PROGRESS IN ENGINEERING APPLICATION AND TECHNOLOGY
e-ISSN: 2773-5303

PEAT

Vol. 6 No. 1 (2025) p. 698-703
https://publisher.uthm.edu.my/periodicals/index.php/peat

Food Waste Management System

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DOI: https://doi.org/10.30880/peat.2025.06.01.074

Article Info

Received: 20 January 2025
Accepted: 07 February 2025
Available online: 30 April 2025

Keywords

Food Waste, Fertilizer, Compost, Dashboard

Abstract

Employees in a workplace that located in Bayan Lepas, Penang are encouraged to sort waste according to the labels. This project is about to develop a simple dashboard system to manage food waste in the workplace, with the aim of reducing food waste caused by improper disposal. The project emphasizes on the daily tracking food waste so that the waste that being generated is monitored. The developed dashboard system (Food waste Management System) able to displays the pattern of generated food waste, showing whether it increases or decreases on a monthly basis. To reduce daily food waste to be sent to landfills, the workplace has implemented a composting system, where food waste is sent to a vendor so that the food waste can be converted into fertilizer. At the end of each month, the vendor will return the processed fertilizer to the workplace. Food Waste Management System is developed using Microsoft Excel. The findings show that food waste can be effectively managed, and the flow of waste can be clearly monitored through the dashboard. Within the given time, potential users' feedback has been gathered to ensure that the dashboard can be used efficiently. Vendors' information is added on the dashboard including date and receipt number. Additionally, Greenhouse gas (GHG) emissions related to food waste dashboard also were create. To measure the usability of the dashboard among Environmental Health and Safety (EHS) employees, the System Usability Scale (SUS) analysis toolkit was used. The finding of SUS analysis showed that the performance of Food Waste Management System is satisfactory as it effectively contributes to better food waste management at the workplace and providing a useful tool for tracking waste and its environmental impact.

1. Introduction

The government faces a tremendous task in collecting and properly disposing of the thousands of tons of food waste produced in Malaysia every day, ensuring a clean and fresh environment. If food waste is not properly disposed or recycled, it harms the environment. Food waste also is currently capturing the interest of local, national, and European politicians, international institutions, non-governmental organizations (NGOs), and researchers from a variety of disciplines. Millions of tons of organic garbage are degrading in landfills, releasing a potentially hazardous liquid known as leachate, which pollutes our rivers and seas. Food security and environmental impacts, such as resource depletion and greenhouse gas emissions attributed to food waste are increasing concern. Furthermore, this organic waste emits greenhouse gases including nitric oxide and methane,

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which are 21 times more potent than carbon dioxide [1]. Food waste is any edible substance that is discarded, misplaced, or uneaten along the food supply chain. This waste happens at all stages, including manufacturing and processing, distribution, consumption, and disposal. It includes not only food that spoils or rots before it can be consumed, but also food that is abandoned due to cosmetic flaws, overproduction, or inefficient distribution systems. Effective food waste management requires a diversified approach that addresses all phases of the food supply chain. This includes efforts to reduce food waste at the source through better production procedures, improved distribution and storage techniques, consumer education and behavior change campaigns, and the development of innovative food preservation and utilization technology.

By repurposing food waste into the organic fertilizer, it is a sustainable solution, promoting environmental responsibility and resource efficiency. Every year, one-third of the food produced for human consumption is lost or wasted [2]. The organic fertilizer from the food waste can help minimizes the need for chemical fertilizers, which may be harmful to the environment and human health. Moreover, it will provide a sustainable solution by keeping food waste out of landfills, where it would otherwise increase greenhouse gas emissions to address the growing problem of food waste.

Furthermore, developing the food waste management in the workplace can help the organization to make the improvement of the food waste, track monthly changes enables ongoing monitoring and assessment, facilitating informed decision-making and continuous improvement in waste management practices. It also helps contributes to the company's overall waste production reduction, which lowers disposal and management costs. The firm may identify major inefficiencies, such overproduction or excessive plate waste, and take focused action to fix problems by putting in place a systematic system to monitor and manage food waste.

Creating a complete platform that collects, analyses, and reports on food waste data is the first step in developing a management system (dashboard) for food waste. The main reason or factor that contribute to the food waste in the service sector such as consumers leave uneaten food on the plate, consumers' 12 preference for given menu items, and overproduction due to inaccurate forecasting of consumers' demand [3]. Thus, raising customer awareness would therefore seem to be a clear way to prevent food waste. However more recently, technological advancements have made it possible for businesses to quantify the data they collect on food waste [4].

Food waste is a growing worldwide concern because of its effects on the economy, society, and environment. Furthermore, as food comes from agriculture and is wasted while energy is used throughout its life cycle, food waste and climate change are related. Moreover, food preparation, shipping, preservation, and cooking all include energy use and the corresponding greenhouse gas emissions [5].

The used of dashboard nowadays are growing demand for sustainability management and reporting [6]. It will show to the users identify trends, patterns, anomalies and help them guide toward effective decisions [7]. According to Smith (8), there are three main uses for data dashboards: strategic, analytical, and operational. All the uses have different purpose to use. Strategic dashboards are used to give management a top-down perspective of a program's or organization's success.

2. Methodology

A methodology provides a techniques and the process of the research to collect data.

2.2 Dashboard Development

A Microsoft Excel-based on food waste inventory dashboard was developed to track food waste trends. Firstly, the food waste data were collect every day at canteen, level 2 and level 4 at the workplace. The data were taken from the logbook that has been put at every location stated. Therefore, all data were recorded into the Microsoft Excel every day. In pre-development dashboard, there have several items such as collection dates, waste quantities at every location, quantity generated per day and quantity collection by vendor. The data were generated into graph. The data assists in identifying patterns in waste generation and assessing the impact of waste reduction initiatives. The discussions with supervisor have been made to make improvement of the dashboard. Figure 1 shows the flowchart of the pre-development process for the food waste inventory dashboard and Figure 2 shows dashboard of data food waste collected.

Fig. 1: Flowchart of the dashboard development process for the food waste inventory dashboard.

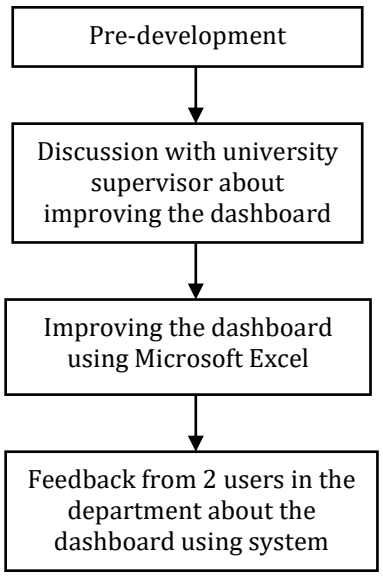

Fig. 2: Dashboard of data food waste collected

FOOD WASTE INVENTORY 2024								
	Date	Quantity (kg)						
		Kitchen	L2 Pantry	L4 Pantry	Coffee Waste	Qty Generated/Day	QTY collection (PREFERENCE)	
	3/22/2024	63.55	1.04	1.2	9.29	75.08	63.55	
	3/23/2024	55.55				55.55		WEEKEND
Week 13	3/24/2024	51.9				51.9		WEEKEND
	3/25/2024	63.5	1.13	1.4		66.03	63.5	NO WASTE
	3/26/2024	28.8	1.22	1.9	5.5	37.42	37.42	
	3/27/2024	40.5	0.965	1.75		43.215	43.215	NO WASTE
	3/28/2024	39.3	1.5	1.1	2	43.9	43.9	
	3/29/2024	34.65	0.815	1.3	8.85	45.615	45.615	
	3/30/2024	28.1				28.1	28.1	WEEKEND
Week 14	3/31/2024	50.85				50.85	50.85	WEEKEND
	4/1/2024	29	0.785	1.1	1.36	32.245	32.25	
	4/2/2024	34.9	1.02	1.9		37.82		NO WASTE
	4/3/2024	26.55	1.72	1.13	7.02	36.42	74.24	
	4/4/2024	36.5	1.565	1.4	1.535	41		
	4/5/2024	43.7	1.08	1.5		46.28	87.29	NO WASTE
	4/6/2024	37.1				37.1		WEEKEND
						0		
Week 15	4/7/2024	34.9				34.9		HARI RAYA
	4/8/2024	19.8				19.8	91.8	HARI RAYA
	4/9/2024	39.45				39.45		HARI RAYA
	4/10/2024					0		HARI RAYA
	4/11/2024					0		HARI RAYA
	4/12/2024					0		HARI RAYA
	4/13/2024					0		HARI RAYA
						0		

2.3 Greenhouse Gas Emission Food Waste

In tracking GHG emissions related to food waste is a crucial step in reducing the company's overall carbon footprint and aligning with its sustainability objectives. The GHG emissions from food waste were collected from the NXMAP website, a platform designed to track and report environmental data. Moreover, it is carbon accounting platform that meticulously tracks, measures, and analyses energy, water, and waste performances. The data provided by NXMAP offers an accurate and current overview of the emissions generated by food waste within the organization. This information is essential for identifying trends and patterns in food waste, understanding its contribution to overall emissions, and finding opportunities to minimize waste and improve resource management.

Moreover, the integration of food waste GHG emissions data into the dashboard supports the organization's commitment to sustainability. It allows decision makers to make informed choices about waste reduction practices and provides a clear way to measure progress toward environmental goals. The data-driven

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approach improves the EHS team's effectiveness and shows the organization's dedication to lowering its carbon footprint and supporting environmental protection efforts.

3. Results and Discussion

Result of food waste inventory dashboard complete developed. Data of the food waste have been keyed in and the dashboard is well-function.

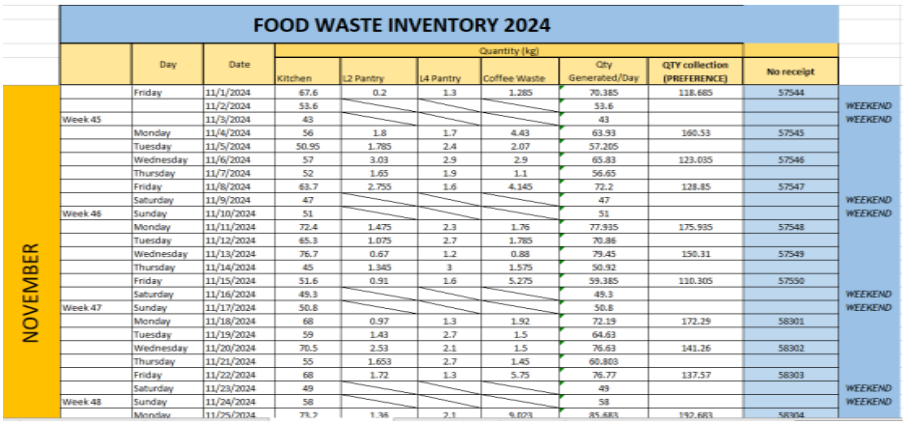
3.1 Food Waste Generation

The food waste was generated starting to make the compost at March 2024. From the data that was generated, it will help to see the track and assist in reducing the amount of food waste in order to manage the unacceptable quantity of food waste that ends up in landfills. In order to achieve sustainable development and environmental protection, the food waste collection process ensures that waste is gathered daily from multiple locations, weighed accurately, and tracked efficiently in the dashboard. The dashboard shows the details of food waste quantities recorded for each month, indicating patterns such as increased waste during peak dining periods and reductions during holidays. The insights from the collected data highlight areas where waste can be minimized

3.2 Improvement of Food Waste Inventory Dashboard

Information that displayed through dashboard's interface may provide a clear understanding that produced waste such as cafeterias, individual employee habits, meetings and events, pantry and kitchen areas. Figure 3 and Figure 4 illustrated the improvements made to the food waste inventory dashboard. The updates include the addition of the day and the receipt number collected by the vendor (Preference), which makes it easier to view and track the data. The receipt number is particularly important for auditing purposes and for verifying payments made each month.

***Fig. 3*:** Improvement of food waste inventory dashboard generated by day



FOOD WASTE INVENTORY 2024

		Day	Date	Quantity (kg) Kitchen	L2 Pantry	L4 Pantry	Coffee Waste	Qty Generated/Day	QTY collection (PREFERENCE)	No receipt	
NOVEMBER		Friday	11/1/2024	67.6	0.2	1.3	1.285	70.385	118.685	57544	
			11/2/2024	53.6				53.6			WEEKEND
	Week 45		11/3/2024	43				43			WEEKEND
		Monday	11/4/2024	56	1.8	1.7	4.43	63.93	160.53	57545	
		Tuesday	11/5/2024	50.95	1.785	2.4	2.07	57.205			
		Wednesday	11/6/2024	57	3.03	2.9	2.9	65.83	123.035	57546	
		Thursday	11/7/2024	52	1.65	1.9	1.1	56.65			
		Friday	11/8/2024	63.7	2.755	1.6	4.145	72.2	128.85	57547	
		Saturday	11/9/2024	47				47			WEEKEND
	Week 46	Sunday	11/10/2024	51				51			WEEKEND
		Monday	11/11/2024	72.4	1.475	2.3	1.76	77.935	175.935	57548	
		Tuesday	11/12/2024	65.3	1.075	2.7	1.785	70.86			
		Wednesday	11/13/2024	76.7	0.67	1.2	0.88	79.45	150.31	57549	
		Thursday	11/14/2024	45	1.345	3	1.575	50.92			
		Friday	11/15/2024	51.6	0.91	1.6	5.275	59.385	110.305	57550	
		Saturday	11/16/2024	49.3				49.3			WEEKEND
	Week 47	Sunday	11/17/2024	50.8				50.8			WEEKEND
		Monday	11/18/2024	68	0.97	1.3	1.92	72.19	172.29	58301	
		Tuesday	11/19/2024	59	1.43	2.7	1.5	64.63			
		Wednesday	11/20/2024	76.5	2.53	2.1	1.5	76.63	141.26	58302	
		Thursday	11/21/2024	55	1.653	2.7	1.45	60.803			
		Friday	11/22/2024	68	1.72	1.3	5.75	76.77	137.57	58303	
		Saturday	11/23/2024	49				49			WEEKEND
	Week 48	Sunday	11/24/2024	58				58			WEEKEND
		Monday	11/25/2024	73.2	1.36	2.1	9.023	85.683	192.683	58304	

***Fig. 4*:** Improvement of food waste inventory dashboard generated by month

FOOD WASTE INVENTORY 2024

Month	Quantity (kg) Kitchen	L2 Pantry	L4 Pantry	Coffee Waste	Qty Generated	QTY collection (PREFERENCE)	
March	1865.87	25.121	31.35	67.5	1989.841	479.75	Start collected by vendor
April	1034.5	29.003	26.33	47.199	1137.032	1137.03	Hari Raya
May	1288.07	46.24	32.1	60.987	1427.397	1427.297	
June	1083.3	34.49	29.8	62.784	1210.37	1147.87	Raya Haji
July	1525.48	29.913	41.5	85.181	1682.97	1744.57	
August	1529.07	39.395	44	88.733	1701.2	1671.04	
September	1199.4	22.394	37.9	62.638	1322.332	1352.532	Deepavali
October	1813.545	46.51	42.96	63.56	1966.575	1918.28	
November	1722.15	31.063	42.2	57.533	1852.946	1901.238	
December							

3.3 Greenhouse Gas Emissions of Food Waste Disposal by Monthly Result.

When food waste is composted, the GHG emissions associated with it are significantly different from when it's s Table 1 shows the quantity of food waste (kg) and the GHG emissions (kg (CO_2e) over the months. The GHG emissions in kg CO_2e represent the amount of carbon dioxide equivalent emissions (CO_2e) produced as a result of food waste disposal. Figure 5 shows the graph that have been generated according to the data.

Table 1: Quantity result generated by monthly GHG emission food waste.

Food Waste Inventory by Preference 2024		GHG Emission Food Waste
Month	Quantity Out (KG)	KG CO2
March	479.75	329.0131 kgCO2e
Apr	1137.03	188.0039 kgCO2e
May	1427.397	236.0156 kgCO2e
June	1147.87	192.4716 kgCO2e
July	1744.57	288.4585 kgCO2e
Aug	1671.04	281.2875 kgCO2e
Sept	1327.632	218.6426 kgCO2e
Oct	1918.28	317.1809 kgCO2e
Nov	1901.238	1300.8060 kgCO2e
Dec	2029.014	1984.464 kgCO2e

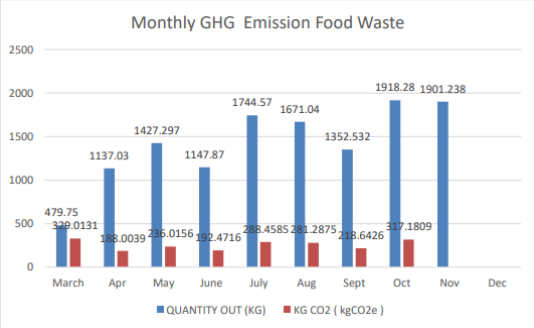


Fig. 5: The graph of quantity out of food waste and GHG emission food waste.

3.4 Result Feedback from User Using System Usability Scale (SUS)

The SUS results were collected from two workers in the EHS Department, who are responsible for inputting data into the dashboard. The primary objective of this questionnaire is to see the effectiveness of the improvement food waste dashboard. The indicate level of agreement with the following statements by choosing a rating from 1 to 5, where is: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The data shows in Figure 6 graph between user 1 and user 2 feedback SUS.

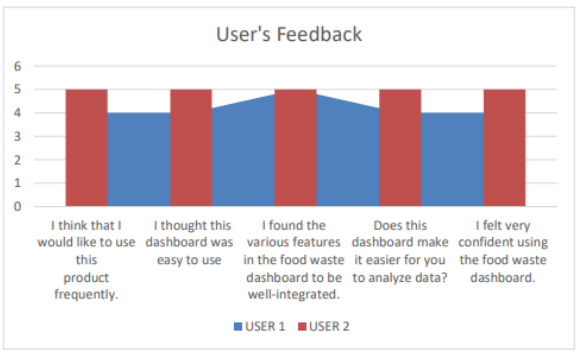


Fig. 6: Graph between user 1 and user 2 feedback SUS.

Mostly the user feedback is answered agree and strongly agree. It indicates that they find the dashboard useful and would be willing to use it regularly. Positive responses suggest that the dashboard meets their needs and preferences, making it a valuable tool.

4. Conclusion

In conclusion, the project successfully developed a dashboard to manage food waste at the workplace, improving understanding of food waste trends through visual graphs. Key information, such as dates and reasons for missed collections, was displayed clearly. After discussions with the supervisor, the dashboard was enhanced to include data on greenhouse gas emissions. Usability testing with the SUS questionnaire confirmed that users found the dashboard helpful and would be willing to use it regularly.

Acknowledgement

The author expresses gratitude and appreciation to the Faculty of Engineering Technology (FTK) at University Tun Hussein Onn Malaysia (UTHM) for significant role in the completion of this project.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

Nur Ain Afiqah Binti Azhar confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation; 'Ezrin Hani binti Sukadarin' assist with the data interpretation and revising the manuscript.

References

[1] Wanghu S., Y. S. (2023). Research on Biomass Waste Utilization Based on Pollution Reduction and Carbon Sequestration. *Sustainability*, *15*(5), 4535, https://doi.org/10.3390/su15054535

[2] Mat Sulaiman, N. S., Rahim, S. M., Jopry, N. U., Roslan, A., Mohamad, A. S., Irwandy, H. A. A., & Hashim, N. (2023). Conversion of Kitchen Food Waste to Halal Organic Fertilizers. *Journal of Wastes and Biomass Management (JWBM)*, *5*(1), 08-14, http://doi.org/10.26480/jwbm.01.2023.08.14

[3] Ferreira, L. D. V. (2022). *The dangers of leaving food leftovers on your plate: consumer behavior and food plate waste* (Doctoral dissertation). http://hdl.handle.net/10400.14/38439

[4] Martin-Rios, C., Hofmann, A., & Mackenzie, N. (2020). Sustainability-oriented innovations in food waste management technology. *Sustainability*, *13*(1), 210. https://doi.org/10.3390/su13010210

[5] Sun, W., Sun, Y., Hong, X., Zhang, Y., & Liu, C. (2023). Research on Biomass Waste Utilization Based on Pollution Reduction and Carbon Sequestration. *Sustainability*, *15*(5), 4535. https://doi.org/10.3390/su15054535

[6] Shields, M., & Shelleman, J. (2020). Dashboards for sustainability management and reporting. *Journal of Environmental Management, 274*, 111138.

[7] Brath, R., & Peters, T. (2004). The benefits of dashboards for decision making: A guide to designing successful business intelligence systems. *Business Intelligence Journal, 9*(4), 22-28.

[8] Smith, C. (2013). Data dashboards for strategic, operational, and analytical purposes. *Business Intelligence Review, 15*(2), 54-60.