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Empowering sustainability: The impact of student engagement in Cacao planting for waste reduction and environmental awareness

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Abstract

This research study examines the impact of student engagement in cacao tree planting initiatives on waste reduction and environmental awareness at CSU Lasam, Philippines. The objective was to assess students' perceptions and experiences after participating in the project. A total of 61 students from various degree programs were involved in the cacao tree planting activities and were surveyed to gauge their level of participation and perception. The findings indicate a significantly positive impact of student engagement in cacao tree planting on waste reduction and environmental awareness. The students reported feeling more knowledgeable about cacao tree planting and believed that it contributes to waste reduction. Their participation in the initiative heightened their environmental awareness and fostered a sense of accomplishment and pride. As a result of their involvement, the students expressed being motivated to adopt more sustainable practices in their daily lives and felt a sense of responsibility towards environmental sustainability. Thematic analysis of the students' experiences further supported these positive outcomes. Through cacao tree planting, students gained a deeper understanding of environmental issues and developed a personal connection to their campus environment. This newfound appreciation for nature inspired them to advocate for environmental conservation. Student engagement in cacao tree planting for waste management and environmental awareness is a valuable strategy for promoting sustainability and empowering students to become responsible stewards of the environment. The integration of such initiatives into educational settings can contribute to building a greener and more environmentally conscious future for CSU Lasam and beyond.

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Introduction

In recent years, there has been a growing global concern about the impact of carbon emissions and their contribution to climate change. Universities, as major institutions of education and research, have increasingly recognized their responsibility to address environmental challenges, including reducing their carbon footprint. Carbon emissions on university campuses are a significant aspect of this broader issue, as these institutions consume substantial amounts of energy and resources to support their operations, research, and campus life. Across the globe, universities are facing increasing pressure from students, faculty, staff, and the wider community to take meaningful action to combat climate change and achieve carbon neutrality. Many universities have responded to this call by adopting sustainability and carbon reduction goals, committing to net-zero emissions, and implementing various initiatives to minimize their environmental impact. The urgency of this endeavor is further underscored by the scientific consensus that drastic and immediate action is necessary to mitigate the worst effects of climate change.

In this context, universities have been implementing a range of measures to achieve carbon neutrality and create more environmentally sustainable campuses. These efforts encompass diverse strategies, including transitioning to renewable energy sources, improving energy efficiency in buildings and infrastructure, promoting sustainable transportation options, reducing waste generation, and integrating environmental sustainability into academic curricula and research projects (Sintomer *et al.*, 2012; Sun *et al.*, 2017; Yu *et al.*, 2018). Despite progress, challenges persist. Universities often face financial and logistical constraints in implementing sustainable practices and transitioning to renewable energy sources (Chen *et al.*, 2020; Liu *et al.*, 2021). Balancing environmental concerns with the demands of campus growth and development can be complex (Dillard & Dujon, 2019). Additionally, raising awareness and ensuring active participation from all stakeholders within the university community can be a continuous endeavor (Bonney *et al.*, 2016; Velázquez *et al.*, 2020).

Cacao Planting Towards Environmental Sustainability and Literacy of CSU Lasam Initiatives

Cacao (*Theobroma cacao*) is a tropical tree native to the Americas, primarily cultivated for its seeds, which are used to produce cocoa and chocolate. Beyond its significance in the confectionery industry, cacao trees have valuable environmental benefits that align with sustainable waste management goals. When strategically integrated into waste management efforts, cacao planting can contribute to waste reduction, composting, and resource recycling. Cacao planting towards environmental sustainability and literacy is a transformative initiative that aims to address two crucial aspects of community development: environmental conservation and education. By promoting cacao planting as a means to achieve these goals, the initiative can create a positive impact on both the ecosystem and the local community. The Cacao RDE Program (Research, Development, and Extension Program) at Cagayan State University (CSU) in Lasam is driven by a strong rationale to address pressing environmental and agricultural challenges while empowering students to actively contribute to sustainable practices. The program's decision to engage students in cacao tree planting is founded on several compelling reasons.

Cacao tree planting offers a practical and eco-friendly solution to solid waste management. With the increasing volume of waste generated in the campus and surrounding areas, the need for sustainable waste management practices has become evident. Cacao trees provide an avenue for composting organic waste, as fallen leaves and biodegradable materials can be utilized as natural fertilizers for the cacao plantation. This approach helps reduce the accumulation of waste in landfills and promotes the recycling of valuable resources. The involvement of students in cacao planting aligns with CSU's commitment to experiential learning and holistic education. By actively participating in the planting process, students gain hands-on experience in environmental conservation and sustainable agriculture. They become aware of the ecological importance of cacao trees and understand their role as responsible stewards of the environment.

Such engagement fosters a sense of ownership and instills values of environmental consciousness that extend beyond their academic pursuits.

Students' Sustainable practices and Solid Waste management

The rationale for promoting students' sustainable practices and solid waste management lies in the urgent need to address the growing environmental challenges and waste crisis facing our world today. Rapid population growth and increasing consumption patterns have led to a substantial increase in waste generation, contributing to pollution and ecological degradation (UNEP, 2021). Engaging students in sustainable practices and waste management empowers the younger generation to become environmentally conscious and responsible citizens, capable of making informed decisions for a more sustainable future (UNESCO, 2020).

Studies have shown that involving students in sustainability initiatives not only improves their environmental literacy but also enhances their sense of environmental stewardship and motivates them to adopt more eco-friendly behaviors (Chawla, 1998; Johnson *et al.*, 2019). Furthermore, incorporating solid waste management practices into the educational curriculum allows students to understand the full lifecycle of waste, from generation to disposal, and the environmental implications associated with mismanaged waste (Rametsteiner *et al.*, 2018). This hands-on approach encourages critical thinking and problem-solving skills as students actively participate in waste reduction and recycling efforts on their campuses (Boeve-de Pauw *et al.*, 2012). By promoting sustainable practices and solid waste management, educational institutions play a crucial role in nurturing the next generation of environmentally conscious leaders who can contribute to building a more sustainable and resilient world (Carleton University, 2021).

The literature gap is related to the limited research available on the specific topic of cacao tree planting as a mechanism for solid waste management in university campuses. While there may be studies on sustainable practices and waste management in

general, the integration of cacao tree planting as a specific approach for solid waste management appears to be understudied in the existing literature. This study seeks to bridge the literature gap by providing valuable data and insights into the effectiveness of cacao tree planting as a sustainable practice for waste management, particularly in the context of a university campus. By filling this gap, the study aims to contribute to the body of knowledge on sustainable practices and waste management strategies in educational institutions, thus encouraging further research and initiatives in this area. The practical gap in this study lies in the lack of comprehensive engagement of CSU Lasam students in sustainable practices for solid waste management, specifically in the context of cacao tree planting. While there may have been initiatives and projects addressing waste management on campus, the integration of cacao tree planting as a mechanism for waste management may not have been extensively explored. The practical gap indicates that there is a need to investigate and understand the level of students' engagement and experience in cacao tree planting as a sustainable solution for solid waste management at CSU Lasam. By identifying the current level of engagement and experiences of students, the study aims to provide insights and recommendations to enhance and promote more effective and sustainable waste management practices through cacao tree planting.

Objectives of the study

This study generally assesses the engagement of CSU Lasam students in Cacao planting. It specifically aimed to: to assess the level of student engagement in cacao tree planting initiatives for solid waste management at CSU Lasam; and (2) examine the impact of student engagement in cacao tree planting on waste reduction and environmental awareness within the campus.

Materials and methods

Research design

The research design for this study is a mixed-methods approach, which combines both quantitative and qualitative methods. This approach allows for a comprehensive exploration of the role of student

engagement in cacao tree planting for solid waste management at CSU Lasam, providing a deeper understanding of the topic and its implications.

Respondents

The respondents for this study include 61 students from the four degree programs of Cagayan State University at Lasam who actively involved in the cacao tree planting initiatives of CSU Lasam. These individuals were selected based on their participation and contribution to the project, ensuring that their experiences and perspectives are captured in the research. The data reflects a diverse level of participation across different degree programs, signifying that the cacao tree planting initiative has gained attention and support from students with various academic interests. However, to foster a more inclusive and comprehensive approach to environmental sustainability, it is crucial to continue promoting such initiatives and encouraging greater participation from students across all degree programs. This can be achieved through targeted awareness campaigns, integrating sustainability-related topics in various curricula, and creating opportunities for interdisciplinary collaboration to address environmental challenges effectively.

Table 1. Distribution of Respondents According to Degree Program Participated in the Cacao Planting.

Degree Programs	Number of Students Participated	Percentage
BS Food Technology	15	24.59%
BS Mechanical Technology	8	13.11%
BS Automotive Technology	2	3.28%
BSED English	22	36.07%
BEED Generalist	15	24.59%
Total	61	100%

Instruments

To gather data, the study utilized two main instruments: surveys and interviews. Surveys were conducted to collect quantitative data on the level of student engagement, waste reduction impact, and environmental awareness among the university community. Interviews were used to obtain qualitative insights into the experiences and perceptions of the respondents regarding the cacao

tree planting initiatives and their role in promoting sustainability.

Data gathering procedure

The data gathering was conducted after the conduct of cacao planting activities in the three school sites of the School Plus home Cacao project, namely, Magsaysay Elementary School, IBJ Elementary School and Nabannagan National Highschool. The data gathering process involved distributing surveys to the identified respondents involved in the cacao tree planting project. The surveys were designed to collect information on various aspects of their engagement and experiences in the initiatives. Additionally, individual and group interviews were conducted to delve deeper into their perspectives, motivations, and challenges related to the project.

Table 2. Cacao Planting Sites.

Planting Sites	Date of Activity
IBJ Elementary School	April 1, 2022
Magsaysay Elementary School	March 31, 2022
Nabannagan National Highschool	July 11, 2022

Data Analysis

Quantitative data obtained from the surveys were analyzed using statistical methods, such as descriptive statistics and inferential analysis, to identify patterns and trends in student engagement and waste reduction outcomes. Qualitative data from the interviews were analyzed thematically to gain insights into the experiences and perceptions of the respondents. The integration of both quantitative and qualitative findings allows for a comprehensive understanding of the impact of student engagement in cacao tree planting for solid waste management at CSU Lasam and the potential benefits for promoting sustainability.

Results and discussion

Students' Perception after their participation in Cacao planting activities

The results from Table 3 indicate that students' participation in cacao tree planting activities for solid waste management at CSU Lasam had a significantly positive impact on their perceptions and attitudes.

The mean scores for all six statements were above 4, indicating that students perceived the experience very positively.

Table 3. Assessment of Students' Environmental Perception after their participation in Cacao planting activities.

Statement	Mean (n=61)	SD	Interpretation
1. I feel more knowledgeable about cacao tree planting.	4.35	0.89	Very High
2. I believe cacao planting contributes to waste reduction.	4.51	0.76	Very High
3. I am more environmentally aware after participating.	4.67	0.72	Very High
4. I feel a sense of accomplishment from my participation.	4.19	0.92	High
5. I am motivated to engage in more sustainable practices.	4.41	0.83	Very high
6. I am proud to be part of the cacao planting initiative.	4.49	0.78	Very High

Legend: 4.20-5.00- Very High; 3.40-4.19 - High; 2.60-3.39 - Moderate; 1.80-2.59 , Low; 1.00-1.79 - Very Low

A closer look at the table shows that, the students reported feeling more knowledgeable about cacao tree planting, with a mean score of 4.35. This suggests that their involvement in the initiative provided them with valuable insights and practical knowledge about sustainable agricultural practices. The students strongly believed that cacao planting contributes to waste reduction, as indicated by a mean score of 4.51. This finding highlights the awareness among students that the cacao pods can be utilized as compost material for organic waste, thereby reducing the overall waste generated on campus. Thirdly, the students expressed that their participation in cacao tree planting activities heightened their environmental awareness, with a mean score of 4.67. This shows that the hands-on experience of planting and caring for cacao trees sensitized them to the importance of environmental sustainability and waste management. Fourthly, the students felt a sense of accomplishment from their participation, with a mean score of 4.19.

This indicates that they recognized the significance of their contributions to the project and felt a sense of pride in actively engaging in an initiative that has positive environmental impacts. In like manner, the students reported being motivated to engage in more sustainable practices, with a mean score of 4.41. This suggests that their involvement in the cacao tree planting project inspired them to adopt more eco-friendly behaviors both on and off-campus. Lastly, the students expressed a high level of pride in being part of the cacao planting initiative, with a mean score of 4.49. This feeling of pride indicates a strong sense of ownership and connection to the project and its contribution to waste management practices at CSU Lasam.

The positive impact of student engagement in environmental initiatives, such as cacao tree planting for waste management, aligns with existing literature on the subject. Studies have shown that involving students in hands-on, experiential learning activities related to environmental issues can significantly enhance their knowledge and awareness of sustainable practices. Research by Stevenson and Dillon (2018) highlights the importance of experiential learning in environmental education, which includes activities like tree planting.

The study found that such experiences not only increase students' knowledge about ecological processes but also foster a sense of personal connection to nature and a desire to protect the environment. Additionally, a study conducted by Chawla (2015) emphasized the role of outdoor education and environmental experiences in shaping pro-environmental attitudes and behaviors among students. The study found that students who actively participated in environmental activities displayed higher levels of environmental responsibility and commitment to sustainable practices. Furthermore, studies focusing on waste management initiatives have demonstrated that student involvement can significantly contribute to waste reduction efforts. For example, a study by Scott and Gough (2018) explored the impact of student-led waste reduction campaigns on college campuses and found that active student participation led to significant reductions in waste generation.

Students' Thematic Analysis of their experiences in cacao tree planting on waste reduction and environmental awareness

Theme 1. Increased Waste Reduction Practices

Students-informants reported that engaging in cacao tree planting activities led them to adopt more conscious waste reduction practices. They mentioned being more mindful of their waste disposal habits and actively separating organic waste for composting. This experience contributed to a reduction in the amount of waste they generated, as they were now more inclined to recycle and reuse materials. As Student A said *"Participating in cacao tree planting opened my eyes to the importance of waste reduction. Now, I make a conscious effort to separate my trash and compost organic waste. It feels great knowing that I'm contributing to a cleaner campus environment."* Student B confirmed *"Cacao tree planting taught me the value of sustainability. I've started recycling more and using reusable items to reduce my waste. It's a small change, but I believe every effort counts in making our campus greener."* In like manner, Student C said *"Before cacao planting, I didn't pay much attention to waste disposal. Now, I take the time to sort my trash properly and even encourage my roommates to do the same. It's a positive habit that I'll carry with me beyond college."* And Student D confided *"Seeing the impact of cacao tree planting on waste reduction motivated me to take action. I've become more conscious of my consumption, and I try to find creative ways to repurpose items instead of throwing them away. It's been a fulfilling journey towards being more environmentally responsible."*



Pictures 1 & 2. Students During the Cacao Planting in one of the school sites.

The findings on increased waste reduction practices among students who participated in cacao tree planting activities align with existing literature on the

positive impact of environmental engagement on waste management. Studies have shown that hands-on experiences, like tree planting, can lead to greater awareness of waste generation and the importance of responsible waste disposal (Stevenson & Dillon, 2018). When students actively participate in environmental initiatives, they become more mindful of their consumption habits and are more likely to adopt sustainable practices such as recycling and composting (Chawla, 2015). Moreover, these findings are in line with research that emphasizes the role of experiential learning in environmental education. Engaging students in practical activities that have real-world implications, like cacao tree planting, can create a deeper understanding of environmental issues and foster a sense of responsibility for environmental conservation (Stevenson & Dillon, 2018). This sense of ownership over environmental initiatives and waste reduction practices was evident in the students' statements, where they expressed pride in their contributions and a desire to continue their sustainable habits beyond college.

Theme 2. Enhanced Environmental Awareness

Students expressed that their participation in cacao tree planting raised their environmental consciousness. Through hands-on experiences, they gained a deeper understanding of the importance of preserving natural resources and protecting the environment. Many of them acknowledged that witnessing the positive impact of tree planting on the ecosystem motivated them to take greater responsibility for environmental conservation. From the responses, Student E said *"Cacao tree planting made me realize how interconnected everything is in nature. I'm more aware of the environmental consequences of our actions, and I now strive to make choices that have a positive impact on the planet."* For Student F, he said *"Taking part in cacao tree planting activities opened my eyes to the beauty of our ecosystem. It made me appreciate nature more and understand the need to protect it. I now advocate for sustainable practices among my peers."* Student G also mentioned *"I used to take nature for granted, but cacao tree planting changed that. Now, I actively seek ways to contribute to environmental conservation. It's amazing how*

planting a single tree can make a difference, and I want to do more for our environment."



Pictures 3, 4 & 5. Students preparing for the cacao planting taken in one of the school sites.

The students' expressions of enhanced environmental awareness following their participation in cacao tree planting activities resonate with the findings of previous research on the impact of experiential learning in environmental education. Studies have shown that hands-on experiences in natural settings can lead to a deeper understanding and appreciation of the environment (Chawla, 2015).

Engaging in activities like tree planting allows students to witness the positive outcomes of their actions on the ecosystem, fostering a sense of environmental interconnectedness and responsibility (Stevenson & Dillon, 2018). The students' statements highlight the transformative power of experiential learning, where they now view nature with a greater sense of awe and appreciation. They have become advocates for sustainable practices, recognizing the importance of protecting the environment for future generations. This aligns with previous research that indicates that students who engage in environmental activities are

more likely to develop pro-environmental attitudes and behaviors (Chawla, 2015).

Theme 3. Sense of Responsibility and Ownership

Cacao tree planting instilled a sense of responsibility and ownership among the students. They felt personally connected to the project and recognized their role in contributing to waste reduction and environmental sustainability on campus. As a result, they were more proactive in promoting sustainable practices and encouraging their peers to join similar initiatives. Student B said *"Being part of the cacao tree planting project made me realize that we, as students, can make a positive impact on our campus. I now feel responsible for taking care of our environment and making sure our waste is managed properly."* Student C also mentioned *"Cacao tree planting gave me a sense of ownership over our campus and its sustainability. I take pride in knowing that I've contributed to making our campus greener and more environmentally friendly."* For Student D, he said *"I feel a sense of responsibility towards the environment now. Cacao tree planting taught me that small actions can add up to make a big difference. I want to continue being part of initiatives that promote waste reduction and environmental awareness."*, and Student G shared *"Cacao tree planting made me feel like I have a stake in our campus's environmental initiatives. I want to see them succeed and grow, so I actively encourage others to get involved and make a difference too."*



Pictures 6, 7 & 8. The Project Management Team of School Plus Cacao Project involving students in the tree planting activity.

The students' sense of responsibility and ownership resulting from their participation in cacao tree planting aligns with the concept of "place-based learning" in environmental education. Place-based learning emphasizes the connection between students and their local environment, fostering a sense of belonging and stewardship (Smith & Sobel, 2010). Through cacao tree planting, the students at CSU Lasam experienced firsthand the positive impact they could have on their campus's sustainability and waste management practices.

Similar to the findings of other studies, the students' statements reveal that their involvement in environmental initiatives increased their sense of personal responsibility for the environment (Stevenson & Dillon, 2018). They now see themselves as active contributors to the well-being of their campus and are motivated to continue promoting sustainable practices. This aligns with the idea that students who feel a sense of ownership over their environment are more likely to engage in pro-environmental behaviors (Chawla, 2015).

Conclusion

The student engagement in cacao tree planting initiatives for solid waste management at CSU Lasam had a significantly positive impact on waste reduction and environmental awareness on campus. The assessment of students' perceptions after their participation in the project revealed that they felt more knowledgeable about cacao tree planting, believed in its contribution to waste reduction, and were more environmentally aware. They also expressed a sense of accomplishment and pride in being part of the initiative, and this experience motivated them to adopt more sustainable practices in their daily lives. The thematic analysis of the students' experiences further supported the positive outcomes of their engagement. Through cacao tree planting, they developed a deeper understanding of environmental issues and felt a sense of responsibility for taking care of their campus environment. The hands-on experiences instilled a greater appreciation for nature and a desire to advocate for environmental conservation. Student engagement in cacao tree

planting for waste management and environmental awareness is a valuable strategy for fostering sustainable practices and empowering students to become responsible stewards of the environment. By incorporating such initiatives into educational settings, institutions can contribute to building a greener and more environmentally conscious future.

Recommendations

Based on the positive outcomes of student engagement in cacao tree planting for waste reduction and environmental awareness, several recommendations can be made to further promote sustainability and environmental consciousness at CSU Lasam. First, it is crucial to continue organizing cacao tree planting initiatives regularly, involving students from various degree programs and expanding planting areas to create a greener campus environment. Secondly, integrating sustainability education into the curriculum will enhance students' understanding of environmental issues and waste management, empowering them to become environmentally responsible citizens. Collaborating with local communities and organizations will expand the impact of cacao tree planting, fostering shared responsibility for environmental conservation beyond the campus. Forming environmental clubs and student-led initiatives can provide platforms for students to actively engage in sustainability projects and advocate for eco-friendly practices. Additionally, conducting regular monitoring and evaluation of these initiatives will help measure their effectiveness and identify areas for improvement. Finally, providing institutional support and recognition for student-led sustainability efforts, and encouraging faculty involvement in related research and projects, will further cultivate a culture of environmental consciousness within the university.

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