



Research Report

A Study of Carbon Dioxide Emissions from Leftover Food and Carbon Sequestration by Trees

Researchers

Mr. Watcharin Chaiwiset

Mr. Sitthiphong Inthiphan

Mr. Khanchai Netathes

Mr. Rattanakorn Janthong

Researchers advisor

Mrs. Darunee Sermoopak

Ms. Palida Plodthong

Mr. Atchariya Wiangkaew

Phak Mai Wittayanukul School, Huai Thap Than District, Sisaket Province, Secondary Educational Service Area Office, Sisaket-Yasothon, Ministry of Education.

Ministry of Education

Research Title : A Study of Carbon Dioxide Emissions from Leftover Food and Carbon Sequestration by Trees

Researchers : Mr. Watcharin Chaiwiset Mr. Sitthiphong Inthiphan
Mr. Khanchai Netathes Mr. Rattanakorn Janthong

Researchers advisor : Mrs. Darunee Sermoopak Ms. Palida Plodthong Mr. Atchariya Wiangkaew

School : Phak Mai Witthayanukul School

Abstract

This research aimed to: (1) evaluate the carbon dioxide emissions from leftover food consumed by students at Phakmai Wittayanukul School; (2) assess the carbon sequestration capacity and identify tree species around the school canteen; and (3) compare the emissions from leftover food with the trees' sequestration capacity of trees around the canteen. The research was conducted using a field survey method. Tree species around the canteen and school buildings were surveyed. Tree height was measured using the GLOBE Observer application, and trunk circumference was measured at a height of 150 centimeters above ground level using a measuring tape. The collected data were recorded and used to calculate carbon sequestration using the LESS program, along with identifying tree species. In addition, leftover food was weighed daily throughout the 2025 academic year, and the data were used to calculate carbon dioxide emissions in terms of carbon footprint. The results showed that the average amount of leftover food generated by students during the 2025 academic year was 2 kilograms per day, resulting in carbon dioxide emissions of 5 CO_{2e}(kg) per day. A survey of 42 trees around the canteen and school buildings revealed a total carbon sequestration capacity of 32,886.59 CO_{2e}(kg). The three most common tree species were Bullet Wood (*Mimusops elengi*) with 10 trees, followed by Pine trees with 7 trees, and Ironwood (*Cassia siamea*) with 6 trees. When comparing the total carbon dioxide emissions from leftover food during the 2025 academic year (880 CO_{2e}(kg)) with the carbon sequestration capacity of the 42 trees around the canteen (32,886.59 CO_{2e}(kg)) it was found that the trees were able to sequester a significantly greater amount of carbon dioxide than that produced from leftover food.

Introduction

At present, climate change is a major global issue that significantly affects the environment and human quality of life. One of the primary causes of climate change is the emission of greenhouse gases, particularly carbon dioxide, which results from various human activities in daily life. One activity that contributes to carbon dioxide emissions is food waste management, especially leftover food, which is often overlooked. However, the disposal and decomposition of food waste can release substantial amounts of carbon dioxide that negatively impact the environment.

Schools are places where large quantities of food are consumed every day, especially in school cafeterias, where a considerable amount of leftover food from students is commonly found. Without proper management, this leftover food can become a significant source of carbon dioxide emissions and may cause long-term environmental impacts. Therefore, studying the amount of leftover food and the resulting carbon dioxide emissions is essential in order to raise environmental awareness and provide fundamental data for developing strategies to reduce food waste in educational institutions. At the same time, trees play an important role in reducing the concentration of carbon dioxide in the atmosphere, as they are capable of absorbing and storing carbon in the form of biomass. Tree planting and conservation are therefore effective approaches to mitigating the effects of greenhouse gases. The areas surrounding the cafeteria and school buildings of Phak Mai Witthayanukul School contain a variety of tree species that may have the potential to sequester carbon and offset carbon dioxide emissions generated by activities within the school.

Consequently, this study aims to investigate the amount of carbon dioxide emissions from leftover food generated by students at Phak Mai Witthayanukul School, Huai Thap Than District, Sisaket Province, alongside an examination of the carbon sequestration capacity and tree species around the school cafeteria. The data obtained will be used to compare the amount of carbon dioxide emissions from leftover food with the amount of carbon sequestered by trees. The findings of this study are expected to contribute to environmental awareness, promote food waste reduction, and support the effective use of green spaces in schools to sustainably reduce greenhouse gas emissions.

Research Question

Is the amount of carbon dioxide emitted from leftover food in the school cafeteria greater than the amount of carbon sequestered by individual trees?

Objectives

To study the emissions of carbon dioxide gas from leftover food and the carbon sequestration capacity of trees at Phak Mai Wittayanukul School, Huai Thap Than District, Sisaket Province

Research Hypothesis

The amount of carbon dioxide released from leftover food is greater than the amount of carbon sequestered by trees in the cafeteria area of Phak Mai Wittayanukul School.

Variables of the Study

Independent Variables :The physical characteristics of trees (species, height, and trunk circumference) at Phakmai Wittayanukul School.

Dependent Variables : The total amount of carbon dioxide emissions from food waste.

Controlled Variables : The methodology for data collection (e.g., using the GLOBE Observer app and the LESS program).

Expected Results

The study is expected to provide guidelines for reducing food waste and promoting tree planting at Pak Mai Wittayanukul School, Huai Thap Than District, Sisaket Province, in order to reduce global warming.

Scope of the Study 1. Content

1)To study the amount of carbon dioxide released from leftover food

2)To study the carbon sequestration of trees and the role of trees in reducing the amount of carbon dioxide in the atmosphere.

2. Area Scope

The study areas are specified at Phak Mai Wittayanukul School in two locations

Area 1: The school cafeteria, collect data on the amount of leftover food.

Area 2: The tree planting area around the cafeteria, study the carbon sequestration of trees.

3. Time Scope Materials and Research Methodology

Leftover food samples in the school cafeteria will be collected during the academic year 2025.

Materials and Research Methodology

1.Study Site Selection Two study sites were designated at Phak Mai Wittayanukul School: the school buildings.



Site 1: School Cafeteria Phak Mai Wittayanukul School, Huai Thap Than District, Sisaket Province.



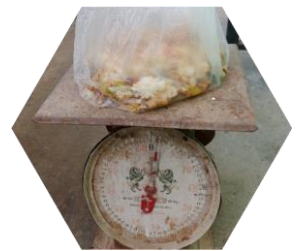
School Cafeteria



Leftover food



Collect leftover food



Measure the weight

Site 2: Tree Measurement Area The second study site was the tree measurement area around the cafeteria and school buildings at Phak Mai Wittayanukul School, Huai Thap Than District, Sisaket Province.



Measure at a height of 1.50 meters above ground level.



Measure the circumference



Pine tree



Senna siamea



Determine the height of the tree



Mimusops elengi

Materials and Equipment

1. Tape measure



2. app GLOBE Observer



3. Logbook



4. Scale



5. Plastic bucket



6. Plastic bag



7. Mobile phone



8. Pen



9. Web LESS



Research Methodology Part 1: Assessment of CO₂e Emissions from Food Waste

1.1 Data Collection: The data collection period was set for one academic year.

1.2 Waste Separation: Food waste left after lunch was collected. Contaminants such as spoons and plastic bags were completely separated and removed.

1.3 Weighing: The total food waste was weighed daily, and the results were recorded.

1.4 Calculation: The total weight of food waste was used to calculate the average daily amount.

Formula: Food waste weight (kg) × 2.5 = Amount of carbon dioxide gas

Part 2: Assessment of Carbon Sequestration by Trees (GLOBE Biometry Protocol)

2.1 Study Area: The boundaries of the green areas surrounding the cafeteria and school buildings were identified.

2.2 Species Survey: Tree species in the study area were identified (common tree species).

2.3 Tree Measurement: Tree circumference was measured at 1.50 meters above ground level (breast height). Tree height was calculated using the GLOBE Observer application. The Low Emission Support Scheme (LESS) website was used to calculate the carbon sequestration of trees in the areas surrounding the cafeteria and school buildings.

Research Results

Based on the collection of food waste samples during the 2568 academic year, from May 2568 to February 2569, the results are presented as shown in the table below.

Table: Carbon emission values from leftover food waste of Phak Mai Witthayanukul School, Huai Thap Than District, Sisaket Province.

Month	Leftover food (kg) x 2.5	Carbon footprint CO _{2e} (kg)
May 2568	26(kg)	65CO _{2e}
June 2568	40(kg)	100CO _{2e}
July 2568	46(kg)	115CO _{2e}
August 2568	44(kg)	110CO _{2e}
September 2568	42(kg)	105CO _{2e}
November 2568	42(kg)	105CO _{2e}
December 2568	40(kg)	100CO _{2e}
January 2569	36(kg)	90CO _{2e}
February 2569	36(kg)	90CO _{2e}
all	352(kg)	80CO _{2e}

Based on the field survey of trees surrounding the cafeteria and school buildings of Phak Mai Witthayanukul School, a total of 42 trees were recorded. The results showed that the three tree species with the highest carbon sequestration capacity were as follows: The large pine tree had the highest carbon sequestration, with 4,006.30 CO_{2e}(kg), followed by the Yang Na tree (*Dipterocarpus alatus*) with 2,915.34 CO_{2e}(kg), and the small pine tree with 954.33 CO_{2e}(kg).

Table: Tree Data of Phak Mai Witthayanukul School, Huai Thap Than District, Sisaket Province

Local name	Number of trees	Circumference(Cm)	Height(M)	Carbon sequestration per tree CO ₂ e(kg)
Spanish cherry	10	133(Cm)	5(M)	387.07 CO ₂ e(kg)
Devil tree	3	165(Cm)	4(M)	641.25 CO ₂ e(kg)
Pine tree	3	144(Cm)	8(M)	954.33 CO ₂ e(kg)
Tamarind tree	1	47(Cm)	4(M)	59.56 CO ₂ e(kg)
Coconut tree	2	70(Cm)	6(M)	185.83 CO ₂ e(kg)
Yang na tree	1	190(Cm)	15(M)	2,915.34 CO ₂ e(kg)
Siamese cassia	6	92(Cm)	13(M)	647.55 CO ₂ e(kg)
Papaya tree	7	10(Cm)	2(M)	1.66 CO ₂ e(kg)
Neem tree	1	42(Cm)	6(M)	70.65 CO ₂ e(kg)
Large pine tree	4	190(Cm)	21(M)	4,006.30 CO ₂ e(kg)
Golden shower tree	1	116(Cm)	11(M)	856.39 CO ₂ e(kg)
Agati tree	2	4(Cm)	4(M)	14.17 CO ₂ e(kg)
Leucaena tree	1	13(Cm)	4(M)	5.24 CO ₂ e(kg)
all	42	-	-	32886.59 CO ₂ e(kg)

Conclusion of the Research

The study of leftover food waste from students at Pak Mai Witthayanukul School during the 2568 academic year found that the average amount of food waste was 2 kilograms per day, which could generate CO₂e(kg) per day. The total amount of carbon dioxide emissions from leftover food waste during the academic year was 880 CO₂e(kg). From the field survey of trees surrounding the cafeteria and school buildings of Phak Mai Witthayanukul School, a total of 42 trees were recorded. The results showed that the three tree species with the highest carbon sequestration capacity were the large pine tree with 4,006.30 CO₂e(kg), followed by the Yang Na tree with 2,915.34 CO₂e(kg), and the small pine tree with 954.33 CO₂e(kg). Overall, the 42 trees were able to sequester a total of 32,886.59 CO₂e(kg). The findings indicate that the amount of carbon emissions from leftover food waste during the 2568 academic year (880 CO₂e(kg)) was significantly lower than the carbon sequestration capacity of the trees surrounding the cafeteria and school buildings.

Discussion

The results of the study showed that the amount of carbon dioxide emissions released from leftover food waste during the 2567 academic year was 880 CO₂e(kg), whereas the 42 trees surrounding the cafeteria had a carbon sequestration capacity of up to 32,886.59 CO₂e(kg). The fact that the carbon sequestration capacity was significantly higher than the carbon emissions indicates that the number, density, and size of the trees around the cafeteria are appropriate, enabling them to function as a highly effective carbon sink. In terms of food waste management, the carbon emission value of 880 CO₂e(kg) is considered relatively low when compared to the carbon sequestration capacity of the surrounding trees. This suggests that the school has implemented food waste management practices at a satisfactory level, or that the actual amount of food waste generated is relatively small when compared to the absorption capacity of the surrounding ecosystem. Overall, these findings demonstrate that the cafeteria area of Phak Mai Witthayanukul School has a greater capacity for carbon sequestration than carbon emissions, reflecting a positive balance between carbon release and carbon absorption within the school environment.

Recommendations

Based on the study of lunch management during the 2569 academic year, it was found that leftover food from the school cafeteria resulted in approximately 880 CO₂e(kg) of carbon dioxide emissions. This indicates that food waste caused by incomplete consumption has an environmental

impact. Therefore, awareness should be raised among students about the importance of consuming food responsibly in order to reduce food waste and its associated carbon emissions. In addition, the survey of 42 trees surrounding the cafeteria revealed a total carbon sequestration capacity of 32,886.59 CO₂e(kg), which effectively helps mitigate the environmental impacts caused by carbon dioxide emissions. Consequently, the preservation and enhancement of green areas around the school should be encouraged, as trees play a significant role in absorbing carbon dioxide and promoting environmental sustainability.

Acknowledgements

This research entitled "A Study of Carbon Dioxide Emissions from Leftover Food and Carbon Sequestration by Trees" was successfully completed with the support and assistance of many individuals. The researcher would like to express sincere gratitude to all those who provided help, support, and valuable guidance throughout the research process. The researcher would like to extend special thanks to the research advisor for valuable guidance, careful review, constructive corrections, and useful suggestions that contributed significantly to the successful completion of this research. Gratitude is also extended to the school/institution and related organizations for providing the research site and facilitating data collection, as well as to all participants who cooperated and supported this research. Finally, the researcher would like to express heartfelt thanks to family members, friends, and all concerned individuals for their continuous encouragement and support, which made the successful completion of this research possible.

References

Food and Agriculture Organization of the United Nations (FAO). (2013). Food wastage footprint: Impacts on natural resources.

<https://www.fao.org/3/i3347e/i3347e.pdf>

NASA. (2024). GLOBE Observer: Trees [Mobile application].

<https://observer.globe.gov/about/get-the-app>

Pollution Control Department. (2023). Thailand pollution situation report 2022. Ministry of Natural Resources and Environment.

<https://www.pcd.go.th>

Thailand Greenhouse Gas Management Organization (Public Organization).

(2023). Guidelines for the development of Low Emission Support Scheme (LESS) projects. <https://ghgreduction.tgo.or.th/th/less.html>

Thailand Greenhouse Gas Management Organization (Public Organization).

(n.d.). Carbon sequestration calculation tool for the forestry sector (LESS Evaluation Sheet). Retrieved from <https://ghgreduction.tgo.or.th>

The GLOBE Program. (n.d.). Trees protocol: How to measure tree height.

<https://www.globe.gov>

Badge



1) I AM AN EARTH SYSTEM SCIENTIST

This research examines the interconnections within the Earth system. Leftover food generated from human activities releases carbon dioxide into the atmosphere during decomposition, contributing to global warming. In contrast, trees in the biosphere absorb carbon dioxide through the process of photosynthesis and store carbon in their trunks, leaves, and soil. This study compares carbon sources from leftover food with the carbon sequestration capacity of trees in order to demonstrate that reducing food waste and planting trees can help maintain the balance of the Earth system in a sustainable manner.

2) I AM A PROBLEM SOLVER

This research aims to address the problem of global warming caused by leftover food, which is a source of carbon dioxide emissions from human activities. The researcher examined the amount of leftover food and calculated the associated carbon dioxide emissions, while also investigating the carbon sequestration capacity of trees. The results were compared to identify practical approaches for carbon offsetting. The findings indicate that reducing food waste in combination with tree planting is a feasible solution that can effectively mitigate environmental impacts and contribute to sustainable environmental conservation.



3) I MAKE AN IMPACT

This research demonstrates that small actions in daily life can create positive impacts on the planet. By examining the amount of carbon dioxide emissions released from leftover food and comparing them with the carbon sequestration capacity of trees, the findings help raise awareness of the importance of reducing food waste and promoting tree planting. These approaches provide practical ways for everyone to participate in reducing carbon dioxide emissions and caring for the environment in a sustainable manner.

