

Choice of Food Waste Management for a Large Vegetable Market in Thailand

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Abstract—The food waste is the emerging issue from the growing global population and hence a need to ensure more food. The appropriate management of food waste is of great importance to minimize environmental burdens. For Thailand, 20 % of total solid waste generation was the fresh market and the lack of food waste management for vegetable market in Thailand is presented. Hence, this research was to develop the choice of food waste management for a large vegetable markets in Thailand. The result showed that cabbage and lettuce products were the primary process by cutting for food waste generation in this market. For the owner food waste management, these vegetable wastes were collected by the private sector for fertilizer production and animal feed. Moreover, the physical and chemical characteristics of food waste in this market were the high potential utilization and were acceptable with Thai soil quality standard for heavy metal contamination. Finally, the fertilizer, biogas and refuse derived fuel productions was the strong ability of utilization for food waste management of large vegetable market by the brainstorming with market owner, shop owner and research team.

Index Terms—Food waste management, large fresh market, large vegetable market, Thailand.

I. INTRODUCTION

The important problem in both developed and developing countries is the waste management issue. Food wastes represents a significantly fraction of municipal solid wastes [1]. One-third of the food produced for human consumption is lost along the food supply chain, which includes unconsumed food that is discarded by food processing industries, retailers, restaurants, and consumers [2], is the single largest component of the waste stream worldwide. The wasting of food is the growing global population and hence a need to ensure more food [3]. Climate and environmental

change will result in the increasingly unpredictable and difficult production of food in the years to come. It's a challenge to answer the question of how to make food production more environment friendly (sustainable) and more flexible to feed more people more efficiently [4]. Hence, the appropriate management of food waste is of great importance to minimize environmental burdens.

Although food wastage occurs at all stages along the food supply chain, later stages such as households and the retail sector play a major role in industrialized countries [5]. In Thailand, 20 % of total solid waste generation was the fresh market and was the second largest solid waste generator after households [5]. Scholz *et al.* [6] reported that the average carbon footprint per ton of food waste from the supermarket store in Sweden was 1.6 t CO₂e. Moreover, the fresh fruit and vegetables were responsible for 85% of the wasted mass, amounting to 74 t per store and year. The option for food waste management of fruit market of Thailand was developed by Puangkeaw *et al.* [7]. The lack of food waste management for vegetable market in Thailand is presented.

Presently, number of technologies of food waste management can transform composting and anaerobic digestion to value-added nutrient products [8]. Only in European country recommended the guidelines on disposal technologies including reduce food waste, redistribute, recycle, compost, recover energy and landfill [9]. Hence, this research was to develop the choice of food waste management for a large vegetable market in Thailand. The value, physical and chemical characteristic and food loss value of a large vegetable market were determined for proposing the choice of food waste management.

II. MATERIAL AND METHODS

A. Situation Analysis of a Large Vegetable Market

A case study in this study is large vegetable market in Thailand where located in the Ratchaburi province. Various vegetable products were transported to the trade show for cutting without rejection ex. leaves outside of the cabbage etc. The vegetable product from the cutting process was collected by the plastic box before sale. The high volume of food waste from the cutting process was found and managed by this market.

B. Food Loss and Waste Value of a Large Vegetable Market

The generation of food waste in a large vegetable market was conducted by interview, observation and weighting in the market for three days. The values of food loss and food

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waste in this market were identified by record forms for proposing the choice of food waste management in the next step.

C. Physical and Chemical Characteristic of Food Waste

The vegetable waste from this market was systemic sampled for the representative of original source for determining the physical and chemical characteristics of food waste. The detail of sampling was following:

- 1) The 1-2 m³ volume of vegetable waste was sampled from the collector point in the morning (9.00 am) and afternoon period (5.00 pm).
- 2) The food waste sample was plied and mixed on the insulator.
- 3) The mixed food waste sample was separated in four quarters and then was selected by two quarters. The selected sample was plied for homogeneous sample.
- 4) The quartering process was continuing to 10 kg of sample. The physical characteristics of food waste sample including volume and density was recorded.
- 5) The chemical characteristics of food waste including moisture, total solid, volatile solid, ash, carbon, hydrogen and heavy metal values were analysis.
- 6) All analyses were carried out in duplicate according to standard procedures [10].

D. Choice Development of Food Waste Management

- 1) The information from all steps including situation analysis of a large vegetable market, physical and chemical characteristic of food waste and food loss and waste value of a large vegetable market was synthesis and developed for choice of food waste management.
- 2) The brainstorming workshop with the environmental, market management, technology management experts and market owner was conducted for selecting and suggesting the potential choice of food waste management. The selecting choice of food waste management was studied the potential of application in the next part of the research.

III. RESULT AND DISCUSSION

A. Situation of Food Loss and Waste in a Large Vegetable Market

From the real survey in a large vegetable market (Table I), the vegetable production was transported at the shop by various farmers and middle man. Ten tons of vegetable productions per day were sold by eleven whole sale shops in this market. The main vegetable product in this market was cabbage and lettuce and was from the northern part of Thailand. The fresh vegetable product was cutting for removing the poor quality during transportation and harvesting. Twenty and twenty-five percents of production loss were found in the cabbage and lettuce product, respectively. The vegetable waste from this process was collected by the private sector for fertilizer production and animal feed.

The characteristic of food waste and loss generation are shown in Fig. 1-2.

TABLE I: THE FOOD LOST AND WASTE IN A LARGE VEGETABLE MARKET

Vegetable types	Total Product (Kg/day)	Total Food waste (Kg/day)	Loss Percentage (%)
Cabbage	4,500	900	20
Lettuce	5,500	1,375	25



Fig. 1. Characteristic of food waste generation in a large vegetable market.



Fig. 2. Characteristic of food loss generation in a large vegetable market.

B. Characteristic of Food Waste in a Large Vegetable Market

Table II presented the physical and chemical characteristic of food waste in a large vegetable market. The results showed that the values of density, moisture, volatile solid, ash, carbon, hydrogen, and total solid were 154 kg/m³, 96 %, 23.46%, 74.62 %, 18.56 %, 18.56 % and 4.5 %, respectively. For health metal values including cadmium, chromium, lead, arsenic and zinc contamination in the vegetable waste found that the values of all health metal was acceptable with the soil quality standard form Thai National Environmental Committee [11]. Hence, the food waste of this market should be applied for fertilizer and biogas production.

C. Choice of Food Waste Management in a Large Vegetable Market

From the result of situation analysis of a large vegetable market, physical and chemical characteristic of food waste and food loss and waste value of a large vegetable market with the recommendation of guidelines on disposal technologies from European country [9] and the brainstorming with environmental, market management, technology management experts and market owner was proposed the three choices of waste management in a large

vegetable market following:

- 1) Fertilizer production: the finding of high carbon value (> 8 %) in this food waste was strongly enough for material of soil amendment. In additional, the heavy metal contamination of this food waste was low value. Hence, the potential of this choice was high performance with low cost operation [12].
- 2) Biogas production: the potential choice of food waste management with biogas production in this waste was high performance with the high carbon value for biodegradation to energy production [13]. However, the issue of operation cost and environmental impact were concerned.
- 3) Refuse Derived Fuel (RDF) production: this choice is the novel model of food waste management for energy production. The improvement process of food waste from solid waste to heat energy was found in this choice [14]. The food waste in this market was transported to the private company. However, the waste collection system and transportation was generated for this choice support.

TABLE II: CHARACTERISTIC OF FOOD WASTE IN A LARGE VEGETABLE MARKET

Parameters	Values
Density (kg/m ³)	154
Moisture (%)	96
Volatile solid (%)	23.46
Ash (%)	74.62
Carbon (%)	18.56
Hydrogen (%)	18.56
Total solid (%)	4.5
Heavy metal (mg/kg)	
- cadmium	9.12
- Chromium	16.91
- Lead	12.30
- Arsenic	18.90
- Zinc	13.20

IV. CONCLUSION

This research was to develop the choice of food waste management for a large vegetable market in Thailand. The result showed that the main of vegetable product for the cutting process was cabbage and lettuce. For the food and food waste found that vegetable waste from this process was collected by the private sector for fertilizer production and animal feed. Moreover, the physical and chemical characteristics of food waste in this market were the high potential of application and were acceptable with the soil quality standard in the issue of heavy metal contamination.

Finally, the fertilizer, biogas and refuse derived fuel productions were the high ability approach in the real situation for food waste management of vegetable market. However, this finding was the preliminary study of food waste management in this market. The advanced analysis in the cost operation and environmental impact should be concerned.

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