sub>2</sub>-eq/year and 2416.59 kg CO<sub>2</sub>-eq/year, while the activity that produces the lowest individual carbon for students comes from scope 1 of transportation activity with individual carbon emissions of 10.73 kg CO<sub>2</sub>-eq/year, and for lecturers comes from scope 4 waste generators with individual carbon emissions of 2.22 kg CO<sub>2</sub>-eq/year. So the total carbon footprint of individual students from 4 scopes is 1416.17 kg CO<sub>2</sub>-eq/year, and the total carbon footprint of individual lecturers is 2491.19 Kg CO<sub>2</sub>-eq/year.

#### Step to reduce carbon emissions

There are several ways from the Ministry of Environment and Forestry (2018) that can be used as a reference to minimize carbon emissions produced when doing activities on campus 1 of UIN Sunan Ampel Surabaya, some of which include:

1. Reforest the campus area by planting trees and ornamental plants to absorb CO<sub>2</sub>, thereby helping to minimize carbon dioxide emissions.
2. Walk when doing activities in the campus area.

3. Minimize the use of paper.
4. Reducing foods that can produce carbon emissions, by choosing foods that have a smaller emission factor.

## CONCLUSION AND SUGGESTION

### Conclusion

Based on the research that has been done, it can be concluded that individual carbon footprints produced by students within the campus area are as follows: In scope 1, transportation activities are 10.73 kg CO<sub>2</sub>-eq/year, in scope 2, electricity usage activities are 30.49 kg CO<sub>2</sub>-eq/year, in scope 3 (three) food consumption activities are 1352.59 kg CO<sub>2</sub>-eq/year, and in scope 4 (four) activities producing waste are 22.36 kg CO<sub>2</sub>-eq/year, with total individual carbon emissions for students of 1416.17 kg CO<sub>2</sub>-eq/year, personal carbon footprints produced by lecturers on campus are as follows in scope 1 transportation activity of 28.39 kg CO<sub>2</sub>-eq/year, in scope 2 electricity use activity of 43.89 kg CO<sub>2</sub>-eq/year, in scope 3 (three) food consumption activities of 2416.69 kg CO<sub>2</sub>-eq/year, and in scope 4 (four) activities producing waste of 2.22 kg CO<sub>2</sub>-eq/year, with a total individual student carbon emission of 2491.19 kg CO<sub>2</sub>-eq/year.

### Suggestion

Research was conducted after the end of the pandemic to compare the total carbon emissions produced during the pandemic and after the COVID-19 pandemic so that it could be used as a study in the environmental field.

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