



Improving Food Waste Management in the School Canteen Utilizing Facility Management Principles

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Abstract

Bang Lamung School in Thailand is a large secondary school with a total of 2,534 people that daily dine at the school's canteen. The amount of food waste is about 180 liters per day, or 900 liters per week, which creates problems for the school in terms of displeased scenery and smell. In addition, the school's mission is to be a "Lab School Project or "One District, One School of Dreams." Therefore, the school should be hygienic in terms of its waste management. This paper presents a food waste management analysis based on the concept of facility management (FM): people, place, and process. The paper has 3 objectives: (1) to study the existing problems of food waste in the school; (2) to compare the 3 methods of food waste management (composting, microorganisms, and biogas); and (3) to propose guidelines for the food waste management in the school. The methodology of the paper was interviews with related peoples—teachers, students, and the canteen's traders. The results revealed that composting was the most appropriate way to solve the problems for Bang Lamung School because the process is basic and can generate maximum revenue. Moreover, the rear area of building number 9 is suggested for carrying out the composting process. This paper will benefit the school director in terms of managing the food waste in a proper way and increasing awareness of food waste for the students and other related people.

Introduction

The food waste is a global concern. Based on data from the Food and Agriculture Organization of the United Nations (FAO), it is estimated that approximately 1/3 of food produced each year is leftovers, and this has a huge negative impact in terms of the economy, society, and environmental problems for countries. The food that is not consumed becomes leftovers and this represents exploited resources (Sucharitthanon, 1991). The over-produced food using large amounts of resources in one

area creates scarcity for other areas. It is statistically true that many people in the world are facing a food shortage situation. Moreover, the waste contaminating the environment causes various kinds of disease. In addition, food disposal causes methane to destroy the atmosphere and is a cause of global warming. Again based on data from FAO, it is estimated that the carbon dioxide produced from food waste in the world is equivalent to 3,300 million tons per year. In Thailand there are more than 26.77 million tons of garbage, of which 64% is food

waste (Ganghair, 2014). For Bangkok, around 50% of the total garbage of 9,000 tons per day is food waste (Ckaewprasert, 2017).

Bang Lamung School in Thailand, a governor secondary school under the authorization of the Office of the Basic Education Commission (OBEC), is located in Na Kluea, Bang La Mung, Chon Buri province. There are approximately 2,534 students, teachers, and staff members at the school, and the school's canteen has 11 shops. At present, the school's canteen manages food waste by hiring outsourcers to scrape out the food at the cost of 20 baht per day (400 baht per month). Due to the fact that the school has entered the "Lab School Project," or "One District, One School of Dreams," as it is sometimes called, it is highly desirable for it to be a school that can efficiently handle such problems (Department of Environmental Quality Promotion, 2015).

This paper presents a discussion of food waste management based on the concept of facility management (FM). At present, the school manages the food waste by hiring outsourced organizations to collect the waste daily at the expense of 20 baht per day (Monday - Friday), equal to 400 baht per month. The paper will benefit the school director in terms of managing food waste in a proper way and increasing awareness of food waste on the part of students and other related people.

Objectives

This paper presents a discussion of food waste management based on the concept of Facility Management (FM). The paper has 3 objectives:

1. to study the existing problems of food waste in the school
2. to compare the patterns of food waste management
3. to propose guidelines for food waste management in the school

Conceptual framework

The conceptual framework of the present paper compares the proper and improper means of managing the food waste. Finally, the proper means of choosing the most beneficial method for the school and to serve the mission of the school being a "One District, One School of Dreams" are discussed.

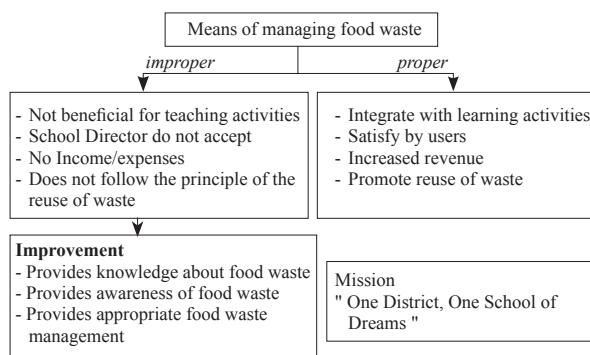


Figure 1 Conceptual framework

Research methodology

The methodology of the paper is interviewing related people: teachers, students, and the canteen's traders. In addition, comparing the effectiveness of well-known approaches toward food waste management was conducted.

1. Population and samples

As of February 23, 2018, there were 2,534 people in the school, consisting of 2,400 of students, 130 teachers, and 4 officers.

2. Research instrument

Bang Lamung School is located on 4 Moo 2, Sukhumvit Road, Na Kluea, Bang La Mung District, Chon Buri province. In the school's canteen, most of the food waste is from the students' consumption process. Based on the concept of Facility Management (FM) which consists of 3 main issues (3P)—people, place, and process (Sikhao, 2018), the food waste management of the school can be analyzed as follows.

(1) In the school people that use the canteen consist of students and teachers, and related people, i.e. parents.

(2) The places that are related to food waste management in the school include the canteen, the school buildings, the school street, etc.

(3) The process of managing food waste in the school is hiring private organizations to discard the food waste in the afternoon.

3. Collection of data

Information about the amount of food waste and the condition of the food waste collected was obtained through observation and interviewing. The observation time was between 12.00 - 13.30 o'clock from Monday to Friday (5 days) for one week. The teachers and students were interviewed about their concern about the food waste problems.

4. Data analysis

According to the school’s layout, as shown in Figure 2, there are 15 areas within the school’s boundary: 6 school buildings, a soccer field, a basketball court, a volleyball court, a gymnasium, a cafeteria, a teacher’s house, a Buddha statue, a teacher’s duty room, a water supply building, and a men’s and women’s restroom..

The cafeteria is located on the 1st floor of building. 6. There are 11 shops that serve 4 types of food, including 5 rice curry shops, 4 noodles, 1 fruit shop, and 1 dessert shop, including the dining area for the dining tables.

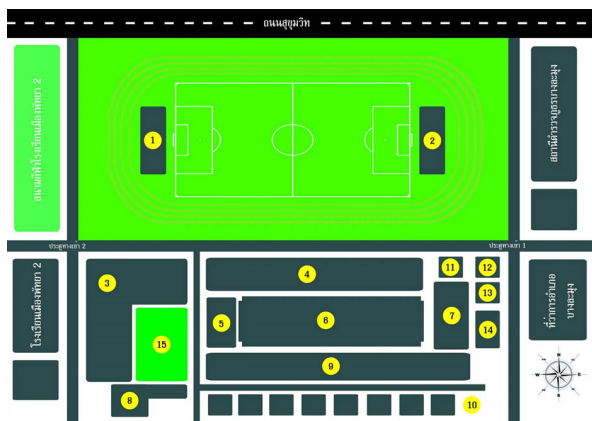


Figure 2 Bang Lamung School’s Layout

Results

1. The amount of food waste

From collecting the amount of food waste from Bang Lamung school, it was found that the average daily food waste amount in the school was 180 liters/day (900 liters/week).

2. The condition of the food waste

The food garbage at the garbage point is comprised of the mixing of various kinds of plastic, i.e. tubes, mugs, and plastic bags, including the meat ball sticks and leaves, as shown in Figure 3.



Figure 3 The condition of the garbage

3. The Management of Food Waste

At present the school has set up a large garbage

point for food waste at the end of the canteen area. This waste is sold daily to private organizations for destruction. At this point there are buckets for leftovers and the students throw their leftovers into them. Finally the canteen sellers clean their plates. The leftovers that are put into the buckets are picked up in the afternoon by an organization. The cost of managing the food waste is 20 baht per day (Monday - Friday) and 400 baht per month, as seen in Figure 4.



Figure 4 School’s lunch atmosphere and the food waste point

4. Interviews

For this research the interviewees comprised the students, teachers, and food sellers in the school. The questionnaire had 3 topics: (1) problems concerning food waste; (2) solving the problem of food waste management; and (3) other methods of food waste management.

(1) Current problems of food waste at Bang Lamung School

There are a lot of food leftovers from the students, and there is no food and water separation so food waste and food garbage such as plastic are combined. In addition, the waste creates a bad smell that disturbs the people in the school. Today the school uses a basic way of managing the waste. First, the canteen sellers leave the food debris in the tank, and then in the evening a private organization comes to collect it daily.

(2) Solving the problem of food waste management

In order to avoid wasting food, in the school, before the students order food, the seller asks them if they want to eat less, and they will then serves less food. At present, this method of food delivery is used seriously. The interviewees stated that they would like

the school director to take care of this issue seriously and practically.

(3) Based on other researches, there are many methods of food waste management, such as composting, using microorganisms, and biogas.

The interviewees give the opinion that using composting, microorganisms, and biogas are practical methods of managing food waste.

5. Comparative analysis of management approaches and patterns of food waste utilization

Based on academic research, three means of food management—composting, microbial water treatment, and the use of biogas (Srijuntrapun, 2016)—are analyzed in the present paper. The 900 liters of food waste are analyzed in terms of the methods and procedures each management. According to the study, it was found that composting was the most beneficial method for solving the problems, followed by biogas and the use of microorganisms, as seen in Table 1.

Table 1 Comparing the cost, materials and the duration of waste utilization using each approach

| List | Compost | Microorganisms | Biogas |
|---|---|---|---------------------------------|
| Volume of food waste | 900 kg. | 900 kg. | 900 kg. |
| Period of time | 21 days | 30 days | 25-30 days |
| Amount of product | 1,125 kg. | 4,500 liters | - |
| Amount of dung | 225 kg. Amount of 675 baht | - | 50 kg. Amount of 150 baht |
| Microbes or fertilizer | 5.625 kg. Amount of 393.75 baht | 300 kg. Amount of 21,000 baht | - |
| Molasses | - | 300 kg. Amount of 6,600 baht | - |
| 200 liters of plastic lids | - | 23 units Amount of 13,800 baht | 2 units Amount of 1,200 baht |
| 120 liters of plastic lids | - | - | 1 unit Amount of 380 baht |
| Equipment for biogas fermentation: PVC pipes of various sizes. Lengths depend on size and location, gas valves, gas transmission, joints, different pipes styles, strapping, pipe covers, cement glue, adhesives, tape and other materials. | - | - | ≈ 2,100 baht |
| All costs | ≈ 1,069 baht | ≈ 41,400 baht | ≈ 3,440 baht |
| price | 5 – 10 baht per kg. Amount of 5,625 baht | 10 – 20 baht per kg. Amount of 45,000 baht | N/C |
| Earnings | 4,556 baht | 3,600 baht | N/C |

Discussion

For solving the existing problems, the management is separated into 3 parts—people, place, and process—based on the analysis of the principle of FM. For further development of food waste management, it can be carried out in the following ways.

People

As indicated above, there are 2,534 people, i.e. students, teachers, and staff, at the school. In the school's canteen, there are 11 shops. The first step to avoid food waste is to make people aware of their food waste by providing information on waste prevention.

Place

Due to the fact that doing composting is considered to be the most beneficial method, it is necessary to prepare the areas and activities for this. The area behind building 9 that is near the canteen was chosen because it is close to the canteen so that the waste can be transported there easily, as shown in Figure 5.

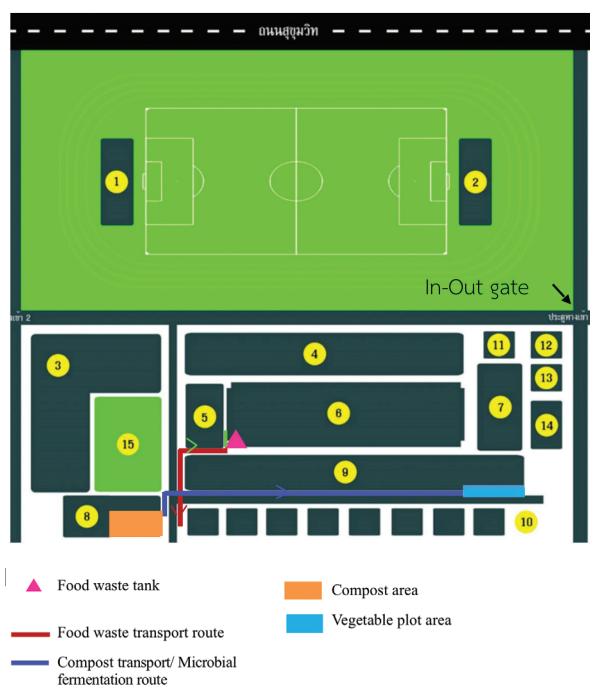


Figure 5 Areas for composting activities

In addition, the area is used for the fermentation process can be cultivated, such as vegetables, for selling back to the canteen shops, thus helping to generate revenue for the school. Growing vegetables should be included as a part of the learning activities.



(a) Examples of vegetable plots
Source: <https://40plus.posttoday.com/lifestyle/325/>



(a) Example of food waste bucket
Source: <http://wessenware.weloveshopping.com>



(b) Examples of various vegetable growing locations
Source: <http://www.thaihealth.or.th/Content/35578>



(b) Example of food waste cabinet
Source: <https://www.gotoknow.org/posts/95237/>

Figure 6 (a) and (b) Areas and activities for composting method

Figure 7 (a) and (b) Separation of food waste

Process

1. From the study, it was found that composting was the most beneficial method for solving the problems. Therefore, the separation of food waste benefits the ferment process. The canteen's officers should separate

food particles by using filters, can be seen in Figure 7 (a) and (b).

A grease trap is set up at a sink to trap food particles before being drained into the sanitary system, as shown in Figure 8.



(a) Examples of grease traps
Source: <https://pantip.com/topic/35866812>



(b) Examples of food waste separation containers
Source: <http://topicstock.pantip.com/home/topicstock/2009/02/R7573682/R7573682.html>

Figure 8 (a) and (b) Setting traps for food waste separation

2. The process of composting

In the compost process, a pound of fertilizer is made from the daily food waste. In one week (5 days), there are 5 pounds of fertilizer. In one month, the fermentation is done 3 weeks, and therefore there are 15 pounds of fertilizer per month. Finally, the compost is used for cultivating vegetables. The transport route of the food waste and the compost is shown in Figure 9. The process of composting is according to the following steps (Greenpeace, 2017).

(1) Prepare a canvas for composting into the compost areas, at the rear of building number 8. In addition, composting should be labeled as follows: Mon 1-Fri 1, Mon- Fri. 2, Mon- Fri 3.

(2) Transport the food waste to the compost areas.

(3) Prepare raw materials; i.e. (1) organic fertilizer and (2) clean water.

(4) Mix the water with the microorganisms.

(5) Use the canvas cover and stick the label number to the compost pile and leave it for 3 weeks.

(6) Put it in the shade to decrease heat.

(7) Cultivate vegetables.

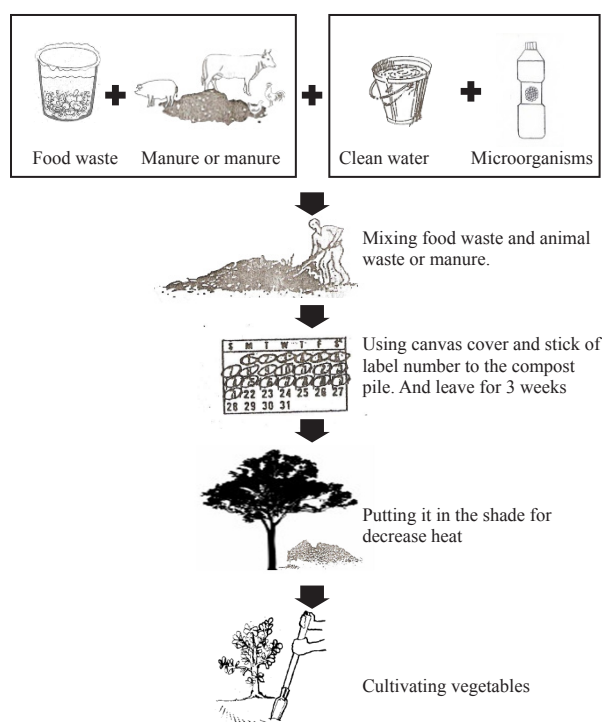


Figure 9 Display of the composting process
Source: Modified from <http://www.google.com>

To conclude this discussion, the food waste management at the Bang Lamung School canteen can be separated into 3 interesting issues, as follows.

(1) The existing problems of food waste in the school

Bang Lamung School is a large secondary school with a total of 2,534 people that daily dine at the school's canteen. The amount of food waste is about 180 liters per day, or 900 liters per week. The food garbage can be found everywhere in the school. In addition, the food garbage is a mixture of various kinds of plastic, i.e. tubes, mugs, and plastic bags, including the meat ball sticks and leaves. There is no separation of the garbage. At present, the school manages the food waste by hiring an outsourced organization to collect the waste daily at the expense of 20 baht per day (Monday - Friday), equal to 400 baht per month.

(2) Comparing the patterns of food waste management

Based on the reviewed literature, the paper compares 3 methods of food waste management, composting, biogas, and microorganisms. Using 900 liters of food waste, it was found that the composting uses fewer raw materials and equipment that can be found easily. It takes 21 days for the production process and costs only 1,069 baht. The output can be sold for 5 to 10 baht per kilogram, equivalent to 5,625 baht. The profit of this is 4,556 baht, followed by making biogas, which takes 30 days to complete and costs approximately 3,362 baht.

(3) Guidelines of the food waste management in school

The present paper introduces guidelines for waste management at the school as follows: (1) setting up the rear area of building number 9 for doing the composting activities; (2) separating the food waste by using filters; and (3) producing fertilizer with the daily food waste.

Suggestions

Some other aspects of managing the food waste in the canteen at Bang Lamung School are as follows:

1. In order to avoid wasting food, students should be asked by the food sellers how much food they want. If students want less, they will serve less food.

2. In order to achieve practical management, the food waste should be separated by types of waste.

3. In order to create maximum benefit, each approach is appropriate for the school at different levels. Besides choosing the composting approaches, the two

other approaches, microbial water and biogas, should be used together.

4. In order to achieve a sustainable environment, teachers should integrate the discussed activities into the lessons in the class, for example, agriculture activity classes and workgroups.

References

- Ckaewprasert, C. (2017). "Garbage, food waste... What are we losing and being affected". Retrieved August 15, 2018, from <https://www.facebook.com/Env.Training/posts/>.
- Department of Environmental Quality Promotion. (2015). *Success lessons in school management Zero waste school*. Ministry of Natural resources and Environment. 1st edition. Bangkok: Agricultural cooperative printing demonstrations of Thai co., Ltd.
- Ganghair, G. (2014). "Food waste overflowing the city" *Reduce and stop Dissolute eating*. Retrieved August 15, 2018, from <http://www.thaihealth.or.th/partnership/Content/26546-.html>.
- Greenpeace. (April 4, 2017). "Various organic fertilizer methods". Retrieved August 15, 2018, from <http://www.greenpeace.org/seasia/th/campaigns/eco-farming-for-our-food/eco-fertilizer/>.
- Sikhao, M. (2018). Horizontal Facility Management Concepts. Paper presented at the 6th National Conference on Chulabhorn Research Rajabhat University. Chom Bueng Rajabhat University "Agricultural Advances Thai Society for Sustainable Development" March 1, 2018. (1636-1644). Chulabhorn Research Rajabhat University
- Srijuntrapun, P. (2016). "Integrated Food Waste Reduction in Households." *Silpakorn University Journal Thai language magazine*, 36(3), 19-36
- Sucharitthanon, S. (1991). Waste. *Thai Encyclopedia for Youth, His Majesty's wishes*. 2018. Bangkok: Darnsutha Press.