

# DISPOSAL METHODS OF SEPARATED WASTES IN PERI-URBAN HOUSEHOLD SETTINGS. A QUESTIONNAIRE SURVEY IN YAKKALAMULLA DIVISIONAL SECRETARIAT, GALLE, SRI LANKA

Udeni Navoda Samarahewa\*

*Zonal Education Office-Udugama, Ministry of Education, Sri Lanka*

---

**Abstract:** Waste Separation (WS) is encouraged by Sri Lankan municipalities. Residents are required to separate at least wastes into two categories as bio degradable wastes and non-bio degradable wastes. The objectives of this research were to quantify and identify the number of waste types separated by the respondents, the types of wastes separated and ultimate Disposal Methods of Separated Wastes (DM-SW), in a representative peri-urban divisional secretariat. Findings will be important to restructure the Source Separation Procedure (SSP) of Local Authorities. The sample consisted of 346, grade 08 and 09 students coming from 346 households of the study area. These students were subjected to a questionnaire survey. Results show that 35% of the respondents separate wastes into 1 – 6 categories. Majority (13%) of the respondents separate two waste categories. Altogether respondents have identified 17 Waste Categories(WC) namely Styrofoam boxes, garden wastes, tires, tin, coconut husks, animal waste, clothes, clay pots, metal, coconut shells, paper/cardboard, glass/glass bottles, food waste, kitchen waste, Polyethylene Terephthalate bottles/plastic yoghurt cups, polythene/grocery bags and plastics. The most separated waste category was polythene/grocery bags (26.6%). There were no clear demarcations with the wastes that are not separated. To dispose separated waste both environmentally friendly and harmful methods are adopted.

**Keywords:** Waste Separation, Waste Categories, Source Separation Procedure, Disposal Methods of Separated Waste

---

## Introduction

Certain countries in the world like Japan encourage extensive waste separation at household level. For instance in the city of Kamikatsu-Japan (Zero Waste Town, 2017), the local authority needs the residents to separate waste into 34 categories. Many other local authorities in Japan seem to follow more or less the similar strategy.

Through this rigorous waste separation program Kamikatsu has managed to produce no trash at all. If it's mixed it's waste, if it's sorted it's a resource was a motto expressed by the Ministry of Environment-Japan (Japan Environmental Sanitation Center, 2017).

Separating waste into two categories as bio degradable waste and non-bio degradable waste is the most common waste separation behavior in many countries. The collector can be satisfied with these two categories of separated waste. Most often municipalities of Sri Lanka practice the collection of bio-degradable waste and non bio-degradable waste separately. It is believed that many of the sorted bio-degradable waste end up in a composting yard. But the pathetic situation here is that, residents know that their bio-degradable waste bag could contain any item that is not non-bio degradable or people tend to separate everything into these two categories only. The vast amount of materials that are being used, ultimately end up in two waste bags. Agarwal, et al (2015) has pointed out that although there are common practices to dispose waste from ordinary people, disposal of waste is becoming a serious and vexing problem for any human habitation all over the world.

Also according to the waste policy of Sri Lanka source separation of about six waste categories should be done using color specific bins.

The other problem under Sri Lankan context is lack of clear demarcations of the waste categories. Urban citizens who do not have enough space to dispose their wastes have to rely completely on external collectors including the itinerant municipal tractors. So all of their wastes go out of their home compound be it polythene, plastics, kitchen wastes, rubber or metal.

The composition of municipal solid waste in Sri Lanka, was analyzed to have nine categories, which is given in table 1.(Mannapperuma, 2017). Once they are mixed, this could be the maximum amount that can be identified. And it's often harder to separate mixed waste, even with the most sophisticated technique.

Table 1 *Composition of Municipal Solid Waste in Sri Lanka*

Waste category	Composition
Short term Bio degradable	56.57%
Long term Bio-degradable	5.94%
Metal	2.76%
Wooden	6.35%
Glass	2.03%
Paper	6.47%
Building	3.89%
Slaughter house	2.34%
Saw dust/paddy husk & cloth/garment waste	6.04%
other	1.68%
Polythene and Plastic	5.19%

In Kamikatsu- Japan they not only separate waste into very many categories but also they use reusing and recycling technologies very efficiently. For instance they use old usable clothes as a raw material(Zero Waste Town, 2017).

But in Sri Lanka, where wastes are separated into only two categories, usable pieces of clothes, paper and cardboard may go into the composting yard. Occasionally paddy husks and coconut shells may also end up in a composting yard, which can be used as raw materials in many cases.

Most schools in Sri Lanka practice Reducing, Reusing and Recycling (3R) strategies very strictly. For instance most schools in the study area are polythene free and students are not allowed polythene to schools. They are informed to bring lunch boxes rather than lunch sheets and wrapping papers. Composting bins and squares are being maintained in many schools. But it is researchable what is really happening at their household levels. It is important whether the students at their household level are keen on good practices and whether they really practice waste separation at least to the above two categories and what happens to their separated waste.

Objectives of this study were to identify and quantify, the number of waste types separated by the respondents, the types of wastes separated and the ultimate disposal methods of the separated wastes.

## Literature Review

Many of the developing countries have recently been recognized the importance of source separation of domestic waste. According to Le et al (2017) most recent MOW – SAS(Municipal Organic Waste – Separation

at Source) programs in developing countries remain pilot programs. The work Abhayawardana et al (2012) revealed that only 37% of the Galle district separate waste into two categories as bio-degradable waste and non bio-degradable waste. The study area of this research is one of the eighteen divisional secretariats in Galle district, Sri Lanka. Many of the previous researchers have suggested the importance of waste separation behavior of the residents. According to Xiaoping et al (2017) a better understanding of waste separation behavior can aid the design and improvement of waste management policies. In their research article Xiaoping et al (2017) also pointed out the methodologies adopted by the Chinese government to facilitate waste separation such as installing waste specific bins for several kinds of wastes in several regions of the city of Zhengzhou, China since 1999.

At present MSW in China is mixed and collected in bags. Although several pilot projects on waste separation are under-way, source-separated collection at household level is an uncommon practice in China (Sidique et al;2010 as cited by Xiaoping et al;2017).

### ***Identification of waste types***

Knowledge of waste separation is important in a proper waste separation program. Xiaoping et al; 2017 has found out that the average proportion of correctly classified unrecoverable waste is only 0.58 and 0.66 for undergraduate students and residents respectively. In an extensive waste separation program it is important that residents' identify the correct waste category. In their study undergraduate students and residents were confronted with samples of 12 different waste materials for identification. These waste types were Aluminum cans, Cardboard, Glass, Cigarette ends, Electric bulbs, Plastic bags, Plastic tableware, leftovers, Napkins, Porcelains, Batteries and Construction wastes. According to Xiaoping et al (2017) the students have a significantly lower correct rate than residents in separating plastic tableware, leftovers, porcelains, batteries and construction waste.

### ***Health and Environmental Effects of Open Burning of Refuse and Other Solid Wastes***

The open burning of certain wastes has scientifically been proven to produce air toxins (Graham,2017). According to Graham(2017) harmful pollutants of particular health and environmental concern from open – air burning include: fine particles, black carbon(soot) particles, furans, dioxins, poly-aromatic hydrocarbons including carcinogens.

In his article Graham(2017) also emphasized the health effects of such. These toxic gases collectively effect the respiratory system, immune system, endocrine system, reproductive system and the developing systems of the young.

Other pollutants of concern in the smoke can include nitrogen oxides, carbon monoxide, arsenic, mercury, lead, hydrochloric acid and volatile organic compounds. The ash from a burn may contain these pollutants and be potentially toxic. Ash can travel thousands of kilometers before it drops out of the sky and possibly enters the human food chain (Graham,2017).

These pollutants are not only harmful to humans but also to all other living beings on the earth, they also contaminate soil and water.

Saskatchewan Environmental Management and Protection Regulations identify the burning of many types of waste may only be done with a permit. In these regulations burning of things like rubber, plastic, municipal waste, treated wood, hazardous substances, oil production by-products, motor vehicle tires are legally restricted(Graham,2017).

## Methodology

The sample consisted of 346 school children of the Yakkalamulla Divisional Secretariat. The research population were grade 08 and grade 09 students of the Sinhala medium public schools in the study area. The target population consisted of 1113 students. A sample of 346, was drawn according to the simple random sampling method. The particular sample was selected based on the convenience factor. The questionnaire survey was conducted in 2017. The study area can be described as peri-urban. The protected Kottawa ever-green forest reserves also lies within the study area. Some of the students come from tea, rubber and oil palm estates. Yakkalamulla Pradeshiya Sabhawa(YPS) is responsible for garbage collection and disposal, of the study area. There is a composting yard belonging to the YPS. Geographical Location of the study area is given in figure 1.

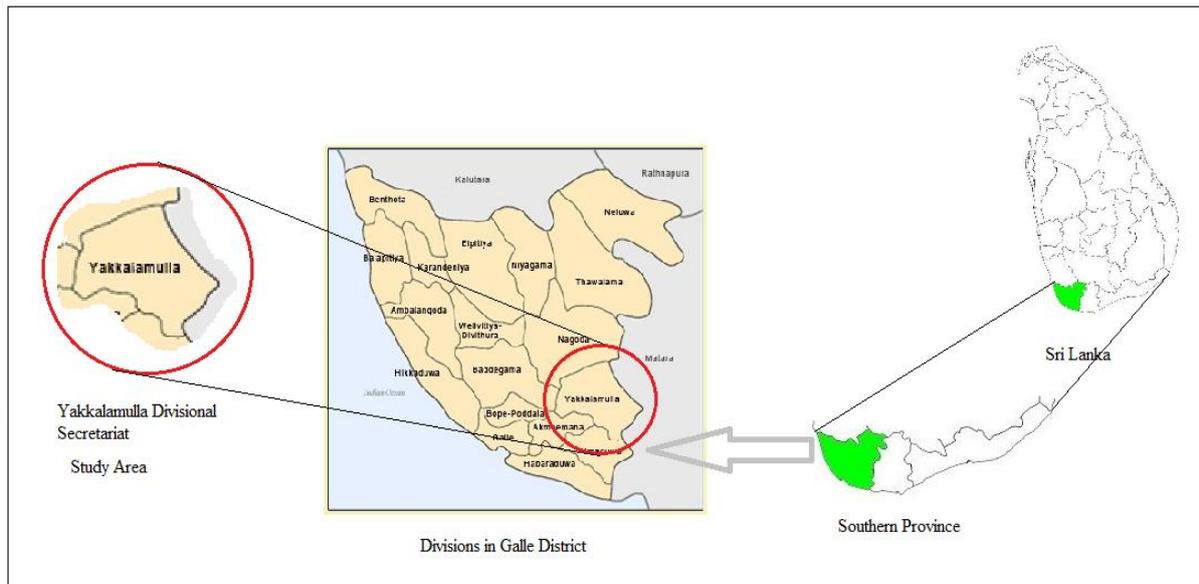


Figure 1:Geographical location of the study Area

## Results and Discussion

Out of 346 students 35% separate waste at domestic level. Abhayawardana et al (2012) also revealed that only 37% of the Galle district separate waste into two categories. According to Hashim, et al., 2012 (as cited by Low, et al., 2016) only 18% of the respondents practice waste separation under institutional settings in Malaysia, but according to Vassanadumrongdee & Kittipongvives (2018), overall in Malaysia 49% of the residents practice waste segregation for recycling. Low, et al. (2016) also discussed the reason behind poor waste separation behavior among the community may be due to various factors such as limited market for recyclables, lack of information about the right way to separate waste and poor access to recycling facilities. A study conducted in urban Accra, in Ghana, showed that only 17.3% of the households separate their solid waste into different types before disposal (Yoad, et al., 2014). Further according Agarwal, et al (2015) “Segregation at source” is one of the four basic principles of Solid waste management. Vassanadumrongdee & Kittipongvives (2018) discovered that 66% of the respondents indicated that they had separated waste for recycling regularly in Bangkok, Thailand. This value was far better than that of the present study and most of the contexts, that the author was able to refer.

Number of waste types separated by the respondents ranged from one to six. Majority of the respondents separate waste into two categories (Figure 2). It was also observed that there were responses varied from bio-degradable waste and non-bio-degradable waste. Therefore majority who separate waste into two categories sometimes do not follow the rule of separating bio degradable wastes and non-biodegradable wastes. There were no clear demarcations with the wastes that are not separated. Separating wastes into two categories in this study

means that they separate the materials they have mentioned and the rest is disposed as a bulk. It was emphasized by Low, et al (2016) the importance of source separation for the recycling process. According to Low, et al (2016) approximately 80% of the solid waste generated in Malaysia, are recyclables but disposed in the landfills. Different respondents in the present study have identified different waste types up to a maximum of six categories.

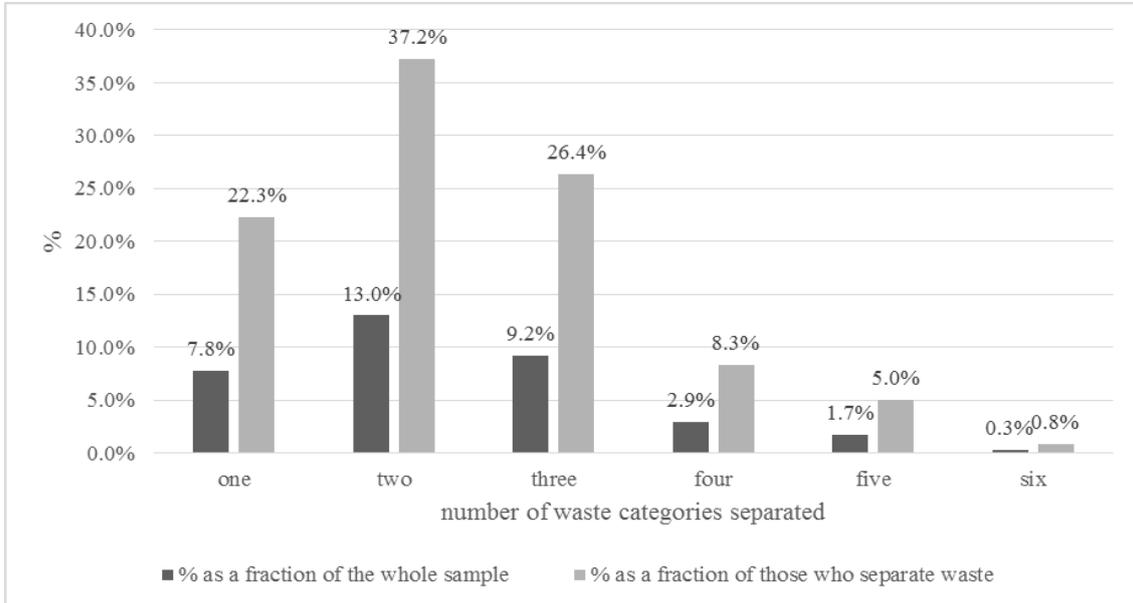


Figure 2: Percentage of the respondents who separate waste into one to six categories as fractions of the whole sample and as fractions of those who separate waste.

### Identification of the Separated Waste Categories

Altogether respondents have identified 17 waste categories. Figure 3 represents the names of waste types identified and separated by the respondents. Respondents separate plastics(9%), Polythene and grocery bags(26.6%), Polyethylene Terephthalate (PET) bottles and yoghurt cups(1.7%), kitchen waste(11%), food waste(7.2%), glass and glass bottles(5.2%), paper and cardboard(4.3%), coconut shells(5.2%), metal(1.7%) , clay pots(0.6%), clothes(0.9%), animal waste/cow dung(0.3%), coconut husks(0.3%), tin(1.2%), tires(0.3%), garden waste(4.6%) and Styrofoam boxes(3.5%). As investigated by Yoda, et al (2014) food debris was the major waste category generated in the city of Accra. The other most generated waste types by the households of urban Accra, Ghana, according to the responses of the residents were plastics, bottles/cans, paper and old clothes (Yoda, et al., 2014). However 82.7% of the households in Accra, Ghana do not separate waste (Yoda, et al., 2014) Uapadhyay, et al (2012) had discovered that, the waste management system of MINT campus in Jaipur, included identifying a variety of waste types and their source areas. The identified waste types at different source areas of the MINT campus were food waste, plastics, paper, tin, rubber, metal, glass, dust, textile, leather, and garden trimmings. Later the collected waste types were directly transported to the final dump site and according to the researcher although they segregate waste categories, the Solid Waste Management in MINT appears to be inadequate and needs up gradation. (Uapadhyay, et al., 2012)

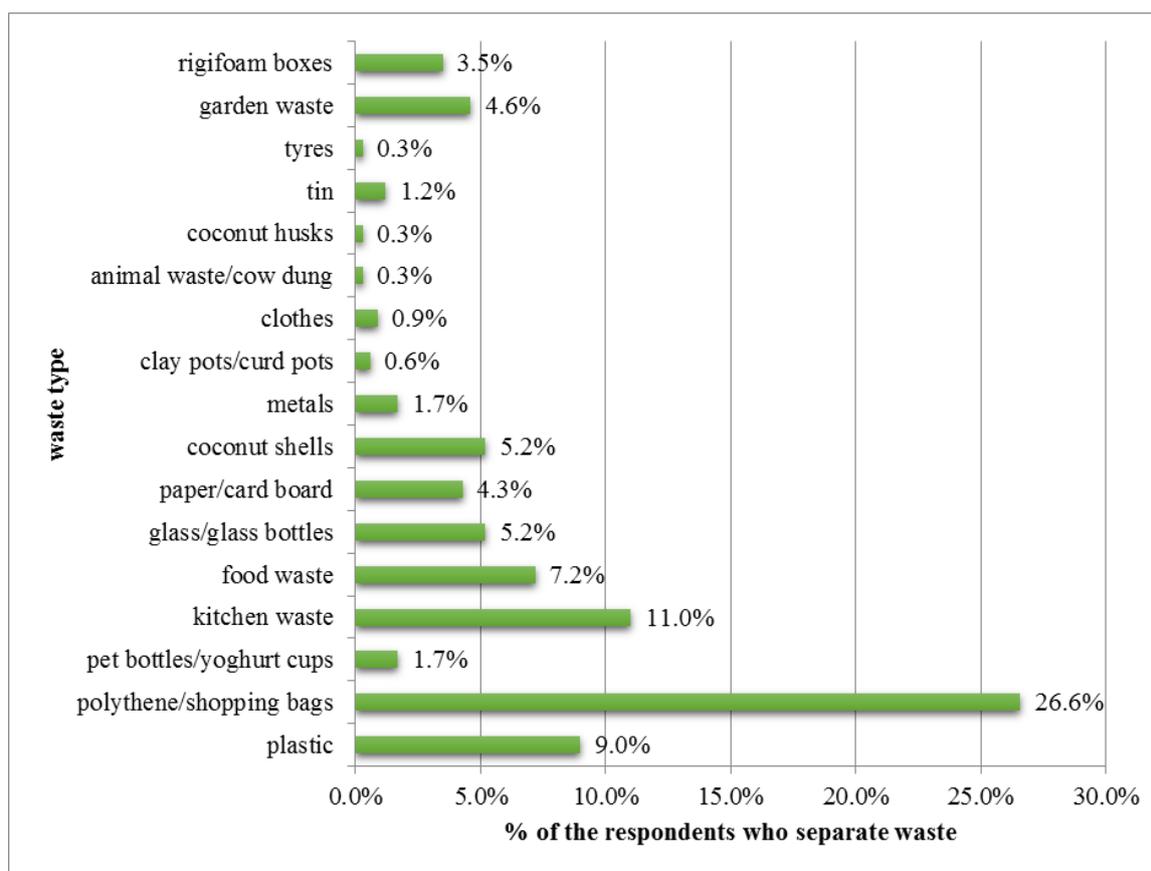


Figure 3: Percentage of the respondents who separate each identified waste category as a fraction of the whole sample.

### Disposal Methods of Separated Wastes

Table 2, gives the details of the ultimate disposal methods of separated waste. However this study do not reveal the plight of unsorted waste of 65% of the respondents who do not separate waste. They most probably may be using environmentally harmful waste disposal methods like open burning, open dumping and burying.

Table 2 : Disposal methods of separated waste.

No	Separated Waste type	Method of disposal	Number of respondents	% as a fraction of those who separate waste	% as a fraction of the whole sample
1	Plastic	Reuse	3	2.5%	0.9%
		Bury	7	5.8%	2.0%
		Hand over to the itinerant municipal tractor/Recyclers	11	9.1%	3.2%
		Burn	10	8.3%	2.9%
		<b>Total</b>	<b>31</b>	<b>25.6%</b>	<b>9.0%</b>
2	Polythene/ Shopping bags	Put in a public container separated for polythene	6	5.0%	1.7%
		Hand over to the itinerant municipal tractor/Recyclers	36	29.8%	10.4%
		Bury	13	10.7%	3.8%

		Burn	37	30.6%	10.7%
		<b>Total</b>	<b>92</b>	<b>76.0%</b>	<b>26.6%</b>
3	Plastic Bottles/ Yoghurt cups	Burn	3	2.5%	0.9%
		Bury	1	0.8%	0.3%
		Reuse for growing ornamental plants	2	1.7%	0.6%
		<b>Total</b>	<b>6</b>	<b>5.0%</b>	<b>1.7%</b>
4	Kitchen waste	Composting	26	21.5%	7.5%
		Put in a hole	11	9.1%	3.2%
		Bury	1	0.8%	0.3%
		<b>Total</b>	<b>38</b>	<b>31.4%</b>	<b>11.0%</b>
5	Food Waste	Put in a public container separated for biodegradables	3	2.5%	0.9%
		Burning	1	0.8%	0.3%
		Composting	16	13.2%	4.6%
		Put in a hole	5	4.1%	1.4%
		<b>Total</b>	<b>25</b>	<b>20.7%</b>	<b>7.2%</b>
6	Glass/Glass bottles	Hand over to the itinerant municipal tractor/Recyclers	9	7.4%	2.6%
		Bury	7	5.8%	2.0%
		Put on the roof top	2	1.7%	0.6%
		<b>Total</b>	<b>18</b>	<b>14.9%</b>	<b>5.2%</b>
7	Paper/ Cardboard	Put in a public container separated for paper	2	1.7%	0.6%
		Hand over to the itinerant municipal tractor/Recyclers	2	1.7%	0.6%
		Hole in the compound	3	2.5%	0.9%
		Burning	8	6.6%	2.3%
		<b>Total</b>	<b>15</b>	<b>12.4%</b>	<b>4.3%</b>
8	Coconut Shells	Hand over to the collector	6	5.0%	1.7%
		Burn	6	5.0%	1.7%
		Bury	3	2.5%	0.9%
		Used as a fuel for cooking	3	2.5%	0.9%
		<b>Total</b>	<b>18</b>	<b>14.9%</b>	<b>5.2%</b>
9	Metal	Hand over to the itinerant municipal tractor/Recyclers	<b>6</b>	<b>5.0%</b>	<b>1.7%</b>
10	Clay pots/Curd pots	Used for growing plants	<b>2</b>	<b>1.7%</b>	<b>0.6%</b>
11	Clothes	Burn	<b>3</b>	<b>2.5%</b>	<b>0.9%</b>

12	Animal Waste - Cow dung	Used as a fertilizer	1	0.8%	0.3%
13	Coconut Husks	Used for growing plants/cultivation of crops	1	0.8%	0.3%
14	Tin	Bury/Press and bury	4	3.3%	1.2%
15	Tyres	used for growing plants	1	0.8%	0.3%
16	Garden Waste	Burn	5	4.1%	1.4%
		Composting	8	6.6%	2.3%
		Put in a hole	3	2.5%	0.9%
		<b>Total</b>	<b>16</b>	<b>13.2%</b>	<b>4.6%</b>
17	Styrofoam/Expanded Polythene boxes	Bury	6	5.0%	1.7%
		Burn	6	5.0%	1.7%
		<b>Total</b>	<b>12</b>	<b>9.9%</b>	<b>3.5%</b>

Many of the respondents in this study commented that they do not receive the service of the itinerant municipal garbage tractor. Vij (2012) also argues the inadequacy and poor situation of the waste transporting vehicles in India, saying that vehicles transporting waste are not designed properly and neither are they covered nor equipped with instruments to collect the whole of the waste.

When referring to the above table, it can be seen that some of the waste disposal methods are environmentally friendly and some aren't. According to Vassanadumrongdee & Kittipongvises (2018), the separated recyclables are handled by the citizens of Bangkok, Thailand in many different ways. 41.5% of the recyclables in Bangkok were sold to Itinerant byers, 33.6% were donated to waste pickers or collectors and 24.3% were sold to nearby junk shops. Separating waste is a good practice. But even the respondents who separate waste, sometimes conduct bad waste management practices such as burning. Especially a group of people still find burning mixed or sorted wastes as an ultimate disposal method. Lack of awareness on impact of burning waste still persists in the society at a larger scale. The summary of the nature of the Disposal Methods are indicated in the following table (table 3).

Table 3: Summary of the Nature of the Disposal Methods practiced by the residents who separate waste

Environmentally friendly methods		Environmentally harmful methods	
Method	Number of responses	Method	Number of responses
Reuse	12	Burying (Non Biodegradables)	38
Hand over to the collectors	70	Burning	79
Put in a public container separated for the waste type	11	Put on the roof top	2
Composting/Burying perishables/Fertilizer	77		

total	170	total	119
% of Environmentally friendly methods	58.8	% Environmentally harmful methods	41.2

According to the above table, 58.8% of the disposal methods used by the respondents who separate wastes are environmentally friendly while 41.2% are environmentally harmful. If we consider the disposal methods used by the 65% of the respondents who do not separate waste, are 100% environmentally harmful then the total percentage of environmentally friendly disposal methods reduce up to 29.4%. Vassanadumrongdee & Kittipongvises (2018) had pointed out that 14.6% of the respondents in their study in Bangkok, found that the separation practice was meaningless as they had seen municipal staffs mixing their recyclables with other wastes. On the other hand Low, et al(2016) observed that out of 33,000 tons of solid waste collected daily in Malaysia, only 10.5% was recycled while the rest was disposed at a disposal site, while their neighboring country Singapore with proper 3R strategies has managed to increase the recycling rate up to 58%. In contrast according to Yoada, et al (2014), 19.8% of household heads in their study did not think waste management was important and another 8.5 % did not know whether it was or not. In conclusion Yaoda, et al, (2014) described that in Ghana low levels of education contribute to poor waste management practices. However in the present study the education levels of the household heads were not considered. Further to increase public participation on waste separation Vassanadumrongdee & Kittipongvises (2018) proposed to convey the message to residents more intensively through door to door or community meetings and various media channels.

## Conclusions and Recommendations

### Conclusions

This study investigated, the source separation behavior of the household wastes in a representative peri-urban context in Southern, Sri Lanka. Further the study identified and quantified the number of waste types separated by the respondents, the types of wastes separated and the ultimate disposal methods of the separated wastes. In the Sri Lankan Peri- Urban context it was discovered that approximately 35% of the residents separate household wastes into one to six categories. Altogether the residents of the peri-urban towns had identified seventeen waste categories namely plastics, Polythene and grocery bags, Polyethylene Terephthalate (PET) bottles and yoghurt cups, kitchen waste, food waste, glass and glass bottles, paper and cardboard, coconut shells, metal, clay pots, clothes, animal waste/cow dung, coconut husks, tin, tires, garden waste and Styrofoam boxes. Further it was identified that the most separated waste category was Polythene and grocery bags. Waste separators dispose the separated waste types in both environmentally friendly ways (58.8%) and harmful ways (41.2%); Reusing, handing over to the recyclers, putting into public containers separated for the waste type, composting, using as a fertilizer and burying perishables are considered as environmentally friendly while burning, burying non-perishables and putting glass on the roof top are not considered as environmentally friendly.

### Recommendations

Waste separation is triggered by effective collection. If separated wastes are not collected or if it is collected at residents own expense they are demotivated to proceed waste separation. Therefore waste separation should be promoted along with an effective collection system.

With an effective collection mechanism, there should be clear demarcations of waste types to be separated. This should be combined with re-using and recycling techniques.

Sorted waste is a resource. If they are to be used as raw materials to another industries, their quality is of concern. For instance in Kamikatsu's rigorous waste separation program, people not only separate but they

wash and clean certain things like chocolate wrappers before handing over to the collecting agency (Zero Waste Town, 2017).

However this study do not reveals the plight of unsorted waste of 65% of the respondents who do not separate waste. They most probably use the strategies like open burning, open dumping and burying, which are far more harmful to the environment. For future research it is recommended to study the waste disposal behavior of the respondents who do not separate waste.

## **Acknowledgement**

The author wishes to acknowledge that this paper was made possible by the support given by the Zonal Director and the staff of the Zonal Education Office Udugama and the guidance given by the lecturers of the National Institute of Education, Sri Lanka, University of Colombo – Department of Education, Faculty of Agriculture – University of Ruhuna and the Faculty of Agriculture – University of Peradeniya.

## **References**

- Abhayawardana, G. P. R. et al., 2012. Suggestions to Implement Integrated Solid Waste Management Plan in Galle Municipal Council Area, Galle - Sri Lanka: Faculty of Engineering, University of Ruhuna, Hapugala.
- Agarwal, R., Chaudhary, M. & Sing, J., 2015. Waste Management Initiatives in India for Human Well-being. *European Scientific Journal*, Volume ISSN 1857-7881, pp. 105-127.
- Graham, B., 2017. Health and Environmental Effects of Open Burning of Refuse and Other Solid Wastes, Saskatchewan: Lun Association of Saskatchewan.
- Hashim, K. S. H., Mohamed, A. H., Zahida, H. & Shah, M., 2012. Developing a Waste Minimization Awareness Model through Community based Movement: A case study of the IIUM Green Team. 5(5), pp. 112-123.
- How This Town Produce No Trash. 2016. [Film] Directed by Akira Sakano. Kamikatsu - Japan: Zero Waste Academy.
- Le Thi, T. L., Hisako, N., Yoshifumi, T. & Mitsuyasu, Y., 2017. Psychological driving forces behind households behaviors toward municipal organic waste separation at source in vietnam: A structural equation modelling approach. *Springer Japan* 2017, pp. 1052-1060.
- Low, S.-T., Tee, S.-Y. & Choong, W.-W., 2016. Preferred Attributes of Waste Separation Behaviour: An Empirical Study. *Procedia Engineering*, Volume 145, pp. 738-745.
- Mannapperuma, N., 2017. Business Opportunities Available in the Waste management Sector of Sri lanka, Waste Management Authority: s.n.
- Upadhyay, V., Jethoo, A. S. & Poonia, M. P., 2012. Solid Waste Collection and Segregation: A Case Study of MNTI Campus, Jaipur. *International Journal of Engineering and Innovative Technology (IJEIT)*, 1(3), pp. 144-149.
- Vassanadumrongdee, S. & Kittipongvises, S., 2018. Factors Influencing source separation intention and willingness to pay for improving waste management in Bangkok, Thailand. *Sustainable Environment Research*, Volume 28, pp. 90-99.
- Vij, D., 2012. Urbanization and solid waste management in India: Present practices and future challenges. *Procedia (Social and Behavioral Sciences)*, 37(ISSN1877-0428), pp. 437-447.
- Waste Management and Recycling Technology of Japan - Towards a Sustainable Society. 2017. [Film] Directed by Ministry of Environment. Japan: Japan Environmental Sanitation Centre.
- Xiaoping, D. et al., 2017. Comparison between students and residents on determinants of willingness to separate waste and Waste separation behavior in Zhengzhou, China. *Saga, Waste management & Research*, 35(9), pp. 949-957.
- Yoda, R. M., Chirawurah, D. & Adongo, P. B., 2014. Domestic waste disposal practice and perceptions of private sector waste management in urban Accra. *BMC Public Health*, 14(697).