Sri Lanka Journal of Marketing
University of Kelaniya- Sri Lanka

Evaluation of Solid Food Waste Management Strategies in Estate Schools in Sri Lanka and Its Environmental Impact

(Special reference to Kegalle and Kurunegala educational zones)

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ABSTRACT

Food wastes (FW) has become a crucial global issues. Food production should be increased substantially to meet the need of growing population, high tendency of spoilage and consumer preference are some of the main reasons for food waste. FW predominantly happen in public places such as hotels, hospitals and industrial parks. FW in Sri Lanka, several institutes can be highlighted including schools. 10194 government schools and 80 registered private school chains are functioning throughout the country. In which, total population including both students and teachers are over 4.5 million. Thus, handling large quantity of food in schools, leads to generate huge quantities of FW and it directly affect to the national economy. Therefore, this qualitative research was designed and implemented to determine reasons for FW and evaluate the efficiency of existing FW handling strategies in schools. The data were collected from 12 schools in each educational zone at Kegalle and Kurunegala, through a survey from teachers and students. Majority of students were provided homemade breakfast in both zones, further 20.92% of students in Kegalle and 37.21% of students in Kurunegala have wasted food with some percentage of breakfast daily. In addition, plate waste of free breakfast provided by school was identified as 20.31% of students and 24.62% of students in Kegalle and Kurunegala areas respectively. Free lunch was provided schools only in Kegalle educational zone and among those who was fed from school meal; 37.5% of students have wasted food in various percentages. Majority of students have brought lunch from home and 26.51% of students in Kegalle and 26.12% of students in Kurunegala thrown some amount of lunch daily. FW was comparatively high, when meals provided from school. Further, study revealed that most of school have not established an effective FW handling system within the premises. Therefore, a systematic programs should be implemented to control food wastes. In addition, awareness programs should be carried out to educate students to minimize FW. It is necessary to investigate the reasons for wasting large quantities from

school meal. Finally, a national campaign on "Stop Food Waste" should be launched for school community to create a sustainable environmental development with appropriate mechanisms of school and family education.

Keywords: *Family Education, Food Waste, Meals from Schools, Sri Lanka, Waste Management*

1. INTRODUCTION

Food waste has become one of the prime issues in the globe threatening food security. It is an important portion of waste stream in industrialized countries, contributing to ecological damages, environmental prolusion (Cerda, 2018), economical problems (Ghosh et al., 2016) and nutritional losses (Baiano, 2014). Approximately, 10,205 MT of FW was generated annually in existing community food system, those waste occur; 20% during crop production, 1% in food processing, 19% while distribution and 60% generated by consumers (Griffin et al., 2008). "Food Waste refers to food that moves through the food supply chain up to a product fit for human consumption, but is not consumed because it is discarded, whether or not after it is kept beyond its expiry date or left to spoil" (FAO, 2011). FW is the result of negligence or a conscious decision to throw food away. In recent decades, FW has been recognized as a significant social, nutritional, and environmental catastrophe (Melikoglu et al., 2013).

Thus, it is difficult to investigate accurate and consistent FW data at national, state or household levels (Pearson et al., 2013). However, according to the FAO, (2012) Food waste has accounted roughly US$ 310 billion in developing countries. A study was conducted in UK statistically confirmed that Food waste was significantly different by school type, with primary schools producing 72 g pupil-1 day-1 and secondary schools 42 g pupil-1 day-1 (Food Waste in School, 2011). Wilkie et al., (2015) carried out, a series of studies in schools that showed 20% to 50% of FW in USA. Waste Wise Schools (WWS) program in Western Australian (WA) has estimated that 3kg of avoidable food waste was discarded per student annually and vegetables and fruits were more common among wasted items (Boulet et al., 2016). Wilkie et al., (2015) has also estimated mean average food waste as 24.7g to 64.9 g student−1•day−1 of schools in Florida.

FW quantities from restaurants, celebrations and social events are massive. Further, waste is significant in festivals and special events where provides excess food than required. There is a need to change society's food culture, particularly among women and youth, as they are the largest segment of the society and the prime food wasters (Baig et al., 2019[a]; Baig et al., 2019[b]). In another study, plate waste was estimated as 10% from elementary and middle-school students, lunch trays were measured using a previously validated digital photography (Smith & Cunningham-Sabo, 2014). Today, large quantities of wholesome edible food are discarded from household kitchens. Knowing that children are the consumers that will shape the FW

situation in the future (FAO, 2018). The training guides were launched at FAO HQ for different age limits such as 5 - 7 year, 8 - 9 years, 10 - 13 years old and fourteen years onwards (FAO, 2018).

Children aged 5-19 years mostly spend their day in the school. Their daily energy intake from school meals/snacks, placing schools in a position to influence significantly children's food choices and meal size. The overall health of children depends, in part, upon food intake that provides sufficient energy and nutrients to support optimal growth and development (Briggs et al., 2010). Pupils of deferent ages respond for food waste was determined largely by social status and attitude. Further adolescents have revealed that they do not have adequate knowledge, skills and competences at school to make decision on how to prevent, minimize or avoid throwing away food (Todorova et al., 2018). Various ways of food wastes in school were published in house of common library as peeling, slicing, trimming and preparation waste, incorrect storage, contamination, damaged stock and plate waste (Downing et al., 2015).

Ministry of Education in Sri Lanka has reported that 10194 government schools and 80 registered private school chains in the country (School Census, 2017). However, study was not conducted yet to determine FW and waste management system in local schools. This research was conducted first time in government schools based on two education zones focusing on postconsumer food waste. There are 4 major categories in government school; 1 AB: Schools with G.C.E. Advanced Level (Grades 12-13) science stream. 1 C: Schools with G.C.E. Advanced Level (Grades 12-13) arts/commerce streams, but not science streams. Type 2: Schools with classes up to G.C.E. Ordinary Level. Type 3: Schools with classes up to grade 8 or 5 (Department of Census & Statistics, 2010).

Children may not receive nutritional benefits from school meals if they do not eat the food served. This may be because of personal eating habits and the meals served at home. Plate waste indicates that children may not fully benefit from having nutritious food in school meals. According to Sri Lankan scenario some of the children taking breakfast at the household or from school cafeteria. Most of the school children taking their main meal as rice and curry for lunch during school time. According to that highest food consumption and FW can occur during the lunch hour. Group and personal interviews were used to quantify waste and identify their techniques for handling solid food waste. This study conducted to identify food consumption pattern in school and wastage according to the students in various grades to assist nutrition knowledge, attitude, and practice of the school food waste management process.

2. METHODOLOGY

Survey was conducted in 12 schools each in Kegalle (out of 533 schools) and Kurunegala (out of 885 schools) education zones. Schools were selected across the educational zone as shown in the map bellow.

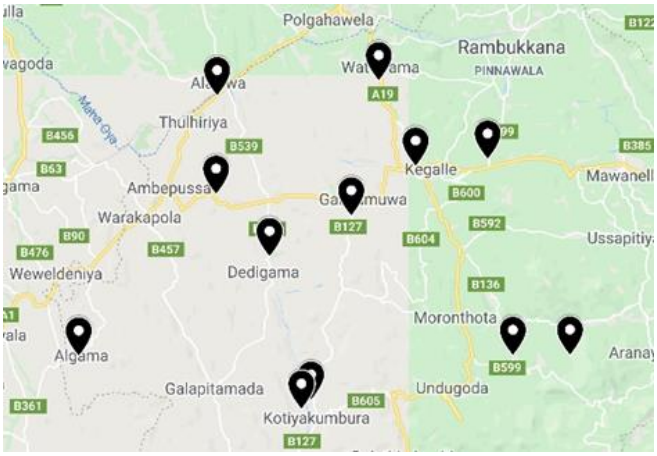


Figure 1: Distribution of School in Kegalle Education Zone

Figure 2: Distribution of School in Kurunegala Education Zone

Stratified random sampling technique was used to select 12 schools in each educational zones and the sample was represented all school categories as 1ab, 1c, type2, type 3. This study was carried out through observation and interviewing. The data was collected with personal interviews of school principals and teachers to identify implemented strategies for disposing FW and /or minimizing FW within the premises. Students were surveyed to determine the reasons for food wasted, waste quantities

and awareness of consequences of wasting food. A pre tested questionnaire was used to facilitate the interviews. A questionnaire was developed to collect data with following considerations; type of school, educational zone, who provides breakfast and lunch to children, type of meal, quantity of FW, reasons of wasting, procedures in place to manage wasted food, knowledge on consequences of food wastage and availability of FW management programme in the school. Descriptive statistic was calculated to analyst the date.

3. RESULTS AND DISCUSSION

3.1. Food Waste in Breakfast

School children in Sri Lanka, usually take breakfast before starting school and consume lunch within the school time. The breakfast intake of school children was given in Table 1 as percentages for both educational zones.

Table 1: Ways of Obtaining Breakfast

Description	Educational zone	
	Kegalle (%)	Kurunegala (%)
Home	79.08	72.64
Provided by school	17.39	21.96
School canteen	3.53	5.07
Shop near school	0.00	0.34

According to the findings, there are 4 categories of students as shown in the Table 1. 17.39 % of students in Kegalle and 21.69 % of students in Kurunegala educational zones were provided free breakfast from the school. Rest of the students were provided breakfast from other means. Food consumption pattern of school children was varied. Students who received free breakfast from school and students who bought breakfast from school cafeteria consumed their meal within the school premises. Other students who obtained breakfast either from home or bought from a shop near school, not regularly waste food in the school. As shown in the table most of the students were consume breakfast at home in both education zones.

In Table 2, revealed in detail, the number of students take breakfast in the school and contribution for waste generation as percentages. Most of the student; 72.16% and 62.79% student in Kegalle and Kurunegala respectively, were willing to eat completely homemade breakfast, further, no one has wasted homemade breakfast completely. When buy breakfast from a shop near school, all students have consumed without any plate waste. When comparing homemade breakfast with school meal, higher number of student (79.69% Kegalle, 75.38% Kurunegala) have completely consumed meal

provide by their schools. Further, over 90% student have completely eaten the breakfast bought from school canteen.

Table 2: Food Wastes Percentages and Ways of Students Obtained Breakfast

Percentage of food wasted	Home		From a shop near school		From school canteen		Provided by school	
	Kegalle (%)	Kurunegala (%)	Kegalle (%)	Kurunegala (%)	Kegalle (%)	Kurunegala (%)	Kegalle (%)	Kurunegala (%)
Eat completely	72.16	62.79	100.00	100.00	92.31	93.33	79.69	75.38
25% wasted	13.06	26.98	0.00	0.00	7.69	0.00	12.50	15.38
50% wasted	14.09	10.23	0.00	0.00	0.00	6.67	7.81	6.15
75% wasted	0.69	0.00	0.00	0.00	0.00	0.00	0.00	1.54
100% wasted	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.54

Table 3 elaborated the specific reasons for wasting breakfast and percentages of students those who were responsible for it, in both educational zones. The main reason for breakfast wastage was recognized as time limitation. Breakfast should be consumed before school is commenced, according to the students' point of view, in most of the occasions time availability is not enough to consume the whole meal. Difficulties of managing time including travelling to school in the morning caused one of the main reasons for food waste. Besides that, we have identified two other reasons for food wastage; bringing large amounts of food which was too big for one child or taking more food into the plate when serving meal from the school. Taste of food was not significantly affected for generate wastes, whereas some students (26.32% and 17.02% of Kegalle and Kurunegala district respectively) have shown less interest for the breakfast as they didn't feel hungry.

Table 3: Reasons for Wasting Breakfast

Reasons	Educational zone	
	Kegalle (%)	Kurunegala (%)
Lack of taste	1.05	0.00
Time limitation	45.26	41.49
Portion is to big	27.37	41.49
No hungry to eat	26.32	17.02

3.2. Food Waste in Lunch

When considering the lunch as shown in Table 4, ways of providing food for students were varied. Over 90% of students in both educational zones have brought packed lunch from home. Further, only 2.17% of students were provided lunch from their school in Kegalle education zone. Obtaining lunch from the school canteen is comparatively low in both educational zones. Schools in Kurunegala have not provided lunch for students.

Table 4: Ways of Obtaining Lunch

Ways of obtaining lunch	Educational zone	
	Kegalle (%)	Kurunegala (%)
Home	94.29	98.65
From school canteen	3.53	1.35
Provided by school	2.17	0.00

In Table 5 indicated that ways of students obtained lunch and percentages of students who wasted food in various ways. Students who bought lunch from school canteen shown the highest preference to eat without waste. Over 70% of students who brought packed lunch from home have eaten lunch completely, however, homemade lunch has generated considerable amount of food wastes.

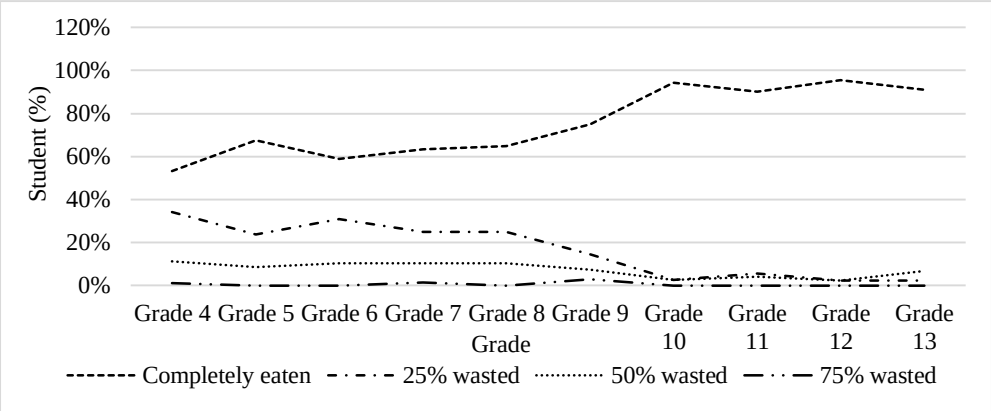
Table 5: Ways of Students Were Obtained Lunch and Food Wastes Percentages

Percentage of food wasted	Home		From school canteen		Provided by school	
	Kegalle (%)	Kurunegala (%)	Kegalle (%)	Kurunegala (%)	Kegalle (%)	Kurunegala (%)
Eat completely	73.49	73.88	84.62	75.00	62.50	0.00
25% wasted	17.29	18.90	15.38	0.00	25.00	0.00
50% wasted	8.93	6.53	0.00	25.00	0.00	0.00
75% wasted	0.29	0.69	0.00	0.00	12.50	0.00

Students has shown comparatively less preference to consume lunch completely when provide food from school. 12.5% of student who obtained lunch from the school has wasted 75% of the meal in Kegalle educational zone. Therefore, wastes generating from school meal is also fairly high. When students bought lunch from school canteen no one has wasted food beyond 75%, whereas, 0.29% and 0.69% of students have wasted homemade lunch more than 75% in Kegalle and Kurunegala zones respectively. 25% of homemade lunch was wasted by 17.29% students and 18.90% of students in Kegalle and Kurunegala educational zone respectively. Further, 8.93% of student in Kegalle and 6.53% of students in Kurunegala have wasted 50% of their lunch leading to accumulate food wastes daily in the school.

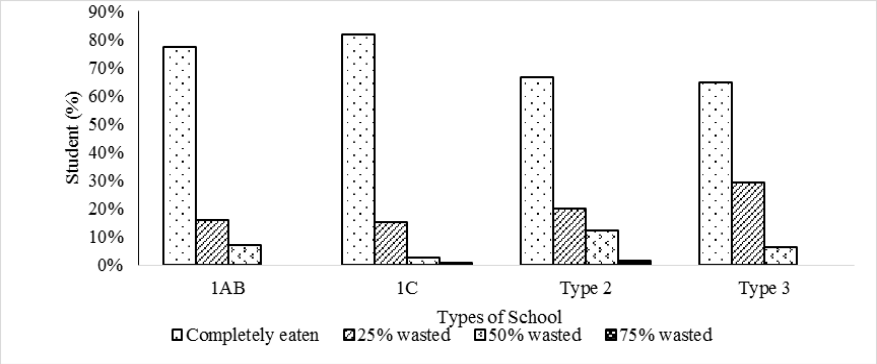
Figure 1 elaborated the details of students who wasted food grade wise in both education zones. When students gone towards higher grades, gradually food waste was decreased. As a results student in grades 10 - 13 have demonstrated less food wastage. Student in grades 4 - 9 were more responsible for food wastes, reasons would be; younger student pay more attention for playing than eating in the break time, lunch was too big per student etc. Grade 8 - 10 have become a transitional age for reducing wastes from their meals, perhaps students may need more energy in this age and increases food intake. Food waste has gone down in grade 5 with unknown reason.

Figure 1: Food Waste by Students Based on School Grade



Schools in Sri Lanka have been grouped in to 04 main categories as; 1AB, 1C, Type 2 and Type 3. Figure 2 has shown food wastes of students based on school type. Food wastage of 1AB and 1C type schools were lower than type 2 and type 3 schools. Thus, 1AB and 1C type schools have provided more facilities for students and these schools consisted of primary section to Advance Level (A/L) classes. Food wastage in O/L and A/L students were comparatively lower than primary students. Therefore, overall food wastage in 1AB and 1C type schools were relatively lower. Besides the type; 1AB and 1C, schools were capable to manage food wastage than type 2 and type 3 schools, because they have more number of teachers and facilities provided.

Figure 2: Food Waste by Students Based on School Type



In addition, analysis regarding food waste management knowledge of students referring to the school type have been illustrated in Table 6. Students in school type 1AB and 1C have more knowledge about food waste management than students in school Type 2 and Type 3 which was one of the reasons to minimize lunch waste in school Type 1AB and 1C. Further, younger children may get an opportunity to learn how to handle wastes from the senior students.

Table 6: Knowledge of Students about Food Wasting and Waste Management

School types	Knowledge about food wasting	
	Knowledgeable (%)	Clueless (%)
1 AB	70.49	29.51
1 C	72.50	27.50
Type 2	55.77	44.23
Type 3	44.19	55.81

Table 7 shown the reasons for wasting food and percentage of students who were responsible under each category. Over 94% of student in both educational zones have brought lunch from home, according to the majority of students (62.89% and 55.84% in Kegalle and Kurunegala) point of view, they couldn't completely eat as the portion is too big. That is mainly because of their parent may not want child to become hungry in the school, hence compelled to add more food in lunch pack. Apart from that parent might have thought that children share the lunch with other. Considerable amount of student have mentioned that they don't feel hungry to have lunch, the reason should be further investigated whether students having any snack in between two main meals or gap between two meals was too closed.

Table 7: Reasons for Wasting Lunch

	Educational zone	
Reasons	Kegalle (%)	Kurunegala (%)
Lack of taste	2.06	0.00
Time limitation	10.31	12.99
Portion is too big	62.89	55.84
No hungry to eat	24.74	31.17

The main reason for food wastage in both educational zones was, carrying more food which cannot completely eaten by a child in one meal. Table 8 has depicted the analysis among the school and food waste management practices.

Table 8: Analysis among the School Types and Food Waste Management Practices.

Strategy	School percentage (%)
S1	71
S2	4
S3	21
S4	83
S5	13

Assessment criteria was developed to make this study convenient as follows; S-Strategy, S1- Prohibit dumping of the food waste inside the school, S2- Look in to nutrition value and quality of food that are

being sold in the school canteen and allow only suitable food items to be sold, S3- Use of food waste to produce organic manure or biogas which are very valuable and eco-friendly, S4- Impose rules in school to bring a lunch box in order to minimize the food wastage and take actions for proper disposal of food waste, S5- Make aware students regarding food wastage and ways to minimize food wastage through awareness program.

Many schools have banned to dispose food waste in school due to security reasons, and students were advised to fetch food waste back home. This decision was taken after terrorist attack in 21 April 2019. As a result, food waste dispose in school was reduced. However, it was not affected overall food wastage in schools. Further, some schools advised student to bring lunch in a reusable box which help to reduce amount of ungradable polythene entering to school. Attention given by school authority was very low (4%) to maintain the quality and nutritional value of food in school canteen. However, student prefer to buy snacks or short eat from canteen, therefore waste was comparatively low. Only very few schools (21%) have paid attention to implemented advance solid food waste techniques within the premises. Further, awareness programmes to minimize food wastes and food wastes handling for school community were conducted only by (13%) less number of school, which may negatively affect food waste management system in schools.

4. CONCLUSION

Comparing Kegalle and Kurunegala educational zones, percentage of students who waste food was more or less similar. One out of four students has shown food wasting habit with big or small quantities daily. According to our observation, young students have wasted higher percentage from their meal than adult students. This study further revealed, students prefer to eat homemade lunch than a meal provided by school. Therefore, it is necessary to conduct an assessment to evaluate quality and sensory parameters of the meal given by schools. According to Table 6, our data revealed that schoolchildren did not have sufficient knowledge about food waste handling. Therefore, it is important to organize a series of awareness program. Food waste handling strategies of some schools were not well established. The reason would be food waste handling in school has not been taken in to account in “government school assessment criteria”. Implementing food waste management strategies such as biogas unit or compost manufacture would be ideal to improve food waste management, through that students may experience high-tech activities on food waste management. Many students have brought pack lunch from home and wasted excess food in the school, therefore, parents should be notifying to monitor closely of their children’s eating habit and avoid over loaded packed lunch.

In addition, the analysis of the factors responsible for food waste, identified in this article suggests a campaign “Stop Wasting Food” should be launched in estate schools in Sri Lanka. Furthermore, adapting to the guideline on “Save Food” given by FAO for schools to minimize food waste will be

helpful to improve awareness of handling food waste and consequences of food generating food waste. Finally, food wastes and waste handling should be considered as It is better to conduct further studies to determine nature of food waste and food waste handling in other areas in the country.

5. ACHKNOWLEDGEMENT

Authors wish to convey their grateful for the support given by Mr. K.E.M.G.W. Bandara, Zonal Education Director, Kurunegala and Mr. N.A.D.R. Hemantha, Zonal Education Director, Kegalle education zone who authorized us to visit school and collect data during this study.

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