Souphanouvong University Journal of Multidisciplinary Research and Development
2024,Vol. 10, No. 1, 277-287
https://doi.org/10.69692/SUJMRD1001277

Studying and Promoting Knowledge on Sustainable Agricultural Waste Management: A Case Study in Banhan Upper Secondary School and Surrounding Schools in Hongsa District, Xayaboury Province, Lao PDR

Insavai SITTHIVOHANE*[1], Phonesavanh PHOUTTHAXAY[1], Vongpasith CHANTHAKHOUN[1], Anousone ONSIMEAUNG[2], Savath THONGPASERT[3], Noy MAHAVONGSANANH[3]

[1]Department of Department of Plant Science, Faculty of Agriculture and Forest Resource, Souphanouvong University, Lao PDR

***Correspondence:** Insavai SITTHIVOHANE, Faculty of Agriculture and Forest Resource, Souphanouvong University, Tel: +856 20 22135047, E-mail: insavai_stvh@su.edu.la or isitthivohane@gmail.com*

[2]Natural Resource and Environment Office, Hongsa district, Xayaboury province. Laos

[3]Banhan Upper Secondary Sondary school, Hongsa district, Xayaboury province. Laos

Article Info:
Submitted: Jan 19, 2024
Revised: Mar 11, 2024
Accepted: Mar 22, 2024

Abstract

The investigation took place at Banhan upper secondary school in the Hongsa district of Xayaboury Province. It spanned a duration of 12 months and involved providing TOT training on managing reused and recycled waste to 35 students and teachers at the school. Additionally, 48 trash bins were supplied and set up across 7 schools and 3 related offices. A school received a trash bin to collect recyclable waste that was set up for the students' practice. The findings presented that 94.71% with understanding index 1.24 SD of the students and teachers were displayed a good understanding and comprehended the project's activities, with 83.47% with sastisfacting index 0.77 SD expressing satisfaction. Only a small fraction, less than 5.29%, struggled with waste management and required further enhancement of their knowledge and skills. The waste collected from 10 locations comprising schools and offices underwent 8 rounds of 2 months collection. In total, 1,121.2 Kg of waste was disposed of, averaging 280.3 Kg per mounth. The waste output in schools increased due to the growing number of students and educators. Banhan upper secondary school accounted for the highest waste quantity output at 49.7 Kg/ month (17.73%), followed by Monk lower secondary school at 36.2 Kg/month (12.91%), and Nasan primary school at 33.8 Kg/month (12.06%) and the least amount of waste was generated by the district office of Education and Sports only 13.7 Kg/month (4.89%) representively. The quantity of 4 categories of waste revealed that the burnable waste promoted largest quantity 149.9 Kg/month (4.99 Kg/day), connected by compost waste 71.4 Kg/month (2.38 Kg/day), Reusable waste 60 Kg/month (2 Kg/day) and harmful waste 2 Kg/month (0.07 Kg/day). Waste in a day per person was calculated from populalation of the institution in 8h a day (working day), result shown that district office of Natural Resource and Enviroment has a high significant in quantity of waste 0.0351 Kg (35.1 g)/person/day. Then, Phonchan primary school 0.0221 Kg (22.1 g)/person/day and Nasan primary School 0.0205 Kg (20.5g)/person/day, the lowest quantity of waste was Hongsa upper secondary school 0.0012 Kg (1.2 g)/person/day. Nevertheless, the primary emphasis of this research was on the quantities of waste can be reuse, aiming to enhance awareness among academic staff, teachers, and students. The goal is to ensure comprehension, discourage indiscriminate disposal of garbage, and promote waste reduction through practices such as reuse and recycling.

Keywords: *Waste, reused, agricultural, sustainable, management.*

1. Introduction

Numerous individuals worldwide confront environmental adversities and natural calamities. Both developing and underdeveloped nations have witnessed a surge in production and consumption, with several factories generating novel and advanced materials for containment and sale (Minghua et al., 2009). Among the hazardous waste types, plastics pose a significant challenge, constituting a key predicament that is hard to address. The issue of plastic waste pollution has reached unprecedented levels. Despite relatively low recycling rates, with only around 15% of the annual 400 million tons of plastic produced globally being recycled, the production of plastics continues to accelerate. (Eze, 2021). Roughly 1.6 million barrels of oil are utilized annually solely to produce plastic water bottles, as per approximations. Plastic waste represents just one among numerous waste categories that require an extensive duration for decomposition. Typically, plastic materials can take as long as 1,000 years to decompose in landfill sites. Even the ordinary plastic bags we utilize in our daily routines can take anywhere between 10 to 1,000 years to break down, while plastic bottles might necessitate 450 years or more for decomposition (Hossain & Tuha, 2020). The rapid growth of urban populations is expected to drive a substantial increase in annual waste production, anticipated to reach 3.88 billion by 2050, exceeding the levels observed in 2020 (World Bank, 2022). Effectively managing municipal solid waste (MSW) in an environmentally sustainable and health-conscious manner is essential to prevent adverse impacts on human society, ecological issues, and the squandering of valuable resources (Sharmistha, 2023). Waste-to-energy technologies are vital in comprehensive waste management approaches, aiding in waste mass and volume reduction, waste disinfection, and energy recovery. Various technologies offer both advantages and limitations in handling municipal solid waste within urban settings (Liu, 2023).

Plastic contamination impacts both terrestrial environments and bodies of water, including oceans. Approximately 1.1 to 8.8 million tons of plastic refuse are believed to find their way into the ocean annually from coastal regions (Jambeck et al., 2015). Littering poses a threat to human life in various aspects, encompassing health risks, hygiene issues, environmental harm, and property damage. Moreover, it endangers biodiversity, potentially resulting in population decline or habitat-related diseases, leading to a reduction in oxygen levels and eventually culminating in the extinction or loss of habitats. (De, 2015). Various human actions result in the creation of a substantial amount of waste. As living standards and dietary preferences evolve, a more diverse and intricate array of waste is generated regularly. Urban areas particularly face a significant solid waste challenge. Hence, inadequate bin numbers and capacities in different areas frequently contribute to waste overflow (Rana, 2015). It is crucial and unavoidable to urgently pursue viable solutions for these issues, as doing so will not only save countless lives but also prevent the potential collapse of human civilization (Xia, 2022). The traditional practices of incineration and burial in landfills can lead to both environmental contamination and the squandering of precious land (Rathi, 2023). Minimizing and repurposing stand as the most efficient approaches to conserving natural resources, safeguarding the environment, and cutting costs (Kabirifar, 2020). Repurposing construction debris aims to lessen the release of greenhouse gases, which fuel global climate shifts, support the preservation of the environment for upcoming generations, and enable maximal utilization of products (Oyenuga, 2016; Park & Tucker, 2017). Japan has prioritized waste management through a strong push for recycling and minimizing landfill waste, with a particular focus on containers, packaging, and electrical devices. Aligned with the OECD's Extended Producer Responsibility (EPR) policy, Japan enacted the Packaging Waste Recycling Law in 1995, enforcing the segregation and recycling of containers and

packaging. Additionally, the Home Electric Appliance Recycling Law, implemented in 1998, ensures the recycling of designated household electrical appliances into new products (Tanaka, 1999). The ratio of paper and plastics including voluminous materials such as food containers and wrapping materials is high in Laos, where tourism industry is expanding. The low content of the organic material in Laos PDR is mainly due to the agricultural lifestyle where a large scale of the food waste is used as an animal feed (Glawe, 2014).

In the past, waste was not a concern in Laos, as people used natural materials in their daily household activities, relying on local resources such as banana leaves, fabric, textiles, and more for packaging, exchanging, buying, and selling. However, contemporary advancements in technology have transformed the use of scarce resources to plastics, offering convenience and ease. The population of Xayaboury Province is roughly 380,000 distributed across 11 districts, with the capital being Xayaboury District. Estimations suggest a daily waste generation of about 48 tons, calculated based on an assumed individual daily waste generation of 0.6 kg and a population of 79,189. The quantity of collected waste is approximately 27 tons, attributed to a population of 45,165. Nevertheless, the reported amount of waste transported to the disposal site is 39 tons per day (JICA, 2021). Hongsa district, situated within the Xayaboury province in the northwestern part of Laos, which serves as a dwelling place for a varied ethnic community comprising approximately 27,000 individuals. Since the latter part of 2009, the Hongsa Power Company (HPC) has been carrying out a program focused on relocating communities and improving their means of living. During this time, multiple companies had also ventured into investments related to electricity generation. Consequently, with an increase in the number of incoming residents, the production of waste escalated rapidly as well (Phusuwan, 2015). Banhan upper secondary school is a core educational activity, the school places emphasis on extracurricular pursuits such as cleanliness initiatives, sports, and artistic activities, in line with the five principles of education. The school's mission centers around effective management, fostering discipline among teachers and students, prioritizing education and self-development, encouraging strong teaching, and learning practices, striving towards predetermined goals, cultivating experienced educators, establishing a model school, maintaining a green and clean environment, and nurturing positive student attitudes. (Banhan secondary school report, 2021). Inadequate waste management can directly and indirectly impact the local population's health, leading to contaminated water, air pollution, and disease spread. Growing waste volumes make educational institutions, markets, and public areas uninhabitable, increasing individual expenses due to overflowing bins. Effective waste management practices minimizing landfill waste are vital. To address this, a circular economy initiative regulates plastic use in schools and populated areas, repurposing waste. A pilot project engaged teachers, students, and community members in reusable waste management, reducing costs and promoting eco-friendliness. Innovative waste-derived products were showcased, with plastic waste recycled for nursery materials.

Objective

- To investigate and elucidate the rise in the quantities of waste produced at educational institutions and affiliated organizations in the Hongsa district.

- To elevate the awareness of young learners and investigate the understanding and satisfaction of both students and teachers involved in the effective utilization of recyclable waste for agricultural use.

2. Material and Methodology

2.1 Study site and timefarme

The investigation into the amount of recyclable waste was primarily carried out at Banhan Upper Secondary School, along with six

other educational institutions and three associated offices in Hongsa district, Xayaboury province. These encompassed Banhan Upper Secondary School (BS), Hongsa Upper Secondary School (HS), Monk Lower Secondary School (MS), Banahan Primary School (BP), Phonchanh Primary School (PP), Viengkeo Primary School (VP), Nasan Primary School (NP), as well as the district office of Natural Resource and Environment (DoNRE), District office of Education and Sports (DoES), and District office of Agriculture and Forest (DoAF). The completion of this study took four months within the project's time frame.

2.2 Scope of study

The primary of this study was focused on the young students and teachers' population, who are set to be the pillars of the future nation, with a particular emphasis on educational institutions and the targeted groups within the project. The study centered on the environmental situation and the management of waste through the principles of the 3 Rs: Reduce, Reuse and Recycle, with a specific focus on their impact on agricultural production.

2.3 Method of study

The Clean and Green Youth Group was created for project participation and a training program on the topic of agricultural waste management was conducted for students of the Clean and Green Youth Group and their teachers.

The trash bin installation was divided into 10 plots, one plot per organization with 4 categories of trash bins, named digested (compost) waste, general (burnable) waste, reusable waste, and harmful waste. The waste was collected from 10 locations every two weeks, weighed, and transported to the Banhan High School for the separation. Waste in aday per person was calculated by a month to a day (22 of days) from avarge of 8h/day (working day), the total of amount of waste devided by single person in the schools or staff in the offices.

Waste management includes building compost houses, waste separation and product display, compost making from waste and grass/dead leaves, experimenting with making bio-extracted from household waste, and bringing plastic bottles or plastic water bottles to reuse in the invention as materials and tools for agriculture.

Waste was created as a new product for agricultural work, which has organized a competition to create an invention within the clean and green youth group and an exhibition of the products from the invention between rooms in the school with prizes given to the groups that worked well.

2.4 Data collection and analysis

Totally 8 roughs of waste collecting were noted by teachers and then calculated in a mounth, the data including the total weight of quantity and the amount of each category of waste in every plot, typing data in the Excel file. Teachers and students 34 people who attended the project were interviewed. The data were collected for analysis. Data was calculated in the program Microsoft Excel and analysis in program SPSS.

3. Result

3.1 General information

Banhan High School, originally established in 1981 as a lower secondary school, underwent multiple relocations over the years. In 1999, it was relocated to the rice field near Banhan village, and in 2010, it was displaced to the Thongsida area, subsequently being renamed as an upper secondary school. Falling under the Xayaboury Provincial Department of Education and Sports, the school operates with approval from the District of Education and Sports office, adhering to the curriculum set by the Ministry of Education and Sports. With a program spanning seven years of study across seven levels and comprising 14 classrooms, the school currently employs 31 teachers 68% male and 32% female. Of these, 15 teachers (42%) hold bachelor's degrees, 16 teachers (44%) possess diploma degrees, and 5 volunteer teachers (14%) (Fig.2).

The student body, drawn from eight villages, consists of 354 individuals, 50% male and 50% female, representing three main ethnic groups: Lao-tai 311 people (89 %), Khmu 37 people (10%), and Hmong 2 people (1%).

The interview was conducted in Banhan Secondary School where the project was implemented, in total 34 people of youth who joined the project were interviewed. There were 15 men and 19 women, the age range between 10-20 years covered 29 people, 31-40 years consisted of 4 people and > 50 years 1 person (Table 1).

3.2 The study on quatities of wastes at educational institution and related organization in Hongsa district

The waste collected and measured in quantity as the results showed that the total amount of garbage dumped in 2 months was 1,121.2 Kg. If it had calculated within the month, it was 280.30 Kg/month, and the weekly average was 70.15 Kg/week. This amount has increased in the schools whereas it had numerous students tropically, BS school had 49.7 Kg/month (17.72 %), followed by MS school 36.2 Kg/month (12.9 %) and NP school 33.8 Kg/month (12.08 %), then BP and VP schools have the same amount 31.6 Kg/month (11.27 %), next HS shool 28.7 Kg/month (10.24 %), PP school 26.9 Kg/month (9.60 %), while the DoAF was 14.2 Kg/month (5.07%), DoNRE at 13.9 Kg/month (4.96%) and the smallest amount is the DoES at 13.7 Kg/month (4.89 %) (Table 2 and Figure 4). The categories of waste revealed that burnable waste promoted the largest number 149.9 Kg/month (4.99 Kg/day), then compost waste 71.4 Kg/month (2.38 Kg/day), followed by Reusable waste 60 Kg/month (2 Kg/day) and the last harmful waste 2 Kg/month (0.07 Kg/day) representatively (Figure 5). The garbage had separated into recyclables from 280,3 Kg/month to 60 Kg/month or equal to 22%. These cartigory of reusable waste were bottles and grasses, plant debris, or food waste. Waste in a day per person shows that DoNRE has a high significance in the quantity of waste 0.0351 Kg (35.1 g)/person/day. Followed by PP school 0.0221 Kg (22.1 g)/person/day and NP school 0.0205 Kg (20.5g)/person/day, while DoES office presented 0.0178 Kg (17.8g)/person/day, DoAF office indicated 0.0175 Kg (17.5g)/person/day and MS school represented 0.0171 Kg (17.1 g)/person/day. The low quantities per individual was VP school at 0.0118 Kg (11.8 g)/person/day. BP school revealed at 0.0079 Kg (7.9 g)/person/day while BS school was 0.0058 Kg (5.8 g)/person/day, and lowest amount was HS school at 0.0012 Kg (1.2 g)/person/day (Table 3).

3.3 Results of awareness raising

The initiative project called "Small Tash Bin Make Money and Reduce Waste" aims to raise awareness among students and educators through training, demonstrations, and practical application in the field. Over 35 teachers and students actively participated in activities involving the collection and separation of waste in designated areas. The collected waste was transformed into useful products, including compost and flower plant pots, serving as agricultural tools. These items were created through a learning process that emphasized detailed methods, creative ideas, and procedures for effectively repurposing waste. The concept revolves around reusing waste in diverse ways, promoting the idea of waste reduction. The group of environmentally conscious youth students not only learned about waste reduction but also shared their knowledge within the school community, serving as a model for other students.

3.4 The understanding of participants on reusable waste management in agricultural purpose

Based on the evaluation of the students and teachers involved in the project, there was a commendable average understanding of 94.71%, with a well-understanding index of 1.24 standard deviations. This indicates that both students and teachers demonstrated a strong grasp of the project's activities. The

aspects they comprehended particularly well were the significance of environmental protection and waste management for their health. They also recognized that separating waste at its source could effectively reduce waste in the community. The program effectively imparted knowledge about environmental management and conservation, emphasizing the potential reuse of garbage and certain rubber waste. After participating in the program, all participants achieved a full understanding (100%) of waste management and garbage recycling, as detailed in the table (Table 4).

3.5 The satisfaction of program participants on reusable waste management in agricultural purpose

The feedback gathered through interviews with students and teachers indicates that the program, particularly for those actively involved in the project, garnered the highest level of satisfaction. The overall satisfaction rate averaged at 83.47%, with a noteworthy satisfaction index of 0.77 standard deviations, signifying a high level of contentment. This underscores the project's significance in facilitating learning, acquiring knowledge, and gaining valuable experiences. Furthermore, participants expressed the ability to transfer their acquired knowledge and skills to the next generation, with a notably high satisfaction level (average 4.44), highlighting the sustainable nature of knowledge management. The benefits derived from project participation, including training and knowledge demonstrations by the project team, were deemed suitable for effective project management. Additionally, the organization's cooperation with the project and the adherence to the scheduled implementation were both rated at 83%, reflecting alignment with practical realities (Table 5).

4. Discussion

The surge in waste has detrimental impacts on organisms and their surroundings, leading to degradation and decline. The total emissions equate to 33,889 tonnes annually in terms of carbon dioxide-equivalents (CO2-eq). Specifically, in Luang Prabang, an estimated 29,419 tonnes of MSW were recorded for the year 2015 (Xaysackda et al., 2017). Our investigation revealed an increase in the volume of waste at Banhan Upper Secondary School, despite having a larger student population and being situated farther from communities. Monk Lower Secondary School (MS) followed suit, given the full-time presence of students. The office, with fewer staff members, reported the lowest amount. Interestingly, when considering daily waste per person, the office exhibited an increase, possibly due to staff spending more time there, consuming more food and beverages compared to students. Data from the Department of Natural Resources and Environment (DoNRE) indicated a significant waste quantity in the office, while HS had the lowest waste quantities. Comparing our findings to previous research on health care waste (HCW) in the capital, where it was 0.62 kg/bed per day (Vientiane municipality) and 0.38 kg/bed per day (Bolikhamxay) (Soulivanh Phengxay, 2005), our results indicated lower quantities. Additionally, the Ministry of Natural Resource and Environment's 2018 report suggested that the average daily garbage disposal per person in Laos ranged from 0.45 to 0.97 Kg, resulting in an estimated annual waste generation of 1,791,820 tons. This suggests a decrease in waste at educational institutions and offices. However, a 2020 report from the District Office of Natural Resource and Environment revealed an increase in waste in households, restaurants, and industrial companies. Combustible waste, especially packaging and containers made of plastics, polyester, and cotton, contributed significantly. This increase contrasts with lower numbers for compostable and reusable waste, indicating that offices and schools consumed fewer diverse fresh fruits, vegetables, fast foods, and drinking water. Nevertheless, this underscores the critical importance of waste separation as a fundamental direction for sustainable waste management. In the evaluation of awareness enhancement in agricultural waste management, most teachers and students demonstrated a favorable level of understanding, with some indicating strong comprehension. Furthermore, participants expressed high satisfaction with the program. However, a portion of the participants did not

grasp the content or were dissatisfied with the training and practice activities. Possible reasons for this discrepancy include it being their first exposure to such a project, a lack of motivation, inattentiveness to the learning and practice sessions, and hesitancy to ask questions.

5. Conclusion

The investigation focused on the management of reusable waste within educational institutions and associated offices. Burnhan Upper Secondary (BS) and Monk Lower Secondary Schools (MS) displayed varying amounts of waste, with burnable waste being the most prominent category. The Department of Natural Resources and Environment exhibited the highest quantity of waste per person per day. The research also evaluated the level of awareness among students and teachers, indicating a higher percentage with a comprehension of waste management. Participants expressed notable satisfaction with the initiative, which not only heightened awareness but also encouraged environmental responsibility and incorporated extracurricular activities. The school's involvement in environmental programs aligns with the objective of transforming Hongsa district into a clean, green city. Accomplished teachers and enthusiastic students play pivotal roles in the success of these projects, fostering creativity and active engagement.

6. Conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

7. Acknowledgments

In the course of our research endeavor, we wish to express our heartfelt thanks to SGP, GEP, and UNDP for their financial backing throughout the period spanning from 2021 to 2022.

8. References

Banhan high school report, (2021). www.thebalancesmb.com

Dea, S., & Debnathb, B. (2015). *Prevalence of Health Hazards Associated with Solid Waste Disposal-A Case Study of Kolkata, India*. International Conference on Solid Waste Management, 5 Icon SWM 2015. a Teacher, Children Academy School, Kolkata, India. Democratic Republic Final Report, Ministry of Natural Resource and Environment. JAPAN

Eze, W.U., Umunakwe, R., Obasi, H.C., Ifeanyi, M., Ugbaja, C., Uche, C.C & Madufor, I.C. (2021). Plastics waste management: A review of pyrolysis technology. Department of Polymer Technology, Nigerian Institute of Leather and Science Technology, P.M.B.1034, Zaria, Nigeria. And Department of Metallurgical and Material Engineering, Federal University, Oye-Ekiti, Nigeria. *Clean Technologies and Recycling, 1*(1), 50–69.

Glawe, U., Visvanathan, C., & Alamgir, M. (2014). *Solid Waste Management in Least Developed Asian Countries–A Comparative Analysis*. Geotechnical and Geoenvironmental Engineering Program, Asian Institute of Technology, Khulna University of Engineering & Technology, Khulna, Bangladesh.

Hossain, M. I., & Tuha, M. A. S. (2020). Biodegradable plastic production from daily Household. *International Journal of Advancement in Life Sciences Research, 3*(3), 16-19.

Jenna R. J., Perryman, M., Geyer, R., Wilcox, C., Theodore R. & Lavender, L. (2015). Plastic waste inputs from land into the ocean. *sciencemag.org 13 FEBRUARY 2015, 347*(6223), 768.

JICA. (2021). Data Collection Survey on Waste Management Sector in The Lao People's

Kabirifar, K., Mojtahedi, M., Wang, C., & Vivian, W.Y. (2020). Construction and demolition waste management contributing factors coupled with reduce, reuse and recycle strategies for effective waste management. *Journal of Cleaner Production, 263*(2020), 121-265.

Liu, J., Kua, H.W., Wang, C. H., Yen Wah Tong, Y. W., Zhang, J., & Peng, Y. (2023). *Improving urban ecosystem*

holistic sustainability of municipal solid waste-to-energy strategy using extended exergy accounting analysis. Department of Mechanical Engineering, School of Mechanical Engineering, Shanghai Jiao Tong University.

Mondal, S., & Mandal, B. (2023). Assessment of urban solid waste management in a Class II Indian city using geospatial and statistical approaches: A case study of Rampurhat Unicipality. Department of Geography, Institute of Science, Banaras Hindu University. *Varanasi 221005, India. Waste Management Bulletin, 1*(2024) 74–92.

Oyenuga, A. (2016). *Economic and environmental impact assessment of construction and demolition waste recycling and reuse using LCA and MCDA management tools* (Doctoral dissertation, London South Bank University).

Park, J., & Tucker, R. (2017). Overcoming barriers to the reuse of construction waste. material in Australia: a review of the literature. *International Journal of Construction Management, 17*(3), 228-237. DOI: 10.1080/15623599.2016.1192248.

Phengxay, S., Okumura, J., Miyoshi, M., Sakisaka, K., & Kuroiwa, C. (2005). *Health-care waste management in Lao PDR: a case study*. Department of Health Policy & Planning, School of International Health, University of Tokyo, Tokyo, Japan.

Phusuwan, S., Xayalath, S., & Pongpa-ngan, L. (2015). *Challenging Hongsa Resettlement and Livelihoods the First Mine-Mouth Power Plant Project in Lao PDR*. Hongsa Mine-Mouth Power Plant Project, Xayaboury, Lao PDR, p.2.

Rana, R., Ganguly, R., & Gupta, A.K. (2015). *An Assessment of Solid Waste Management System in Chandigarh City, India*.

Department of Environment, Ministry of Natural Resource and Environment (2022). *Report and Manual of Technical Guideline on Community Hazardous Waste Management*, p.1-2.

Tanaka, M. (1995). *Policies and measures for waste minimization in Japan*. OECD Washington Waste Minimization Workshop, vol II. OECD, Paris, p 236–237.

Tanaka, M. (1999). Recent trends in recycling activities and waste management in Japan, J Mater Cycles Waste Manag (1999), *1*,10–16.

Vilaysouk, X., & Babel, S. (2017). Benefits of improved municipal solid waste management on greenhouse gas reduction in Luang Prabang, Laos. *Environmental Technology, 38*:13-14, 1629-1637, DOI: 10.1080/09593330.2017.1301562.

waste materials and Comparison the decomposing time with synthetic polyethylene plastic.

Xia, J., He, J., Hu, B., Yang, R., Jiang, Y., & Yuan, Z. (2022). *The Causes and Solutions of Marine Littering and Water Area Destruction*. Shenzhen College of International Education, Shenzhen, 518053 Guangdong, China.

Table 1. General information of interviewers

No	Basic information	No. Interviewer	Percentage %
1	Education level		
	Lower secondary school	6	17.65
	Upper secondary school	23	67.65
	Diploma's degree	3	8.82
	Bachelor's degree	2	5.88
2	Occupation		
	Students	29	85.29
	Government employee	5	14.71
3	Ethnic group		
	Lao Loum	29	85.29
	Lue	5	14.71
4	Religion		
	Buddhism	20	100

Table 2. The quantity and rate of wastes per month at educational institution in Hongsa district

No	Institudtions	Reusable waste (Kg)	Composting waste (Kg)	Burnable waste (Kg)	Harmful waste (Kg)	Total of wage (Kg)	Rate of waste (%)
1	BS school	7.2	10.4	30.1	2	49.7	17.73
2	HS school	5.2	8.3	15.2	0	28.7	10.24
3	MS school	8.2	10.5	17.5	0	36.2	12.91
4	BP school	7.4	9.4	14.8	0	31.6	11.27
5	PP school	4.2	8.2	14.5	0	26.9	9.60
6	VP school	7.5	8.4	15.7	0	31.6	11.27
7	NP school	8.4	7.2	18.2	0	33.8	12.06
8	DoNRE	3.2	3.5	7.2	0	13.9	4.96
9	DoES	4.2	2.7	6.8	0	13.7	4.89
10	DoAF	4.5	2.8	6.9	0	14.2	5.07
	Total	**60**	**71.4**	**146.9**	**2**	**280.3**	**100**

Table 3. The everages of waste quantity had thrown out at institutions per single person.

Institutions	No. of Students or staff	Quantity (Kg/month)	Qauntity (Kg/day)	Quatity (Kg/person/ 8 hours or a day)	Quantity (g/person/ 8 hours or a day)
BS school	389	49.7	2.2590	0.0058	5.8
HS school	769	28.7	1.3045	0.0017	1.7
MS school	84	31.6	1.4364	0.0171	17.1
BP school	155	26.9	1.2227	0.0079	7.9
PP school	65	31.6	1.4364	0.0221	22.1

VP school	140	36.2	1.6455	0.0118	11.8
NP school	75	33.8	1.5364	0.0205	20.5
DoNRE	18	13.9	0.6318	0.0351	35.1
DoES	35	13.7	0.6227	0.0178	17.8
DoAF	37	14.2	0.6455	0.0175	17.5

BS = Banhan upper secondary school; HS = Hongsa upper secondary school; MS = Monk lower secondary school; BP = Banhan primary school; PP = Phonchan primary school; VP = Viengkeo primary school; NP = Nasan primary school; DoNRE = District office of the Natural Resource and Environment; DoES = District office of the Education and Sport; DoAF = District office of the Agriculture and Forestry.

Table 4: Understanding of participants on reusable waste management in agricultural purpose.

Understanding of Teachers and Students in participation	**Correct**	**Incorrect**	**Total No.**	**Percentage (%)**		**SD**
				UN	**Not U**	
Do you join any other environmental project before?	25	9	34	73.53	26.47	2.78
Do you hear and know the problem of environmental pollution?	32	2	34	94.12	5.88	1.18
Do you know some of the waste can be reused and recycled?	34		34	100.00	0.00	1.21
Have you ever separated the waste in your home?	31	3	34	91.18	8.82	1.23
The wast is the sources of environmental pollution, water contamination, air pollution, and soil degradation, because this resons the waste has to managed.	32	2	34	94.12	5.88	1.04
One of the approaches of the management and waste reduction model is using 3 R (Reduce Reuse and recycle).	32	2	34	94.12	5.88	0.98
Environmental conservation and reusable waste management promote to take care of your health.	34	0	34	100.00	0.00	0.80
Separate your waste from the beginning and bringing waste to reuse are the way to reduce the wast in the landfill.	34	0	34	100.00	0.00	0.90
After participating in the project, you can understand more about waste management and recycling.	34	0	34	100.00	0.00	1.04
The project provided knowledge about waste management and environment conservation right/wrong.	34	0	34	100.00	0.00	1.27
Total of average				94.71	5.29	1.24

UN = Understanding; Not U = Not understand; SD = Standardization

Table 5: The satisfaction of program participants on reusable waste management in agricultural purpose

Description	**Satisfaction score**					**N**	**Average**	**Percentage (%)**	**SD**	**Satisfaction Level**
	5	**4**	**3**	**2**	**1**					
Knowledge and Techniques about waste management	4	19	10	0	1	34	3.76	74.71	0.62	
The project had multiple activities and related to waste reduction and management.	10	15	6	2	1	34	3.91	78.24	0.98	

The result of the project had achieved by the goal setting and relevant to the project's objective.	13	15	5	1	0	34	4.18	83.53	0.78	
The government offices and authorities had a good cooperation during the project implementation.	14	15	4	0	1	34	4.21	84.12	0.87	
Knowledge providing, training, practices, and demonstration of project's team were great on you for long term wast management.	16	14	2	1	1	34	4.26	85.29	0.92	
After training has completed, at what level do you assess your understanding and satisfaction.	10	19	3	2	0	34	4.09	81.76	0.78	
What kind of benefit did you get from project attending and how much satisfaction would you like to provide for the project?	15	17	1	1	0	34	4.35	87.06	0.68	
How much do you understand about reusable waste management from this project?	11	17	5	0	1	34	4.09	81.76	0.85	
This project has advantages and benefits for all the participants.	18	14	2	0	0	34	4.47	89.41	0.61	
After joining the project, you can transform your knowledge and skills to the next generation.	18	13	3	0	0	34	4.44	88.82	0.65	
Total of average							**4.18**	**83.47**	**0.77**	**High Satisfaction**

N = Number in total; SD = Standardization