

# Reducing the Ecological Footprint in a University Farm through Environmental Education Process

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## Abstract

This research aimed to study the ecological footprint and to develop approaches for reducing ecological footprint by environmental education process on the farm of the Department of Human and Community Resource Development, Faculty of Education and Development Sciences, Kasetsart University, Kamphaeng Saen Campus. The population was 192 students in Agricultural and Environmental Education and 5 lecturers in charge of courses on professional experience in agricultural and environmental education. The data were collected from interviews, observation, a pre-test, and a post-test. After the activity, the results were concluded and reflected through focus group discussions and interviews. The data were analyzed using percentage, mean, standard deviation and content analysis. The findings revealed that most ecological footprint on the farm was related to agricultural activities as the learning process of agricultural and environmental education used the university farm as a base for learning and gaining the agricultural and environmental field experience. The activities have resulted in changes in resource and environmental utilization on the university farm. Moreover, to develop approaches for reducing ecological footprint through the environmental education process on the farm, there were three activities to raise agricultural and environmental awareness, namely “World Planet”, “Environmental Keywords”, and “Pop-up Kayab-lok.” After the activities, it was found that the students had knowledge in ecological footprint, and the participation of the students in the activities was significantly at a high level. The benefit of this study is to create an eco-friendly model farming, which can be applied to other farming communities.

**Keywords:** Ecological Footprint; University Farm; Environmental Education Process; Agricultural and Environmental Education

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## 1. Introduction

Sustainable Development Goals (SDGs) have been observed by countries all over the world, including Thailand to guide the world’s development from 2016-2030. It has created three sustainability dimensions: society, economy, and environment. There are 17 targets, covering five main targets of the environmental and natural resource aspect (United Nations, 1987). This corresponds to the fourth strategy of the Twelfth National Economic and Social Development Plan:

strategy for environmentally friendly growth for sustainable development (Office of the National Economic and Social Development Council, 2017). From international development goals to national development plans, environmental issues have continuously challenged the country’s development towards sustainability. Environmental education has found progress in the field of science, engineering, and economics. There have been attempts to measure or assess the

human activities on land and water affecting the environment, both in terms of resource consumption and waste generation, also known as Ecological Footprint (Wackernagel & Rees, 1996). It is a statistical estimation based on scientific principles. The components of ecological footprint can be broken down into four aspects, namely 1) food, 2) consumer goods and services, 3) housing, and 4) transportation (Calcott & Bull, 2007). In conclusion, the ecological footprint concept is an environmental sustainability indicator to analyze the relationship between human demand for resources and human supply of biocapacity. If humans have used resources quickly and excessively to the extent that timely regeneration is not possible, the result is that humans would be exposed to the risk of existence with unsustainability (Weeranakin, 2020).

Agriculture is one of the most significant components of the ecological footprint, according to the research of Brower and Leon (1999). It was found that food transport and production processes have the highest impact on the environment due to the changes in ecosystem structure. It is crystal clear that food is an essential fundamental resource for human beings worldwide as evident from the large consumption of natural resources. In addition, the world population has increased at present. The research of Shakir Hanna, Osborne-Lee, Cesaretti, Misso and Khalil (2016) indicated that the predicted 10.50 billion global population in 2050 and the 2.36 billion hectares of world area have raised concerns about whether there will be enough resources in the future for human consumption needs, and food shortages are also the most significant concern for humans (Rees, 2004). It is therefore a challenge for humans to find ways to reduce the ecological footprint and encourage future biocapacity.

Environmental education is an educational process that develops human potential in handling environmental problems, with an emphasis on knowledge, understanding, awareness, skills, attitudes, evaluation, and participation in solving problems and living with nature (Piampongson, 2005). It is a guideline to solve the problem of ecological footprint covering content dimensions in all

subjects. The instructors must understand and realize the importance of integrating content and environmental education activities accordingly and appropriately (Jankaew, 1993).

According to the research of Moffatt (2000) on the advantages and disadvantages of the ecological footprint measurement method, it was found that this method is clear and easy to calculate. However, it is still questioned for its reliance on sole statistical estimation and lacking the ability to predict technological change. The researcher found the gaps in education on environmental issues in the social science dimension and recognized the importance of ecological footprint problems in university farm activities, which are considered a comprehensive agricultural activity simulation in the supply chain. Therefore, it is deemed appropriate to find guidelines to reduce the ecological footprint on the university farm using an environmental education process that leads to an environmentally friendly green farm and ecological management to promote a sustainable green university. This research therefore aimed to (1) study the ecological footprint of the Department of Human and Community Resource Development farm, Faculty of Education and Development Sciences, Kasetsart University, Kamphaeng Saen Campus, (2) develop approaches for reducing ecological footprint through the environmental education process on the farm of the Department of Human and Community Resource Development, Faculty of Education and Development Sciences, Kasetsart University, Kamphaeng Saen Campus.

## **2. Materials and method**

### *2.1 Study Area*

This research used purposive sampling. The study area was the farm in the Department of Human and Community Resource Development, Faculty of Education and Development Sciences, Kasetsart University. It has simulated the area of an integrated farming system as well as the supply chain, which can be applied to other agricultural areas.

## *2.2 Population for examining ecological footprint*

The population was 192 students in Agricultural and Environmental Education.

## *2.3 Participants in the community of practice*

The participants in the community of practice consisted of as follows;

1) 35 sophomore (2<sup>nd</sup> year student) leaders in agricultural and environmental education whose awareness of environmental education for farm work was raised in order to change their farming behavior to be environmentally friendly and enable them to transfer such practice to others.

2) 10 student mentors in agricultural and environmental education with the goal to become agricultural and environmental change agents and to have more confidence in transferring the activities to others.

3) 5 lecturers in charge of courses on professional experience in agricultural and environmental education directly supervising students and farm activities and integrating environmental education process with their instruction to reduce the ecological footprint on the farm.

4) 2 trainers who were experts in environmental science, working with the researcher to determine environmental awareness activities to reduce the ecological footprint on the university farm and served as persons transferring knowledge to the students.

## *2.4 Research Processes*

The research was conducted based on action research methodology, which can be divided into three parts as follows:

### 1) Planning Process

1.1) The researcher consulted with curriculum instructors teaching farm work to gain thorough understanding about the research, roles, and activity plans in the project.

1.2) The researcher examined ecological footprint in the Department of Human and Community Resource Development,

consisting of courses, farm contexts, activities, and measurement of students' environmental knowledge and potential prior to the activities. The data were analyzed in order to design activities and contents for the students to gain knowledge, attitudes, and behaviors that show awareness of agriculture and environment through the environmental education process.

### 2) Action and Observation Process

The process started from taking action according to the plan, observing the activities, to reflecting the outcomes of the process.

2.1) The data on ecological footprint on the farm of the Department of Human and Community Resource Development were brought for discussions in focus group discussions with instructors, trainers, and general administration officers in charge of the university farm to plan an agricultural and environmental education camp and design and create learning activities for developing student leaders by using the results obtained from the conference forum.

2.2) Focus group discussions were organized among trainers and student mentors to explain the activities of the agricultural and environmental education camp, consisting of the activity contents, structures and approaches for measurement and evaluation.

2.3) Learning activities and evaluation were carried out for 35 second-year student leaders.

2.4) The student leaders transferred knowledge through project activities to first-year to fourth-year students and evaluated their learning results.

2.5) Environmental knowledge was measured after the activities through a post-test, observation and participation in the activities.

### 3) Reflecting Process

A conference forum among participants was organized to summarize the process and lessons learned from the beginning to the end, listen to opinions, and exchange knowledge. The results of the conference forum would be used to improve the activities to reduce the ecological footprint on university farm.

## 2.5 Research Instruments

Research instrument are as follows;

1) The environmental education awareness measurement was created from Jankaew's concept, aiming for three main goals: awareness, attitude, and participatory behavior in the environmental and agricultural ecological footprint. It consists of 30 five-point-rating-scale items with the interpretation based on Best's criteria (Best, 2006).

2) The environmental knowledge test consists of 20 multiple choice questions, each with four choices created by the researcher and validated by experts. The interpretation was based on Bloom's interpretative criteria (Bloom, 1971).

3) As for semi-structured interviews and participant observation, the thesis advisor considered the validity of the content.

## 2.6 Tool Quality Testing

The tool was validated by three experts to examine the questions' consistency with objectives, language usage, and content validity. The index of item objective congruence (IOC) was at 0.67 – 1.00. The tool was piloted with 30 students in the Faculty of Agriculture, Kasetsart University, Kamphaeng Saen Campus, and the reliability was 0.87 based on Cronbach's alpha coefficient.

## 2.7 Data Analysis

Quantitative data were analyzed by descriptive statistics, namely mean, standard deviation, and percentage, and the difference was tested by t-test. Meanwhile, qualitative data used content analysis and data accuracy was examined by the triangulation technique. The findings were presented in the form of description.

## 3. Results and discussion

The findings of reducing the ecological footprint on university farms through the environmental education process can be divided into two parts as follows:

### 3.1 Study of Ecological Footprint on Student Farm of the Department of Human and Community Resource Development

1) The analysis of the Bachelor of Science Program in Agricultural and Environmental Education

The Department of Human and Community Resource Development established the Bachelor of Science Program in Agricultural and Environmental Education in 2006. The goal is to produce graduates with the knowledge and ability to integrate agriculture and environmental management, and enhance sustainable agricultural development in response to the university's strategy of promoting environmentally friendly agriculture. The researcher analyzed three issues of the curriculum content that affected the ecological footprint on the farm, namely curriculum; teaching and learning processes; resource and learning resources.

2) The Activities on the Farm of Agricultural and Environmental Education Students

The organization of agricultural and environmental education activities by using the farm as a base for learning and practice can be divided into two types:

2.1) Activities included in the first to fourth-year professional courses of Agricultural and Environmental Education students

2.2) Extracurricular activities with organizations and clubs, mostly focusing on agriculture and the environment.

3) Environmental Education Awareness of Students in Agricultural and Environmental Education

The findings revealed that the overall environmental education awareness of the students was at a high level ( $\mu = 3.97$ ,  $\sigma = 1.12$ ). After the consideration of the three components, it was found that the environmental perception was at a high level ( $\mu = 4.14$ ,  $\sigma = 0.98$ ), the environmental behavior was at a high level ( $\mu = 3.99$ ,  $\sigma = 0.97$ ), and the environmental attitude was at a high level ( $\mu = 3.74$ ,  $\sigma = 1.38$ ) as shown in Table 1.

**Table 1.** Environmental Education Awareness of Students in Agricultural and Environmental Education

Contents	(N = 192)		
	$\mu$	$\sigma$	Results
1. Environmental Perception	4.14	0.98	high
2. Environmental Attitude	3.74	1.38	high
3. Environmental Behavior	3.99	0.97	high
Environmental Education Awareness	3.97	1.12	high

The study of ecological footprint on the farm of the Department of Human Resource and Community Development found that the ecological footprint on the farm was mainly related to agricultural activities as the farm of the Department of Human Resource and Community Development was used as a base for learning and practicing in agricultural and environmental education with an emphasis on students' practice and project-based learning related to the field of agriculture and environmental education. The activities resulted in ecological footprint in the form of agriculture. In addition, from the study of environmental awareness, it was found that the students had environmental attitude the least compared to environmental perception and environmental behavior.

*3.2 Guidelines to Reduce the Ecological Footprint on the Farm of the Department of Human Resource and Community Development*

Goal 15 of the Sustainable Development Goals (SDGs) focuses on promoting sustainable use of terrestrial ecosystems by raising awareness of environmental education to serve as guidelines to reduce ecological footprint on the farm of the Department of Human Resource and Community Development. It can be summarized as follows:

1) Activity Plan of Agricultural and Environmental Education Camp

The results of the farm ecological footprint data were discussed with teachers who taught farm work, farm staff, trainers, and students participating in the project to design activities to raise awareness of the use of natural resources and the environment on the farm. Education was organized based on the environmental education process by conducting training to give

knowledge about the development that causes environmental problems in the agricultural and environmental education camp. The researcher, trainers, and ten student mentors in agricultural and environmental education jointly designed and planned the agricultural and environmental education camp activities through group discussions. It can be divided into three activities, namely "World Planet", "Environmental Keywords", and Pop-up Kayab-lok."

2) Agricultural and Environmental Education Activities

From an analysis of management of activities to develop an approach for reducing ecological footprint on the student farm of the Department of Human Resource and Community Development by using the environmental education process through training, it was found that the students who participated in the activities paid attention, were enthusiastic and participated in expressing opinions, and asked questions.

2.1) For the activity "World Planet," the students received knowledge from the trainers and watched videos that encouraged them to recognize the importance of the environment and jointly find ways to conserve the environment. There were group discussions for the participants to express their views about the ideal environment by making a diagram on the topic of "The New World I Want to See" and presenting the diagram in front of the class, which allowed the participants to gain more knowledge and understanding about environmental issues.

2.2) For the activity "Environmental Keywords," the trainers divided the students into groups to play a word-guessing game on environmental issues. It was found that the students were enthusiastic about playing the game and guessed the words correctly. The students became more knowledgeable about the environment in various aspects.

The trainers gave knowledge about environmental terminology to be used for the next activity.

2.3) For the activity “Pop-up Kayab-lok (Changing the World),” the knowledge and words learned were used to create stories and presented in the form of pop-ups made from waste materials and old calendars to make the students appreciate the environment value. It was found that the students actively participated in the activities, did further research, asked questions to gather information, participated in exchanging ideas in the group, prepared three sets of knowledge, namely global warming, world and development, and ecological footprint, and presented the knowledge in front of the classroom.

3) Findings and comparison of environment knowledge

It was found that the average scores of the participants before and after being exposed to the Agricultural and Environmental Education Camp activities in terms of knowledge were at a medium level ( $\bar{X} = 14.29$ , S.D. = 1.38), and at a high level ( $\bar{X} = 17.00$ , S.D. = 1.53), respectively. According to the comparison of the average scores before and after the activities, it was found that the participants’ knowledge after the activities was higher than before at the statistical significance level of 0.05.

The findings suggested that the Agricultural and Environmental Education Camp’s activities for ecological conservation have resulted in the participants having environmental knowledge, as shown in Table 2.

4) Reflection

According to the reflection from instructors and students, results of driving the Agricultural and Environmental Education Camp, the evaluation by the researcher through observation, and reflection of the training outcomes, it was found that the students participating in the project were eager to learn the activities, could respond

and ask questions, gained knowledge and awareness of the environment, and could apply the knowledge gained in the farm work. Therefore, the usage of the environmental education process can help the students to gain knowledge and change the way they work on the farm. In addition, the instructors and students proposed approaches to reduce the ecological footprint on student farms of the Department of Human Resource and Community Development, starting at the individual level where students need to have awareness and mindfulness for the environment. Meanwhile, at the community level, there must be rules or agreements to preserve the farm environment, and everyone needs to cooperate to protect the environment. The university must also have a clear and actionable environmental policy.

The researcher has brought the data to synthesize to find an approach to reduce the ecological footprint, which can be divided into four dimensions.

1. The Dimension of the University’s Environmental Education Policy

Universities should impose policies for social responsibility, especially in environment preservation. It is one of the missions for an educational institution wishing to become a green university. In other words, the educational institution should take into account the environment and integrate environmental education into teaching, research, and activities. This will bring positive changes to the environment and the community, such as green university management according to the UI Greenmetric’s approach; management strategies of higher education institutions according to the concept of green university (Jarueksil & Charoenkul, 2017); the policy to increase green area and manage the green area in the educational institution according to Khongouan and Sitachitta’s approach (2011), which indicated that to increase the green area

**Table 2.** Environmental knowledge before and after the activities

Dimension	Before the activities			After the activities			t	P
	$\bar{x}$	S.D.	level	$\bar{x}$	S.D.	level		
Environmental Knowledge	14.29	1.38	medium	17.00	1.53	high	8.96	*0.00

Note: \*statistical significance of 0.05

in the university, the area should be managed most effectively; the action plan on sustainable urban green space management of the Office of Natural Resources and Environmental Policy and Planning, which requires educational institutions to have sustainable green area at least 30 percent of their site (Office of Natural Resources and Environmental Policy and Planning, 2007). In addition, the approach of outdoor environment management to increase green spaces is consistent with Suebsiri *et al* (2017) and Maneerod (2020), who indicated creating an environment and improving the landscape to reduce energy emissions can raise the awareness of personnel, instructors, students, and others who use the area, and they will provide cooperation in creating a sustainable environment.

## 2. The Dimension of Student Learning Management and Activities in Agricultural and Environmental Education

Instructional curriculum and student development activities are important in reducing the ecological footprint as they determine the utilization of farm resources. Therefore, environmental education concepts should be integrated into the curriculum. It is consistent with Karnpukdee (2019) and Boonserm *et al.* (2015), who found that environmental training helped students develop a positive attitude toward environmental participation and the development of environmental education activities using the green poetry process where students acted as activity drivers. It demonstrated the importance of poetry and the use of poetry for environmental conservation. Learning management of university farms focused on farm management and raising awareness of environmental education to create a systematic farm management based on the zero-waste concept. This is in line with the work of Yohon Haryanto *et al.* (2023) on Rural Community Empowerment through the Utilization of Straw as Compost, which focused on achieving zero agricultural waste and making compost from rice straw. It can be seen that raising environmental awareness must begin with an instructor who teaches farm work. The instructor must be rigorous and can produce student leaders who are

aware of the environment, can extend the results to the younger generation, and create the sense of ownership and willingness to use resources appreciatively. It is consistent with the research of Supnui *et al.* (2013), who said that the farm in the Department of Human Resource and Community Development is ready to organize activities in agriculture and environmental education in three aspects, namely fundamental factors, experience in activity management, and network. As for the results of the curriculum development, it was found that leaders of agricultural and environmental education activities have an essential role in leading activities and passing on knowledge to students.

## 3. The Dimension of Resources and Environmental Management in University Farms

The farm resources and environmental management have promoted learning and practical activities in agriculture and environmental education, and created a positive atmosphere for the students to change their behavior and to continually care for the environment, such as waste management, water management, energy consumption, effective utilization of farm equipment and disposal that does not destroy the environment. It is consistent with Maneerod (2020), who found that organic waste disposal by turning waste into compost reduces the landscape cost. The research of Jahiel & Harper (2004) examined green universities and the challenges of reducing the ecological footprint at Illinois Wesleyan University. The results revealed that waste recycling in schools led to increased environmental awareness. It started by reducing paper and electricity utilization and encouraging the students to utilize resources effectively. Moreover, it corresponds to the research of McNamara (2010), which studied cultivating sustainable environmental development in higher education among leaders and giving knowledge on environmental awareness by integrating an environmental research program into the curriculum and creating a green environment in educational institutions.

4. The Dimension of Environmental Education Participation and Networks

The participation to reduce the ecological footprint on the farm should start with instructors, personnel, students, and individuals using the farm area. They must be aware of the environment and engagement between the university and the community or the network outside the university. It is consistent with the work of Nilo E. Padilla *et al.* (2021) on Awareness on the Benefits of the Adoption of Dairy Vermicomposting Technology in Selected Cooperatives in Region 02, which found that farmers and the government must participate in promoting the use of vermicomposting technology. The research of Yingyuad *et al.* (2018) studied the development of agriculture and environment learning activities in schools through the participation of network partners. It was found that the development of food safety learning activity in schools by using agricultural area for the environment under a collaborative network of universities, schools, and community can promote food security in

the community and sustainable environmental management in schools. It is consistent with the United Nation Environment Programme (2013), which indicated that one of the indicators of a sustainable green university is publication to the community, namely social services, cooperation with other institutions, and community development projects. In addition, Samsuwan & Danteravanich (2012) found that the student participation in environmental management relating to teaching and learning activities in the university, such as saving water, electricity, and paper, was the main issue that students acknowledged and engaged in the most.

It can be summarized that from the guidelines to reduce the ecological footprint on the university farm by using environmental education process, the students gained the awareness of environmental education. As a result, their farm work behaviors have changed for the better. Therefore, these guidelines have been established in four dimensions to reduce the ecological footprint as shown in Figure 1.

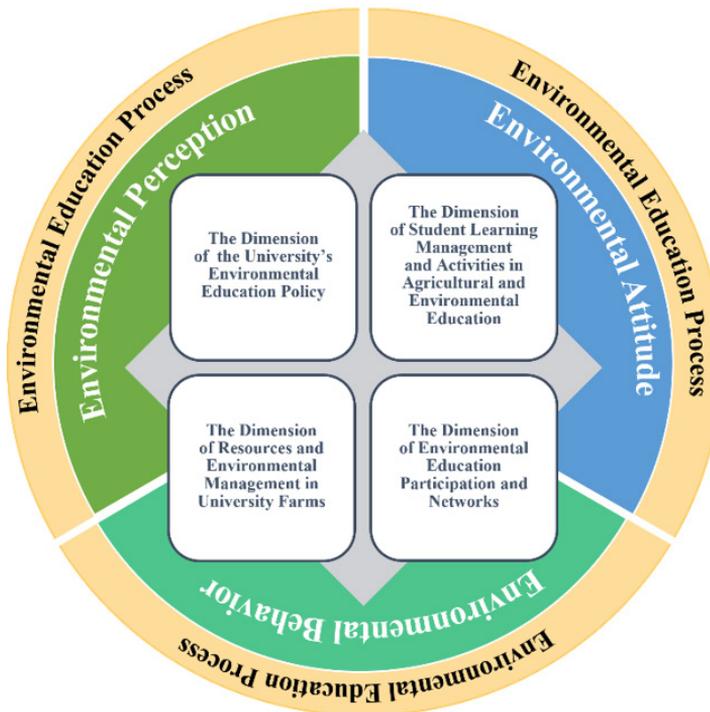


Figure 1. Approach of Reducing Ecological Footprint on the Farm of the Department of Human Resource and Community Development

## **4. Conclusion and recommendations**

### *4.1 Conclusion*

The ecological footprint reduction on university farms by using the environmental education process of participatory action research can be summarized and discussed as follows:

1) From examining the ecological footprint in the Department of Human and Community Resource Development and Community farm, it was found that the farm has fundamental factors that can support the agricultural and environmental activities. There are 48,000 square meters of the total area within the farm, divided into sections to facilitate various agricultural and environmental activities, namely the area for planting crops, buildings for instruction, structures that support the production of mushrooms in plastic bags, and a space for students to practice small farm management. Therefore, there should be guidelines to reduce the ecological footprint on the university farm to make students aware of the use of natural resources and the environment, leading to a green farm and an environmentally friendly green university.

2) The research to promote ecological footprint reduction in the Department of Human and Community Resource Development farm by using environmental education process to organize an agricultural and environmental education camp consisted of three activities, namely “World Planet,” “Environment Keywords,” and “Pop-up Kayab-lok (changing the world).” These activities were found to be suitable, which led to smaller ecological footprint on the farm. As for the result of measurement of environmental knowledge and environmental awareness after the activities, it was found that the students had increased environmental knowledge and understanding of environmental education, especially the environmental education awareness was at the highest level.

### *4.2 Recommendations*

1) The study of the learning activity process to reduce the ecological footprint on the farm can be extended to other educational

institutions with the adjustment of the criteria for selecting leaders and increase of activities suitable for the context of each farm.

2) Further research should be conducted with other farms by applying the guidelines for farm ecological footprint reduction, and using the environmental education process and the participation principle for everyone to be aware of and jointly solve the problems to achieve sustainable natural resources and environment.

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