MINIMIZE VEGETABLE WASTAGE AT HOUSEHOLD STORAGE: A PILOT STUDY USING A REMINDER NOTIFICATION APPROACH

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Abstract

Food wastage at the household level is a substantial contributor to the overall challenge of global food waste. Recognizing the significance of minimizing vegetable waste in households, this study delves into the complexities of vegetable wastage at the household storage level. The primary objective is to devise strategies for reducing vegetable wastage by providing guidelines for storage arrangements at the household level, employing a reminder notification approach as a central intervention. The research methodology employed a purposive sample technique, selecting fifty households engaged in weekly vegetable purchases from the *Matara* and *Kamburupitya* DS divisions. Data collection involved the administration of structured questionnaires. As part of the intervention, the project introduced a three-color scheme for organizing vegetables within refrigerators. The study unfolded in two phases: an initial examination of current vegetable storage practices in households followed by the implementation of the reminder notification approach, with subsequent evaluation of its impact on vegetable storage practices. The findings of the study illuminated a positive correlation between the color-coded system and heightened participant awareness regarding the freshness of vegetables in the refrigerator. Furthermore, the results underscored the significant and favorable impact of the reminder notification approach on reducing vegetable wastage at the household storage level.

Keywords: *Notification, Refrigerator, Reminder, Storage, Vegetable, Wastage*

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1. Introduction

Vegetables provide many vitamins and minerals which are essential for the growth and development of the body (Dias, 2011). Among the plants, vegetables stand out as excellent sources of minerals. Minerals are vital components of the diet, supporting the normal metabolic activities of body tissues (Rumeza *et al*., 2006). Vitamins are essential organic nutrients in our meals, utilized by our body's cells for proper growth, development, prevention of deficiency disorders and to enhance the efficiency of the immune system (Farhan Aslam *et al.*, 2017). In Sri Lanka, vegetables are affordable and abundant, leading to a higher consumption of vegetables over fruits for nutritional needs (Bandara *et al.,* 2021). A significant portion (16-40%) of vegetable production in Sri Lanka is wasted post-harvest due to issues like inadequate packaging, transportation, and storage facilities (Antonio and Easdown, 2015). Additionally, modern lifestyles with fast-paced schedules and diverse work patterns pose challenges to food-saving goals, as limited time for frequent shopping leads to bulk vegetable purchases requiring proper storage for quality maintenance. Limited time for frequent shopping leads people to purchase vegetables in bulk, requiring proper storage to maintain quality (Ananda, Karunasena and Pearson, 2022).

Household food waste, comprising 61% of total waste, raises environmental and socio-economic concerns. Fresh fruit and vegetables contribute to almost 50 % of food wasted by households (Laurentiis, Corrado and Sala, 2018). Vegetables exhibit the highest loss rate among food categories. Strategies such as minimizing household food waste are crucial, particularly during economic crises. Vegetable waste arises during cooking, processing, consumption, and storage due to factors like poor conditions and misarrangement. Understanding the shelf life of different vegetables and consuming them accordingly can significantly cut down on wastage. Various countries use methods like notifications, storage arrangements, light alarms etc. to reduce vegetable waste from poor storage at household level, but such practices are rare in Sri Lanka. Parfitt, Barthel and Macnaughton (2010) reported that improving food labeling and enhancing consumer understanding of labeling and food storage can significantly contribute to reducing food waste. This pilot study in *Matara* District investigates the impact of reminder notifications on reducing household vegetable wastage at storage. It employs a traffic light system to guide users in making informed choices about vegetable consumption based on alerts they receive.

2. Literature Review

Food waste encompasses discarded, uneaten, or spoiled food including leftovers and food left to spoil (Nunkoo, Bhadain and Baboo, 2020). Also, food loss can occur in upstream stages (before consumption) and food waste can occur in downstream stages (Retailer or consumption level) of the supply chain (Luo *et al.*, 2022).

Food waste can vary from one country or culture to another. For instance, whereas animal offal is regarded as food waste in certain cultures, it is seen as food in others. Personal habits also influence food waste, as an example, some people do not like to eat apple peels and bread crusts. In the end it goes to waste. Due to changing lifestyles, rapid industrialization and socio-economic and demographic changes, the food waste at the household level has been increasing over the past years (Nunkoo *et al*., 2020).

Considering quantity of household food waste, protein from plant sources and carbohydrates are the most wasted food in households. There are different techniques for preservation of food and among those methods refrigeration is the most used method of food preservation (Busari *et al*., 2022). According to the findings of Stancu *et al*. (2016) indicate that there is a significant connection between food waste and household economics, suggesting that individuals are more influenced by self- interest in their food waste practices.

Understanding the factors influencing consumer food waste behavior at the household level is crucial for improving food management as explained by Pellegrini and Sillani (2019). Price consciousness, environmental concern and time management influence attitudes, which, in turn, affect food waste behavior. According to Hebrok and Boks (2017), food wastage is a complex, influenced by shopping, storing, cooking, and eating. Furthermore, improper purchase planning, excessive cooking, overstocking and mis-understanding the labels like "best before" and "use by" dates are the factors contribute to the disposal of food that could still be consumed, leading to unnecessary waste (Xue and Liu, 2019).

The refrigerator is most popular method used in many Sri Lankan households, serving as a prevalent means for storing a variety of foods and contributing to the convenience of food preservation (Jayasekara, 2021). The domestic refrigerator is divided into different compartments. They are fresh food compartment, a frozen food compartment and a crisper. The fresh food compartment accommodates a variety of items, from perishables like meat and fish to prepared foods and dairy products. The frozen food compartment is designated for freezing and storing items like frozen desserts, cheeses and processed meats. The crisper focuses on preserving the freshness of fruits and vegetables by minimizing dehydration (Mascheroni and Salvadori, 2011). Farr-wharton *et al*. (2014) states that the storage is the most critical practice to address when aiming to reduce food waste, and that consumers should be able to better organize food storage.

In today's fast-paced lifestyles, consumers often neglect the organization of their refrigerators and struggle to find time to manage their food products. The lack of awareness and memory of people leads to food wastage. Recognizing this, the focus on creating solutions that offer simple and user-friendly methods for reminders becomes important (Fridge, 2013). Household fridges extend food shelf life but can lead to food wastage due to stockpiling and forgotten items pushed to the back. This underscores the importance of minimizing such behaviors to reduce food waste (Schneider, 2008; Farr-wharton and Foth, 2014).

Users often neglect to monitor the expiration dates or freshness of food items stored in a refrigerator unless they individually inspect and track them. This lack of awareness is particularly concerning for products without explicit expiration dates, leading to significant food spoilage and additional expenses for users (Nasir *et al.*, 2018).

Farr-wharton and Foth, (2014) employed FridgeCam to reduce food stockpiling by enhancing consumer knowledge of their food supply, while the Color Code Project increased consumer awareness of food item locations to encourage consumption of forgotten foods. Also cooking classes, fridge cameras, food sharing apps, information campaigns, advertising and information sharing like methods are

also recommended to reduce food waste (Reynolds *et al.*, 2019). Other than that, the smart refrigerator system with proactive alerts is one of the best solution for minimize food wastage. Notifying users about the duration of stored food and issuing warnings upon reaching set limits enhances food management, minimizing the risk of spoilage and reducing food waste (Nasir *et al.*, 2018).

According to Schneider (2008) he suggests ways to prevent food waste, such as utilizing shopping lists, emphasizing rational food portion sizes, understanding the financial value of wasted food, educating about creative uses of food residues and general food waste awareness training. Also the project carried out by Geremy Farr-Wharton and Marcus Foth (2012) using color coding schemes in refrigerator to reduce food wastage. There are specific colors used for different types of food. Those are green for produce, white for dairy, yellow for condiments, red for meat, clear for bread, baked goods, and blue for drinks and black for leftovers. In this study, consumers were encouraged to store the type of food corresponding to the color in the refrigerator shelves by pasting specific color sheets. To facilitate easy reference, a „map" illustrating this configuration was created and printed on an A4 sheet, then pasted on the front of the fridge. By this when opened the refrigerator door by any household member, and helped to quickly find the required type of food based on the prescribed color scheme. This visual and organized approach has been a simple yet effective strategy to improve awareness and reduce the risk of food waste.

Hebrok and Boks, (2017) emphasize the importance of understanding the environmental and economic impacts of food waste to motivate individuals to take action. Awareness of resources and energy used in food production and disposal encourages waste reduction efforts. Financial considerations, highlighted by (Reynolds et al., 2019), such as the cost of vegetables and potential savings from waste reduction, significantly influence household waste reduction efforts...

Quested et al., (2013) highlight that using subtle nudges such as visual prompts on refrigerator doors or near waste bins, influence to reduce vegetable wastage. Color-coded labels indicating freshness status can prioritize consumption based on expiration dates.

3. Methodology

The study was conducted in *Matara* and *Kamburupitiya* DS divisions. The targeted consumers purchasing vegetables weekly in urban and rural areas, with a sample size of 50 households evenly distributed, with 25 households in each division. Data collection occurred in two stages. In stage 01, a preliminary assessment was conducted using a questionnaire comprising structured (multiple choice and Likert scale) and unstructured questions. At the same time, the reminder notification approach was implemented and vegetable storage record sheets and stickers were distributed. Vegetables are categorized based on perishability and using traffic Light color code system for these three categories of vegetables. According to that, red color stickers for vegetables which are very close to use (Leafy vegetables), yellow for close to use vegetables (beans, eggplant etc.) and green for vegetables which have time to use (potato, beetroot etc.) were also distributed. In stage 02, vegetable storage record sheets were collected and utilizing a second questionnaire to assess the impact after three weeks. Data in this study was analyzed with both descriptive and inferential

statistics. In this study Wilcoxon Sign rank test and Paired T-Test were used as non - parametric statistical tool.

4. Results and Discussion

The consumer profile reveals most participants are female, likely due to their roles in meal preparation and shopping. Age-wise, the largest group is over 51 (42%), with 31-40 year-olds being the least represented (14%). Income levels mostly range from 50,000 to 100,000 per month, with the 35,000-50,000 bracket next. Occupation-wise, many work in the public sector. Households typically have 4-6 members (52%), followed by 1-3 (34%) and over 6 (14%).

Table 1: Responses for demographic characteristics

Factor	Category	Frequency	Percentage
Gender	Male Female	2	4%
		48	96%
Age	<30 years	9	18%
	31-40 years	7	14%
	41-50 years	13	26%
	>51 years	21	42%
Income Level	< Rs.35000	2	4%
	Rs.35000- 50000	13	26%
	Rs.50000- 100000	24	48%
	>Rs.100000	11	22%
Occupation	Public sector	30	60%
	Private sector	9	18%
	Self Employed	4	8%
	Not Employed	7	14%
Household size	1-3 members	17	34%
	4-6 members	26	52%
	>6 members	7	14%

Source: Authors "own survey data (2023)

Most consumers visit the market weekly, mirroring their vegetable storage habits, with nearly all storing vegetables for a week. One household store them for just three days. Refrigeration is the most use method for vegetable storage, though some use additional methods. The study found that 96% of consumers store vegetables separately to minimize spoilage, while 4% store them together. Based on the storage mode employed, the results are categorized into four types: plastic boxes, polythene bags, paper bags, and without bags. A significant majority of consumers option for polythene bags to store vegetables, while others prefer plastic boxes. Notably, none of the participants utilize paper bags for vegetable storage. Additionally, a portion of respondents do not employ any specific mode for storing vegetables in the refrigerator. Same as this, in a study conducted by Kaur *et al*. (2013) it was observed that a significant majority of respondents opted for the use of shopping bags or zip lock bags as their preferred method for storing fruits and vegetables.

Table 2: Responses for present situation of vegetable storage

Factor	Category	Frequency
Frequency of going to market	Once a week	44
	Once in 2-3 days	6
Vegetable storage period	For one day	0
	For three day	1
	For a week	49
Storage Method	Refrigerated storage	50
	On the floor	2
	Storing in the basket	7
	On the table	2
	Other	0
The arrangement of the vegetables at the storage	Separately All together	48 2
The type of mode use for storage	Plastic boxes	7
	Polythene bags	48
	Paper bags	0
Cooking and meal planning	Without bags	2
	Yes	28
	No	22

Source: Authors own survey data (2023)

The study examined household vegetable purchasing and wastage, categorizing vegetables into leafy vegetables, tubers, gourds, and beans. Tubers are purchased the most (760g/week), while gourds are least (457g/week), with leafy vegetables being the most wasted. Additionally, 56% of consumers have a cooking plan, which may help reduce waste, whereas 44% do not, leading to possible wastage.

The last component is awareness of vegetable wastage. That is, in here assessed consumer's awareness levels regarding vegetable wastage. Out of the responses, eight indicated a high level of awareness, twenty were for a moderate level, fourteen for a low level, and four responses reflected a very high level. The data was subsequently analyzed using Wilcoxon Sign Rank Test. The results obtained there are as follows.

Table 3 Awareness of vegetable wastage at household level.

Variable	Mean Value	Test Value	P Value
Awareness of the vegetable wastage at household level	1.040	0.398	0.698

Notes: Significance at the level of 0.05
Source: Authors own survey data (2023)

The Null Hypothesis (H_0) is People do not have awareness of the vegetable wastage at household level and the alternative hypothesis (H_1) of the test is People have about awareness of the vegetable wastage at household level. According to the result the P value (0.698) > 0.05. That means People do not have better idea of vegetable wastage at their household level.

The findings indicate a gradual reduction in wastage for all three types of vegetables during the second and third weeks compared to the initial week. The

observed trend of gradual reduction in vegetable wastage over the three-week period suggests that the reminder notification approach has had a positive impact. The reminders likely contributed to an increased awareness among consumers, leaded to more mindful vegetable consumption and storage practices. However, the study was limited to these three vegetables, as all participants consistently consumed them throughout the study period.

Table 4: Average storage record of vegetables

Average storage record	**Average amount of purchased (g)**			**Average amount of wastage (g)**		
	Week 1	Week 2	Week 3	Week 1	Week 2	Week 3
Leeks	425	395	392	101.3	61.3	27.5
Pumpkin	590	518	502	65.4	25.9	8.4
Cabbage	486	449	399	89.9	39.2	14.8

Source: Authors own survey data (2023)

The effectiveness of the reminder notification approach in reducing vegetable wastage was confirmed through questionnaires and storage records over three weeks. With P values below 0.05 for all vegetable categories (tubers, beans, gourds, and leafy vegetables) in the paired T test, it indicates a significant reduction in wastage after the approach was implemented.

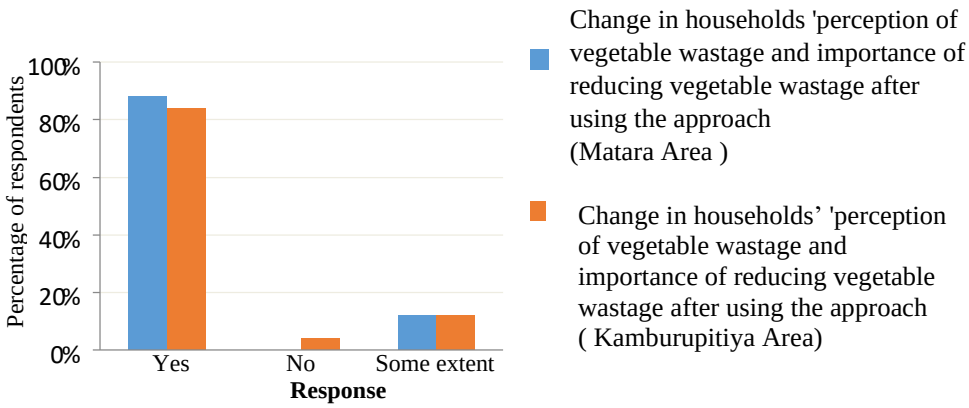
Table 5: The results of the paired t-test

Vegetable Type	**P value**	**Test value**
Tubers	.000	6.534
Beans	.000	6.768
Gourds	.000	9.492
Leafy Vegetables	.000	8.002

Notes: Significance Level is 0.05
Source: Authors own survey data (2023)

Considered the impact of this approach in the two selected areas for study, the importance placed on minimizing vegetable wastage and the perceptible shift in household opinions concerning this issue, it is that a higher percentage of households in the *Kamburupitiya* area have undergone a positive change through the application of the reminder notification approach. It is, however, that this observed change is relatively lower, when juxtaposed with the responses from the *Matara* area. Therefore, the impact of this approach has been particularly noteworthy among customers in the *Matara* area, where a more pronounced influence has been observed in altering perceptions and behaviors

Figure1: Change in households' perception vegetable wastage and importance of reducing vegetable wastage after using the approach *Matara* and *Kamburupitiya* area



Source: Authors own survey Data (2023)

The reminder notification approach significantly impacted households‟ perception of vegetable wastage, meal planning, cost effectiveness, and storage behavior. It is confirmed through Wilcoxon Sign Rank Test analyses with p values below 0.05.

Table 6: Results of the Wilcoxon sign rank test

Factor	Mean	P value	Test value
Households 'perception of vegetable wastage after using the approach	1.14	0.02	2.333
Improving meal planning at the household level	3.30	0.004	2.887
Cost Effectiveness	1.38	0.000	3.755
Behavioral change in household vegetable storage with this approach	1.34	0.000	3.494

Notes: Significance level 0.05
Source: Authors own survey data (2023)

After three weeks of implementing the reminder notification approach, customer feedback was collected. Most respondents found the method user-friendly, simplifying vegetable storage and meal preparation. While the adoption rate was moderate, participants noted that the study's follow-up duration might be insufficient to fully assess adoption. However, memorizing color codes was remarkably easy for most customers, attributed to the use of familiar colors.

Table 7: Feedback for reminder notification approach

Factor	Category	Frequency
Frequency of Usage	All three weeks	47
	Only two weeks	2
	Only one week	1
Ease of Practice	No	3
	To some extent	7
Adoption rate of approach	Yes	40
	Low	1
	Moderately	26
	High	22
	Very High	1
Memorizing Color codes	Very difficult	1
	Difficult	0
	Quite Easy	1
	Easy	11
	Very Easy	37

Source: Authors own survey data (2023)

5. Conclusion

The reminder notification method has significantly reduced vegetable wastage by implementing color-coded containers and timely reminders. The three-color container system offers a sustainable and visually intuitive alternative, organizing vegetables effectively and mitigating polythene's adverse environmental impact. The integration of reminders enhances engagement and encourages mindful consumption, fostering a sustainable and economically viable approach to vegetable storage.

Adopting mindful shopping, preserving vegetables, changing cooking and buying habits, and selecting proper storage methods are crucial to reduce wastage. However, the pilot study's limited participants and short duration may hinder diverse representation and long-term effects assessment. Longer follow-up is vital to gauge intervention persistence.

References

Acedo Jr. Antonio and Easdown, W. (2015) „Post-harvest Lisses of Vegetables in South Asia", *CASPA palawija newsletter*, 32(2), pp. 1–12.

Ananda, J., Gayana Karunasena, G. and Pearson, D. (2022) „Identifying interventions to reduce household food waste based on food categories", *Food Policy*, 111, pp. 0–2.

Bandara, S. *et al.* (2021) „Changes in Food Consumption Patterns in Sri

Lanka: Food Security and Sustainability: A Review of Literature", *Open Journal of Social Sciences*, 09(10), pp. 213–237.

Busari, A.O., Alabi, A.A., Bayero, G.S. and Idris-Adeniyi, K.M. (2022) 'Determinants of household' food wastes in osogbo metroplis, osun state, Nigeria', 20(2), pp. 89–103.

Dias, J.S. (2011) „World Importance, Marketing and Trading of Vegetables", pp. 153–170.

Fridge, T.P. (2013) „The Pervasive Fridge. A smart computer system against uneaten food loss José Rouillard to cite this version: HAL Id: hal-00825886".

Hebrok, M. and Boks, C. (2017) „Household food waste: Drivers and potential intervention points for design – An extensive review", *Journal of Cleaner Production*, 151, pp. 380–392.

Jayasekara, J.M.C.M. (2021) „Usage of Domestic Refrigerators for Safe Food Storage among Sri Lankan Families", pp. 372–379.

Laurentiis, V. De, Corrado, S. and Sala, S. (2018) „Quantifying household waste of fresh fruit and vegetables in the EU", *Waste Management*, pp. 1–14.

Luo, N. *et al.* (2022) „Reducing food loss and waste in supply chain operations", *Transportation Research Part E*, 162(March), p. 102730.

https://doi.org/10.1016/j.tre.2022.102730.

Mascheroni, R.H. and Salvadori, V.O. (2011) 'Household Refrigerators and Freezers', pp. 251–271.

Nunkoo, R., Bhadain, M. and Baboo, S. (2020), Household food waste: attitudes, barriers and motivations", *British Food Journal*, 123(6), pp. 2016–2035.

Pellegrini, G. and Sillani, S. (2019) „Household food waste reduction: Italian consumers "analysis for improving food management Article information", (May): https://doi.org/10.1108/BFJ-07-2018-0425.

Rumeza Hanif, Zafar Iqbal, Mudassar Iqbal, S.H. and M.R. (2006) 'Use of vegetables as nutritional food: Role in human health', *Journal of Agricultural and Biological Science*, 1(1), pp. 18–19.

Xue, L. and Liu, G. (2019) *1. Introduction to global food losses and food waste, Saving Food*. Elsevier Inc. https://doi.org/10.1016/B978-0-12815357-4.00001-8.

APPENDIX

Appendix A

Questionnaire 01

Minimize Vegetable Wastage at Household Storage: A Pilot Study using a Reminder Notification Approach

I am final year undergraduate who are following Agribusiness Management Degree at Faculty of Agriculture, University of Ruhuna. I intend to conduct a research regarding the reduce Vegetable Wastage at Household Storage. This questionnaire is prepared to obtain data regarding for that in Matara District. The data which are obtained from this questionnaire are only used for the research purposes.

Your commitment regarding to fill this questionnaire is highly appreciated.

Thank you.

1. Gender

Male		Female	

2. Age

<30	31-40	41-50	>51

3. Income level

< Rs.35 000	Rs. 35 000 – 50 000	Rs. 50 000 – 100 000	>Rs. 100 000

4. Occupation

Public sector	Private sector	Self employed	Not employed

5. Household size

1-3	4-6	>6

6. How frequently do you go market/grocery shop to buy vegetables?

Once a day	Once in 2-3 days	Once a week

7. How much you weekly buy following?

	Leafy vegetables	Tubers	Beans	Gourds
<500				
500g-750g				
750g-1kg				
>1kg				

8. What type of storing method currently used for vegetable?

Refrigerated storage	On the floor	On the table	Storing in a basket	Other

9. How do you currently arrange the vegetables at the storage?

Separately	All together

10. What type of mode use for storage?

Plastic boxes	Polythene bags	Paper bags	Without bags	Other

11. Temperature level of the refrigerator.

32-35˚F	36-45˚F	46-50˚F	>50˚F

12. How long do you store vegetables?

For one day	For three day	For a week	Other

13. How much vegetable do you store in a week?

	Leafy vegetables	Tubers	Beans	Gourds
<500				
500g-750g				
750g-1kg				
>1kg				

14. How much vegetable do you waste at home per week?

	Leafy vegetables	Tubers	Beans	Gourds
No wastage				
100g-300g				
400g-600g				
>700g				

15. Are you aware of vegetable wastage?

No	Low	Moderately	High	Very high

16. Do you follow any cooking and meal planning?

No	Yes

Appendix B

Questionnaire 02

1. Was this reminder notification approach easy to practice?

No	Yes	Somewhat/to some extent

If not, reasons:
…….
…….

2. Adoption rate of the approach

Low	Moderately	High	Very high

3. Was there any behavioral change in household vegetable storage with this approach?

No	Yes	Somewhat/to some extent

If not, reasons:

……
…….....

4. Did you practice this method in all three weeks?

Did not follow	Only one week	Only two weeks	All Three weeks

5. Was this reminder notification approach help to improve meal planning at household level?

No	Low	Moderately	High	Very high

If improve in which way:

……
……..

6. Were the color codes easy to remember?

Very difficult	Difficult	Quite easy	Easy	Very Easy

If was a difficult, suggestion for improvement:

……
……

7. Was there any change in households' perception of vegetable wastage and the importance of reducing it?

Yes	No	Some extent No

If not, reasons:

……
…….....

8. Did this approach help to reduce costs by reducing wastage of vegetables?

Yes	No	Some extent

If not, reasons:

……
…….....

9. How much wastage of vegetables reduced?

	Leafy vegetables	Tubers	Beans	Gourds
No change				
<100g				
100g-300g				
400g-600g				
>700g				

10. Overall feedback on this approach

……
……