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Solid Waste Management in Banthreampunya School. La-ae subdistrict, Yala Province, Thailand.

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Abstract. The purpose of this study was to investigate solid waste and its contents in Banthreampunya School, La-ae subdistrict, Yaha District, Yala Province. The result was used in planning and managing solid waste disposal system within Banthreampunya school. The researcher employed literature review, local survey, observation, as well as students' participation, and school staff which include teachers for data collection and collaborated planning for the best solid waste management system that should be implemented within the school. The result of the study showed the contents of school solid waste consist of 4 major types of waste i.e. recyclable waste, organic waste, general solid waste, and hazardous waste in the percentage proportion of 48.93, 32.21, 14.50, and 4.36 respectively. The consensus agreement between participating parties has been reached to solely manage the recyclable waste by means of waste bank to reduce and add value to the waste.

1. Introduction

Economic development and population growth are part of the reasons for the heavy reliance on natural resources recently, which create massive number of by-products or waste streams from manufacturing processes, industrial activities, packaging materials, household activities, etc. These wastes include food waste, scrap paper and plastic waste that were increasingly and consecutively generated between 2008-2017, from 23.93 million tons in 2008 with waste generation rate of 1.14 kg per capita per day to 27.40 million tons in 2017. If there still lack proper management and planning to deal with these wastes, all local communities will be filled with waste and a lot of nuisances, pollution, and risk to the public health [1].

Thai government and responsible agencies have been trying to resolve the waste problem issue by implementing suitable waste management systems that can integrate seamlessly to the local societies. However, these recent efforts have not yield the intended results, due to the tremendous growth of population as social behavior lean towards higher consumption to satisfy personal esteem. Nowadays, increased population generates huge amount of waste, and the existing waste disposal systems cannot bare the increasing load of waste anymore. Recent government policies on social and economy development also play a part in raising waste generation, arising from the booming industrial activities which come with a lot of waste and disposal rejects. The aforementioned reasons lead to depletion of



natural resources, pollution to the environment, and social issues [2]. Schools are part of communities also must deal with these waste problems.

Banthreampunya School is a primary school consisting of six grades with a total of 71 students. In the past, the waste generated from the school was collected by local municipality with the cost of 1,000 THB/month but nowadays there is no collection as the school cannot pay the price anymore. From the survey, no waste separation within the school was done before disposal as all the wastes were burned in the open space causing air pollution to the nearby environment.

This research therefore aimed to find the best waste management alternative in the school in order to reduce waste problem through students' and staff participation. Students and school staff were recruited to participate in planning, choosing waste management system as well as finding the best and suitable method for the school as means to create ownerships mindset for sustainable waste reduction culture.

Research objectives

1. To study waste contents in Banthreampunya School, La-ae subdistrict, Yaha District, Yala Province.

2. To find the best alternative of waste management system in Banthreampunya School, La-ae subdistrict, Yaha District, Yala Province.

2. Theoretical Background

Solid waste means the refuse left over from consumption which has different characteristics depending on the source of waste. Commonly solid waste can be classified into 4 types which are general waste, hazardous waste, recyclable waste, and organic waste. The rate of solid waste generation is affected by various factors that are geographical location, seasonal variations, characteristic of population, the standard of living, frequency of collection, and legislation. [3]

There are different methods of solid waste management, including open dumps, use as animal feed, composting, sanitary landfills, incineration, waste treatment, and disposal. The most popular and acceptable solid waste disposal methods used are composting, incineration, and sanitary landfills. However, if there is still incorrect management according to academic principles, there would affect the environment such as water pollution, soil pollution, air pollution, visual pollution, and nuisance. Moreover, inefficient solid waste management causes direct economic loss. There is also the indirect loss from the sick leave of labor resulted from the illness after contacting the contaminated waste. In addition, each type of solid waste can be used for other purposes such as organic waste that can be used by fermenting into the fertilizer or animal feed. Solid waste such as paper can be recycled and plastic packaging (i.e., soft drink bottles, fruit juice bottles, and vegetable oil bottles) transform into new plastic products.

Most activities of solid waste management in schools are conducted to reduce waste problems such as waste separation, composting, fermenting the organic fertilizer, waste bank, waste exchanged for eggs, waste donation on Buddhism activities (Tod Pha Pa Recycle). These operations are performed by students and teachers act as advisors.

3. Methods

This study took the form of combined research between qualitative and quantitative studies. The study site was Banthreampunya School, La-ae subdistrict, Yaha District, Yala Province. The study consists of 2 main parts

3.1 Study of waste contents in the school.

Wastes were collected using random sampling, then mixed followed by coning and quartering techniques and finally analyzed their contents by separating each type of waste (into food waste, fruit and vegetable wastes, leaves, grass, wood, plastic, paper, aluminum, metal, glass, leather, rubber, stone, tile, and hazardous waste, etc.) The waste proportion by type was calculated using the equation below. [4]

Waste proportion by type (percentage) = (waste weight x 100) / total waste weight)

3.2 Waste management selection method: Consisted of 3 steps;

3.2.1 Brainstorming sessions began with current waste situation report. Data from part 1 were used to analyses and present to participants before brainstorming sessions. Twenty participants comprising the management board, teachers, janitors, and school committees. All participants reviewed the current waste situation and brainstorm together on the best way to manage waste within the school.

3.2.2 The researchers presented waste management with few examples to all participants. Then, the participants are allowed to work together to come up with the best waste management system or method. After the meeting, the verdicts are collected and summarized by the researcher.

3.2.3 Assessing of alternatives: at this stage, researchers allowed participants to vote for the best waste management method that can be implemented seamlessly in the school in order to reduce waste problem. Voting was done in form of word card; all participants gave each alternative desired point. Then the researchers collected and counted total points voted. Each alternative would be revealed with points voted to the meeting.

4. Results and Discussion

Waste contents analysis

The result showed that waste contents in the school consisted of 4 main types, i.e. general waste, recyclable waste, organic waste, and hazardous waste. The highest proportion of waste percentage recyclable waste (with 48.93%) followed by organic waste, general waste and hazardous waste (with 32.21%, 14.5% and 4.36%) respectively, as shown in Figure 1.

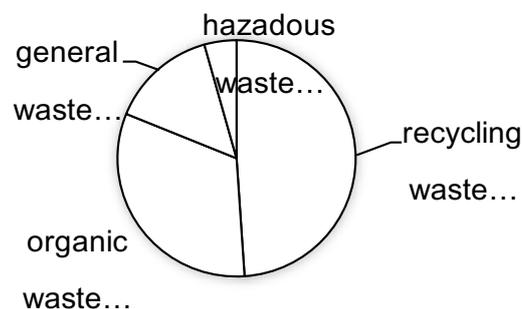


Figure 1. Waste proportion percentage in Banthreampunya School

Given that the highest proportion of waste in the school is constituted by recyclable with 48.93% composition of the total waste generated. A chunk of the recyclable wastes include scrap papers, scantling, as well as plastic waste. This result was concordant with the study about waste management method in high schools within Ubon Ratchathani municipality. [5] They found that recyclable waste generated in schools mostly comprises scrap papers, plastic cups, and water bottles. These recyclable wastes can be sold for prices and create incentive for student in waste separation and sell it for profit. Furthermore, the study of photilukha W and et al. [6] also found that most of recyclable wastes comprise plastics and scrap papers, especially during special activities in the school, i.e. student sport competition. Similar findings were reported in an elementary schools in Khon Kaen province, by Thunhikorn P [7] who found that the highest proportion of waste comprises scrap papers with average generation of 355.88 kg/day, and plastic bags with average generation of 120.40 kg/ day in Suankularb Rangsit College school. Overall, the study concluded that the cooperation from both school staff and students were vital to manage waste separation and gain profit by selling them.

However, with organic waste management, the school already had a proper management practice in place. For example, it can be bio-fermented and/or fermented for fertilizer production. This product is

useful for student's vegetable beds. The vegetables are harvested, cooked and served as food to the school. Food waste can serve as vital feeds for chickens and catfish. The study of Songklang C [8] found that organic waste can be fed to animals or used to produce fertilizer, however, the school chose to use the waste as feeds for the animals to reduce the amount of waste and animal food expenses in Ban Na Dee Sang Bong school, Phasuk subdistrict, Kumphawapi district, Udon Thani province.

Selection of waste management system in the school

The results comprises 3 parts; review and reflection on waste problems, selection of alternatives, and assessing them.

Step 1. Review and assessing wastes problems -

The recyclable waste had the highest proportion (of 48.93%). Surprisingly, most of the students still lack knowledge on waste separation before disposal, and the school had no proper waste management plan in place. The current practice is to burn the all waste unsorted. The waste type mostly generated within the school constitute recyclable waste, which can be turned to profit by selling or reusing. These waste comprises mainly broken study desks and chairs, plastic bags, plastic bottles, as well as other type of plastic wastes, foam, rubber scraps, used paper cups, paper boxes, milk boxes, scrap metals, soft drink cans, wood, cloth, etc. Recyclable waste in the school constituted about 48.93 percent, consistent with the quantity reported by Suparat J [5] who studied waste management system in junior high schools in Ubon Ratchathani province. The conclusion from Suparat J [5] study is similar to that of our study, i.e. recyclable waste comprising the highest proportion of waste generated in schools, and students in general still lack knowledge in proper waste separation and management in schools. Educational sessions to demonstrate waste separation and management should be conducted to enhance the students' understanding and as a result lead to sustainable waste reduction and management practices in the long term. This practice of understanding waste management had been proven successful as elaborated in previous studies of Thunhikorn P [7] who proved that implementing waste management knowledge training in Suankularbwitayalai Rangsit School worked, as most students and school staff have gained awareness in waste management and separation in the school. In agreement with our study is study by Markphan W and *et al.* [9] who completed a project to improve knowledge and understanding about waste management for local community in Trang municipality, Trang province by sending officials and staff of government agencies such as municipalities, local administrative organizations to demonstrate how to properly manage and separate waste. This project helps people better manage waste by themselves, since knowledge sharing is a process that affects people behavioral level and increase better awareness in the long term.

Step 2. Brainstorming of alternatives

The result from brainstorming sessions found 3 alternatives which include the introduction of waste bank, waste exchanges for eggs and creation of educational curriculum. All alternatives that have been chosen aimed to reduce recyclable waste, turn it into profit, or reuse, while creating awareness on the importance of waste management were strong recommendations by Mukda W and Thapinta A [10] who carried a study on developing waste bank in Wat Chan Samosorn School, Dusit district, Bangkok. They found that the successful rate of waste bank operation depends on everyone's cooperation by inculcating real practice thereby making long term sustainable waste management, separation and reduction. They also managed to reduce the costs of waste disposal and make in turn profit for waste separators. Another study that supported the waste bank idea is that of Amornsiriphong W and *et al.* [11] who studied waste management system in Kamphaengsaenwittaya School, Kamphaengsaen district, Nakhon Pathom province. They found that students can make profit by depositing their waste to the bank, and the waste bank in turn make profit by presenting itself as a seller of recyclable waste to antique stores or scraper shops. Additionally, excess profit following the deduction of operating costs can be used as capital, scholarships, or as support for other activities in the school.

Step 3. Assessing of alternatives

From the result of scores that were voted by all participants, The highest percentage score was creation of waste bank (with 50%), While, 35% and 15% of alternatives were for waste-eggs exchange and creation of educational curriculum respectively. It can be concluded from the results introduction of waste bank was the best way to deal with waste problems in the school based on consensus agreement of the participants. One of the reasons is, it can reduce recyclable waste in the large quantity without having to deal with disposal process or costs. Recyclable waste is valuable and attractive for students to take considerably care toward its disposal. Thai Health organization [12] also recommended the creation of waste bank as one of the best alternative ways to manage waste in schools and at its source. Pollution Control Department [13] is another actor that promotes waste bank as the best alternative to separate recyclable waste such as scrap papers, plastics, metals, and glass and in turn make profit while reducing waste at the same time in schools.

The study by Amornsiriphong and *et al.* [11] conducted a case study in Kamphaengsaenwittaya School, Kamphaengsaen district, Nakhon Pathom province. In the case study, they created waste bank which is operated by student volunteers as bank's staff. The student volunteers are responsible for separating, weighting and calculating the rate of exchange then make a deposit record. The rate of exchange and prices of recyclable waste turned in by people will be based on an agreed prices between the school and scarp shop collector. The total rate of return will be finalized after deducted profit with operating costs, and public relations. The net profit constitutes the waste bank turn over a part of which is distributed as commission to the volunteers, re-operating costs, scholarships, or use as support fund for other school activities.

Additional benefits from the study.

After selection of alternatives, teachers implemented the program by educating all students to have better knowledge and understanding in dealing with waste, to be the focal points in awareness creation as well as lead the way for collaboration in creation of waste bank in the later stage.

5. Conclusion

Waste of 4 main types in the school found that recyclable waste has highest proportion of waste percentage (with 48.93%) follow by general waste (32.21%), organic waste (14.5%), and hazardous waste (4.36%). Waste management alternatives within school are waste banks. Because it can reduce recyclable waste in the large quantity without having to deal with disposal process or costs.

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