

# **Sustainable Practices and Environmental Impact Assessment in a Lifelong Learning Center**

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**Abstract** - Climate change is a major environmental challenge that should be mitigated by all parties concerned. One such party is the KMITL Lifelong Learning Center (KLLC) which has committed to reducing its environmental externalities, including the impact of its operations on climate change. The idea of a "green KLLC" seeks to reduce adverse effects on the environment and improve indoor environmental quality through the use of natural building materials and biodegradable products, resource conservation (water, energy, paper), responsible waste disposal, and eco-friendly practices (recycling). To reduce these environmental externalities, the environmental performance of the KLLC center should first be examined to establish measures for improvement. However, accurate evaluations of the environmental impact of Lifelong Learning Centers (LLCs) are uncommon because of the lack of data and the immaturity of appraisal methodologies. With a case study of KLLC, the newest LLC in Thailand, this paper appraises the environmental effects, thus setting benchmarks for subsequent studies. The appraisal demonstrates that the KLLC community can significantly reduce the environmental consequences by using e-certificates, motion sensor light installation, banana leaf packaging, solar cell installation, and carpooling systems. Although e-certificates and banana leaf packaging are the most cost-effective methods of implementation, the adoption of carpooling systems and electric vehicles demonstrates the highest potential for Greenhouse Gas (GHG) emissions reduction. The paper showcases how KLLC can reduce its GHG emissions and wastes, thus turning into a more environmentally sustainable business.

**Keywords:** Lifelong Learning; Greenhouse gas emissions; Energy efficiency; Waste reduction

## **1. Introduction**

Thailand has committed to achieving the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs), and its ambition to become a high-income, inclusive, sustainable, resilient and advanced country. In addition, the government has 13 milestones contained in the draft 13th National Economic and Social Development Plan (NESDP) aligned with strategic outcomes for the UNSDCF, including Leave No One Behind, human rights, gender equality, sustainability and resilience [1]. The development of Thailand's inclusive economy into a green, resilient, low-carbon, and sustainable should aid in the improvement of the enabling environment and private sector practices to support green, circular, inclusive, gender-responsive, and low-carbon economic development [1].

In terms of universities, the university's role in life learning (LL) has become one of the most important areas for future education inductive in the 21st Century [2]. The university needs to be prepared to be at the center of local and National Education and training systems. Lifelong Learning Centers (LLCs) provide education for social transformation with the goal

of creating more sustainable societies [3]. In Thailand, although Universities are considered an essential part of Thailand's national education ecosystem, they have not yet attained the full impact and as the volume of education continues to increase, environmental sustainability has affected higher education institutions. Sustainability has its main goal to help LLCs with a definition of “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [3]. Regarding this point of view, KLLC has started looking into its potentially important role in reducing environmental impact [4]. The objective of this study is to provide suggestions for environmental performance improvement of KLLC. The Life Cycle Assessment (LCA) methodology was employed to assess the Greenhouse Gas (GHG) effects of the proposed recommendation. For this purpose, the GaBi software system and databases developed by PE International in Germany, in conjunction with the CML life cycle impact assessment methodology, were applied in this study.

## **2. KLLC’s background and its environmental performance**

A green library is one that was constructed with the environment in mind. The larger green building trend includes green libraries. Libraries, especially those in colleges, serve as sites for lifelong learning for residents of all ages. Libraries are crucial information sources for promoting environmental awareness and adoption of environmentally friendly practices in addition to being stores of knowledge [5] [6]. Green libraries find ways to incorporate green thinking into action [7].

There are many ways to support the concept of a green library, including the use of environmentally friendly recycled and locally sourced materials, efficient use and conservation of natural resources, virtual user services and resource-saving copy services, waste separation, the elimination of plastic bags, the use of recycled private rockery instead of paper cups, fair-trade coffee in the coffee machines, and waste separation. Even though it is still in the early stages of development, it is important to understand that a green or a sustainable library is a building that has been created, refurbished, utilized again, or operated in a way that is environmentally and resource-friendly.

As the King Mongkut’s Institute of Technology Ladkrabang (KMITL), Thailand aims to transform library to KLLC, KLLC has started focusing on waste reduction and has been taking different actions to manage and reduce solid waste, a large fraction of which is represented by general waste. There are 6,000 square meters and there are more than 4,000 learners using KLLC per day. As a result, there are approximately 1,500,000 learners per year. Examples of actions/campaigns for Green LL are shown as follows:

### **2.1 Promoting a green mindset in skills**

As generic green skills are those that are needed in any job content to support sustainable social, economic, and environmental growth, KLLC offers these skills for learners through existing education and training systems, such as DIY cloth face mask, DIY artificial flowers, online course named Bio-Circular-Green (BCG) Economy model [8]. These help to encompass broad knowledge, skills, attitudes, and values. In addition, the adoption of general operating procedures that minimize environmental consequences and the creation of a green mindset are made possible by the development of generic green skills, which are crucial for the greening of all industries [9]. To being contextualized from the standpoint of environmental awareness and a comprehension of sustainable development, generic green skills identified through this classification system are also in line with the key competencies or “soft” skills that learners already recognize as being essential for a modern workforce.

### **2.2 Disposal of surplus, obsolete, or not-needed Books**

As the school aims to transform library in KLLC, library inspected the stacks to get rid of unread books and make space for learning areas. KLLC disposes of surplus or undistributed obsolete instructional materials in its possession that are usable for educational purposes in any of the following ways:

- By donation to a governing board or a county free library
- By donation to children at schools to increase the general literacy of the people
- By fundraising campaign in which people can make a donation through getting books with one bag for 100 baht

Getting involved in community activities can help KLLC build trusting relationships with community as the community support and donations are a crucial component of our work - a segment of a larger effort to get books into hands for those who can make use of them.

### 2.3 Substituting traditionally printed books with electronic books

As LLCs face a number of common challenges for which limited physical space and accessibility of resources for off-campus users, e-theses and e-books may offer solutions [10]. At KLLC, more than 23,500 e-theses can be downloaded online, and these can also potentially enhance learning opportunities when compared with traditional library collections. There are several advantages to introducing electronic resources into the KLLC, such as being able to provide a greater variety of resources than print counterparts can [11].

In terms of the environmental impacts, the lifetime of the originally printed book, from manufacturing to disposal, has a significant negative influence on the environment, especially from the viewpoint of deforestation. The making of paper requires trees to be cut down in large quantities, tipping the balance of a forest ecosystem and contributing to the loss of wildlife. Moreover, paper pollution through pulp mills negatively affects the environment because of air, land and water contamination caused by its facilities under the production [12].

### 2.3 Recycling program

Recycled materials are preferred over virgin ones since they are both more cost- and environmentally-friendly. However, because recycling is only done in small areas, its environmental impact is greater. The totality of factors that guarantee the essential mechanical qualities of freshly created objects is sustainability [13].

There are many solid and recyclable wastes, such as water bottles, plastic cups, cans, etc., and the KLLC gathers them all and sells them to a recycling firm in order to reduce trash. However, there are several additional areas the center can concentrate on to become more ecologically friendly, such as energy efficiency, green transportation, etc.

## 3. Suggestions for improvement

Although KLLC has worked to enhance its environmental performance, there remains room for improvement. The suggestions were derived using the following criteria, and a description of each criterion can be found in. Table 1 lists the five suggestions for improvement in this study.

Table 1: Analysis of Suggestions for improvement.

Suggestion points	Re-liability	Applicability	Cost	Know-ledge	Time to adopt	Parties involved	Public perception	Ease of imple-mentation	Capacity to reduce emis-sions	Administra-tive simplicity
E-Certificate	High	High	Low	Medium	Now	-KLLC	High	High	Medium	Medium
Motion Sensor Light Installation	High	High	Medium	Medium	1 week	-KLLC -Construction company	High	Medium	High	Medium
Banana leaf packaging	High	High	Low	High	Now	-KLLC	Medium	High	Medium	Easy
Solar Cells Installation	High	Medium	High	Medium	1 year	-KLLC -Construction company	High	Medium	High	Medium
Carpooling System	High	Medium	High	High	6 months	-KMITL	High	Medium	High	Medium

## 4. Research method

As indicated in Table 1, the options demonstrating the most reliable, cheap, and easy for implementation are e-certificate and banana leaf packaging, and subsequent to the delineation of these recommendations, the quantification of GHG emissions will be conducted through the utilization of the GaBi 8 software tool using the CML methodology. In order to represent the operational performance of the investigated KLLC from July 2022 to Jun 2023, interviews with the KLLC director and staff were conducted. The interviews helped to clarify the findings and validated that the information was indicative of the KLLC's regular operations.

## 5. Results and discussion

In addition, recommendations are used to interpret the results as a comparison study, which helps to identify important unit processes that have the greatest impact on the results to further improve the processes.

### 5.1 E-certificate

Digital certificates have eliminated the loss of traditional certificates. The popularity of digital certificates has also recently increased due to their longevity. KLLC aims to bring learners closer to the idea of lifelong learning in which it is the process of continuing their education throughout their lives to enhance their knowledge, skills, interests, and competences from a personal, social, and professional standpoint. Technology's accomplishments include ideas like eLearning and digital learning that supplement traditional learning methods in our lives. Digital certificates finally enable learners to maintain the permanence of their lifetime learning [14].

In terms of the environmental impact, as paper is a major emitter in which one unrecycled A4 sheet produces approximately 56 grams of CO<sub>2</sub>-equiv. [15], one of the solutions to the KLLC's current situation is to reduce paper use by switching to an electronic certificate. The notion that all signatures and approvals are made electronically, utilizing electronic signature or electronic seal systems, and that nothing is printed. This helps to eliminate physical documents requiring such as paper, ink, electricity for printer [16]. There are other several benefits of e-certificate with digital signatures. Using it means KLLC is minimizing the cost that would have been paid for paper. Also, using an e-certificate means giving a clear indication to learners, employees, partners and stakeholders that KLLC cares about the environment.

The majority of certificates are typically printed on paper with dimensions of 8.5 x 11 inches. A lighter-weight paper, weighing 24lb, is particularly suitable for certificates. This type of paper, with its weight of 24lb, exhibits excellent print quality and possesses the necessary durability to withstand handling, while also presenting a noticeable appearance [17] [18]. In the cradle-to-gate analysis, the production of one metric ton of paper product resulted in an average greenhouse gas emissions equivalent to 942 kilograms of carbon dioxide (kg CO<sub>2</sub>-equiv.) [19]. According to Ecoinvent data from GaBi 8, paper waste disposed of in landfills was associated with annual emissions of 44,444.46 kilograms of carbon dioxide equivalent (kg CO<sub>2</sub>-equiv.). However, it's important to note that the quantity of ink required during the certification process has not been considered in this study. Spanning from July 2022 to Jun 2023, KLLC distributed a total of approximately 3,376 certificates to our participants. As a result, this study showed that there was  $7.9 \times 10^4$  kg CO<sub>2</sub>-equiv. per year in Global Warming Potential (GWP) category.

### 5.2 Motion sensor light installation

As high demand for electricity consumption at the current supply level in KLLC leads to the rising cost of electricity bills in which this factor is compounded by the fact that many electric generators in Thailand rely on fossil fuels, KLLC has to find ways to solve this problem [20]. With the expected benefit being cost savings for KLLC and energy efficiency, motion sensing is one of the technologies that provides a natural user interface that allows users to interact without any intermediary device. This is because the sensors can capture gestures and/or detect voices [21].

For KLLC, one aspect that can be improved is room lighting in which classrooms/co-working spaces' electricity consumption in KLLC is not yet controlled by a main panel. Other aspects of room lighting usage are office spaces and washrooms, which are mostly on from the beginning of the workday to the end of the night. KLLC's offices and staff rooms

can be manually switched off when not in use, but public spaces such as washrooms and enclosed corridors are frequently used, it is impractical to manually turn off the lighting.

### **5.3 Banana leaf packaging**

The packaging of a product is an important issue to consider when it comes to environmental effects because packaging typically ends up as waste. The debris eventually breaks down into smaller pieces called microplastics, which pose a major threat to the ecosystem [22]. Only 9% of the 9 billion tonnes of plastic that have ever been created have been recycled. This has raised awareness of single-use plastics throughout the world, coupled with predictions of rapidly rising plastic manufacturing. According to the United Nations Environment Programme, the environment, landfills, and oceans will all contain 12 billion tonnes of plastic by 2050.

As a result, one of our objectives is to pursue sustainable natural cycles in people's lives by reducing food packaging and other solid wastes to reduce waste. Instead of using packaging, this study offers KLLC's learners sustainable packaging. Banana leaves can contribute to the replacement of conventional plastic packaging [23]. Banana leaves are a great substitute for plastic since they are big, thick, flexible enough to be folded, and can be degraded after three days, and are discarded as waste [23].

Regarding the quantity of box sets allocated to individuals enrolled in the KLLC program between July 2022 to Jun 2023, a total of 11,299 box sets were provided and the plastic container, 32 oz made from PET, was assumed in this study [24]. In Gabi 8, the results from the CML method showed a notable reduction of 100% observed in the GWP category for the "banana leaf packaging" scenario in comparison to the "plastic packaging" scenario. Compared to banana leaf packaging, GHG emissions released into the air during the entire lifecycle of plastic production have been reduced from  $5.05 \times 10^4$  kg to 0 kg CO<sub>2</sub>-equiv. per year. This packaging not only has the potential to diminish GHG emissions but could also be sustained with a cost saving for KLLC.

### **5.4 Solar cell installation**

With the mitigation of fossil fuel electricity production and lower carbon emissions, the adoption of renewable energy technology can help reduce climate change. Renewable energy technology derives power from sources such as wind, sun, and biomass and it is a viable option for generating clean electricity to meet energy requirements [25]. Solar cells are a promising and potentially important technology and are the future of sustainable energy for human civilization one of the most popular solar cell technologies is PV technology. The key benefits of a solar PV system are that it emits substantially less CO<sub>2</sub> than fossil fuels and there are no fuel costs and relatively low Operation and Maintenance (O&M) costs. The solar PV system is small, highly modular, and practically portable [26].

### **5.5 Carpooling system**

The second-largest source of carbon emissions in Thailand is transportation [27]. Road transportation not only contributes to the high costs of fuel consumption, but it also has high Greenhouse Gas (GHG) emissions. During visit and from the interviews, as most learners arrive to the KLLC by motorcycles or cars from which is preferably considered as the most convenient commuter transport and the continuous increase in learners, this makes it difficult to find a parking space.

A carpooling system, which is one of the alternative transportation systems, can be used to address this issue [28]. The learner (passenger) must enter the pickup and KLLC while another learner (driver) can accept the passenger's request for a ride. As soon as the passenger and driver are matched, the passenger has to share his or her current location and other important information with his or her driver [29]. Assuming that each vehicle accommodates a minimum of two passengers, this approach holds the potential to significantly curtail the influx of motorcycles or cars arriving at KLLC, consequently effecting a substantial reduction of GHG emissions by at least 50%.

Another way is to take an electric bus from the Airport Rail Link (ARL), the railway line that connects Bangkok's downtown with the Suvarnabhumi International Airport, to KLLC as KMITL offers a free electric shuttle bus service for faculty, staff, students, and learners. The shuttle buses are operated by KMITL and run on schedule. This route is suitable for learners who go to school using ARL.

## 6. Conclusion

To enable its progress toward environmental sustainability, KLLC should create a positive impact within the university's ecosystem. Various improvement efforts at KLLC are detailed. With all these suggested improvements, significant environmental, economic, and social benefits have been detected. The results have shown that the most reliable, easy-to-implement, and cheap ways to improve environmental performance are e-certificates and banana leaf packaging. However, the transportation sector is one of the main emitters to the atmosphere and electric vehicles can facilitate the highest reduction in GHG emissions. Hence, electric vehicles can become an important option for the KLLC community to be considered. These suggested areas for improvement can help KLLC to demonstrate a robust model to other Thai Universities to achieve sustainable development goals and fulfill the needs of the century.

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