Categories for Household Food Waste Sorting Analysis
Tokyo Method ver.2.0 (Mar. 2021)

SDG12.3 Research Group

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1. Background and purpose

The UN's Sustainable Development Goal SDG12.3 calls for member states to "by 2030 halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses".   As such, development of international indices for quantifying the performance on the reduction of food loss and food waste is in motion.   In addition to this goal, Japan's National Diet passed a bill in FY 2019 to promote the reduction of "*food loss*"[1].   It has thus become an imperative task for Japan to establish a national definition of "*food loss*" and to standardize a method for waste sorting analysis to accurately grasp the extent and nature of the country's food wastage issue.   Amid these circumstances, Japan's Ministry of the Environment published a manual in 2018 (hereafter referred to as the "Ministry of the Environment's manual") for opening and studying contents of trash bags to analyse household food waste (sorting analysis), encouraging local governments across Japan to cooperate in nationwide analysis.   Nevertheless, the manual's terminologies for indicating details of avoidable food waste lack sufficient definition, creating large inconsistencies in the results and making their use ineffective in accurately grasping the situation.

For this reason, since FY 2018, The SDG 12.3 Research Group has been continuously considering revised definitions for the various types of food waste, measurement methods, and sorting methods that could be effective in reducing food waste.   The purpose is to propose an internationally agreeable sorting method that: (1) makes it clear and easy to understand the concept of avoidable food waste, (2) is practical and does not overcomplicate the work of analysing the situation of food wastage, and (3) is useful in promoting effective engagements and policymaking aimed at reducing avoidable food waste.

2. The concept of avoidable food waste and the process of waste generation

The SDG 12.3 Research Group defines that avoidable food waste consists of "unused foods" and "leftovers" among total household food waste.   Unused foods are further divided into two categories: **A**: unused ingredients (food material for cooking) and **B**: unused ready-to-be-eaten foods (yet to be put on the table, or one whole unit of food items prepared until the last step before consumption).   We define avoidable food waste as the combination of **A** and **B** plus a third category **C**: leftovers (including leftover drinks). The details of these categories will be explained in Section 3-1.

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[1] In Japan, "food loss" (*shokuhin rosu*) is defined as "edible food that had been discarded uneaten".   We consider that the English equivalent of the Japanese "food loss" would be "avoidable food waste" as used by WRAP.   Food loss and food waste in SDGs have no difference in the meaning of whether or not including inedible parts of food. They have a difference in the original generation point (production, consumer etc).

Aside from this, we will classify the remainder of food waste into **D**: intentionally removed parts (food parts that are generally not eaten) as not constitutive of avoidable food waste.   These include parts of food materials intentionally removed in the process of cooking, as well as fruit seeds, clamshells, bare corncobs, and other such parts that remain on the plate after meals.   **D** is further divided into two categories: food parts that are physically edible but not commonly eaten (**De:** "possibly avoidable) and food parts that are "physically inedible" (**Di**), such as bones and shells.

As a note, the "possibly avoidable" category is more or less identical to WRAP's "possibly avoidable food waste" and also to "excessive removal" used by the Ministry of Agriculture, Forestry, and Fisheries (MAFF) and the Ministry of the Environment in Japan.

Figure 1 shows how avoidable food waste and non-avoidable food waste are generated during the flow of processes from the input of foods into the household (buying etc.) to final disposal.
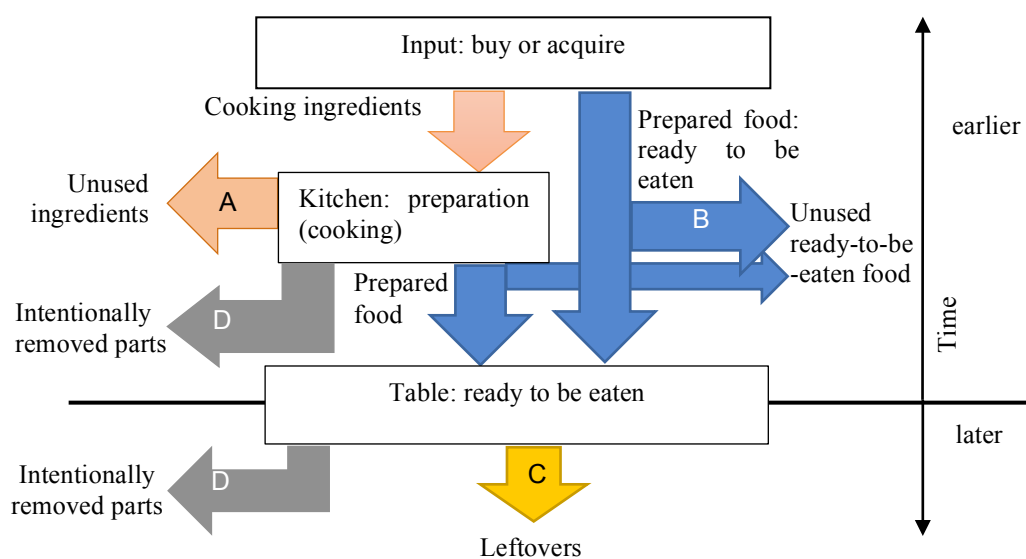

Figure 1: Stages of food waste generation

3. Method for sorting analysis of household food waste

3-1. Food entering the household and the classification of food leaving the household as waste

This section discusses the classifications of household food waste, based on the concepts discussed in section 2.

Foods that enter the household and are brought to the table

Ingredients

Cooking ingredients are foods that are generally expected to take part in some form of cooking or preparation before being laid on the table for consumption.   They include fresh foods, such as vegetables, fruits, fresh seafood, and dressed meat; processed foods, such as dairy products (including milk), tofu, *natto* (fermented soybeans), bread (excluding pastry buns and other bakery products fully prepared for consumption), and ham or bacon. *Chikuwa, hanpen* (fish cakes) and other perishable processed products that are typically delivered to stores daily; seasonings; some kinds of frozen foods, such as mixed vegetables; canned sweet corn.   Various sauces packed in hermetically sealed pouches, and such products sold as "dry foods" (groceries) are also considered ingredients.   Ingredients are usually sold in designated sections of supermarkets. Put simply,

ingredients are foods typically bought at supermarkets in preparation for cooking. We classify unused and disposed food ingredients as category **A**.

Ready-to-be-eaten foods

Ready-to-be-eaten foods are foods prepared until the last step before consumption or is ready to eat and they include: sandwiches, *piroshky* dumplings, steamed meat buns, fried foods, and salads sold as ready-to-be-eaten at supermarkets' deli or bakery sections; canned foods such as canned cooked sardines; foods contained in jars, such as pickles; ready-to-eat dishes in hermetically sealed pouches such as curry; "dry foods" prepared up until the last step before consumption, such as instant cup noodles; and sweets and snacks, including traditional Japanese sweets as well as western sweets, cakes, and snack confectioneries.

We classify uneaten ready-to-be-eaten foods disposed as a whole as **B**. Those that are partly eaten and disposed are classified as **C**.

Foods disposed by households as avoidable food waste
Unused foods A/B

We classify unused foods **A**+**B** into **A**: unused ingredients (entirely or partly unused) and **B**: unused or uneaten ready-to-be-eaten foods.

We classify both groups of unused foods (**A** and **B**) further into 1 or 2. Subcategory 1 refers to packaged foods unopened and discarded, while 2 refers to foods that were never packaged or that at some point were put in packaging but have been opened.

A1 refers to packaged ingredients that have not been opened (note that it does not need to be sealed). **A2** refers to ingredients not in packaging or in opened packaging, and these can be further classified into **A2w**: whole ingredients (i.e., uncut, etc.) and **A2p**: partly used ingredients. Examples of **A1** would be discarded, whole, packaged food ingredients, such as a whole packaged cucumber, or a whole packaged quarter of a cabbage head. Also, a remaining whole cucumber in an opened package that had contained a number of cucumbers is classified as **A2w**. However a remainder of a cucumber partially cut off and used, regardless of the size of the portion remaining (as long as the portion can be used for preparation), is classified as **A2p**. We would classify a package containing a quarter of a cabbage head which has been opened as **A2p** as well.

Among **A2w**, fruit and vegetable appearing not to have been sold and purchased, but obtained from places such as household vegetable gardens are classified as **A2wf**. Additionally, apostrophes following each primary letter category indicate drinks (e.g., **B'**, **C'**, etc.).

B1 consists of ready-to-be-eaten foods in unopened packaging. Regarding individual packaging, each individually packaged food counts as one. For example, if there is an opened bag originally holding twenty individually packaged crackers, and only three crackers remain, and if the individual packages of those three crackers have not been opened, they each count as **B1**. The never packaged or packaged but opened ready-to-be-eaten foods **B2** refer to ready-to-be-eaten foods that are yet to be put on the plate (table), or one whole unit of food with no traces of eating. These include whole, individual pastry buns, sandwiches, etc.; if there is one bag that originally had five pastry buns without individual packages, and only three remained in that bag, those three will each count as **B2**. If a ready-to-be-eaten item is contained in an opened packaging that does not function as a plate or a bowl (the packaging is intended for further storage) such as pickles and candies in

opened packages, the item qualifies as **B2**.   Boiled rice wrapped in cling film for storage for later use is **B2**.

Leftovers C

Ready-to-be-eaten or cooked foods (for example, put on a plate and laid on the table) that appear to have been disposed after being partially eaten count as leftovers. As a principle, items classified as **C** are found without packaging.   However, partially eaten food left in packaging that is designed to serve as plate/bowl (food that is designed to be eaten directly from the packaging) also qualifies as **C**: leftovers.   Parts that may have been left on the plate but are not expected to be eaten, such as bones are not **C** (they are **D:** non-avoidable).   The items enclosed in the boxes with the thickest lines (**A**, **B**, and **C**) of Table 1 are the classifications of <u>avoidable food waste</u> that our research group has established.[2]

Foods not constitutive of avoidable food waste (non-avoidable food waste)

Intentionally removed parts D

We have defined intentionally removed and discarded parts of foods not commonly eaten ("intentionally removed parts") as food waste that does not constitute avoidable food waste.   However, we will further classify these into **De**: possibly avoidable that are removed as they are not commonly eaten much or not eaten at all, and **Di**: inedible parts that are physically difficult to eat.   For example, **De** consists of vegetable scraps, such as the skin and leaves of a daikon radish or skins of potatoes and carrots etc., while the brown skin of an onion, husks and bare cobs of corn, and the skins of taro count as **Di**.   In general, fruit skins count as **Di** (although there is exception such as apple skins, etc.).   Small amounts of such items can be neglected (follow the general principle), but if there is a significant quantity, their potential edibility should be assessed and categorised respectively.

Unclassifiable E

E: unclassifiable refers to very fine food waste that gets caught in kitchen sink strainers, or food waste blended with non-food waste that is difficult to sort further.   Efforts should be made to sort as far as possible and to limit the amount classified as **E**.

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[2] If we were to incorporate "excessive removal" into avoidable food waste in accordance with MAFF and the Ministry of the Environment's pre-existing definition, that may mean inclusion of our "De: possibly avoidable" into avoidable food waste.

Table 1. Classifications of food waste

		A/B: Unused food	A: Unused ingredients	A1：【Unopened ingredients】(in packaging)
Food waste	Avoidable food waste			A2w：【Whole unused ingredients】（not in/no packaging)
				A2wf：【Home-grown vegetables】
				A2p：【Partly used ingredients】
			B: Unused ready-to-be-eaten food	B1：【Unopened ready-to-be-eaten food】(Unopened ready-to-be-eaten food in packaging)
				B2：【Uneaten ready-to-be-eaten food】Uneaten ready-to-be-eaten food (whole portion not in packaging or in opened packaging)
				B'：【Unopened drinks】
		C: Leftovers		C：【Leftover food】(partly eaten)
				C'：【Leftover drinks】
	Non-Avoidable food waste	D:【Intentionally removed parts】Parts that are not usually eaten	De:【Possibly avoidable】Potentially edible residues	
			Di:【Inedible parts】	
		E: Unclassifiable	E:【Unclassifiable】Blended fine particles not possible to be sorted further	

*The capital letters correspond to those in Figure 1.

3-2. Classification at actual sorting work

The classifications of food waste are as shown in Table 1, which is in accordance with the conceptual diagram shown in Figure 1. However, when actually performing a composition analysis, we will use the classifications of Table 2 for the purpose of making initial sorting easier. Sorting of unopened foods requires no pondering about classification. Therefore, they can be set aside to be further sorted later into **A**: ingredients and **B**: ready-to-be-eaten foods. Table 2 indicates that we first sort all **A** and **B** items into 1 or 2, before sorting them into their respective **A** or **B** categories. There is no difference in sorting order for the rest of the classification.

Table 2. Classification for sorting work

Food waste	Avoidable food waste	A/B Unused food	1 Unopened food	A1：【Unopened ingredients】
				B1：【Unopened ready-to-be-eaten food】
				B'：【Unopened drinks】
			2 Food not in packaging or opened packaging	A2w：【Whole unused ingredients】
				A2wf：【Home-grown vegetables】
				A2p：【Partly used ingredients】
				B2：【Uneaten ready-to-be-eaten food】

3-3. Examples of food items in the classification for composition analysis

Table 3 shows examples of types of food waste belonging to each classification. The following procedure is used to categorise the food waste in question during the composition analysis.

First, we will determine as to whether an unopened food is an ingredient, in order to determine whether it belongs to category **A**: ingredients or **B**: ready-to-be-eaten foods. Foods that require as little preparation as adding hot water or warming up in a microwave are to be treated as ready-to-be-eaten foods—not ingredients. This applies to cooked foods that can be laid on the table as they are, and foods already prepared to the stage immediately before they can be laid on the table. For example, unopened frozen foods, ready-to-eat food in hermetically sealed pouch, and instant cup noodles all fall into **B**: unused ready-to-be-eaten foods. Breaking down to the next level of classification, an unopened, frozen pizza or an unopened bag of frozen dumplings, for example, fall into **B1**: unopened ready-to-be-eaten foods. Many dry foods are ready-to-be-eaten foods. However, food items such as frozen boiled spinach and mixed vegetables that are unopened and discarded fall into **A1**: unopened ingredients, and if they are opened and discarded, they fall into **A2p**.

When food items such as cooked dishes, side dishes, etc., are discarded without packaging, they are treated as **C**: leftovers, as it is impossible in the analysis to determine whether a cooked dish has been discarded after being partly eaten or entirely uneaten. On the other hand, boiled spinach that has been cut and wrapped in cling film for preservation, or cooked rice that has been similarly wrapped for storage, will fall into **B2**. Partly eaten items in opened packaging that is designed to function as plate or a bowl will be treated as **C**: leftovers, while partly left items in an opened packaging which is designed for storage even after opening will be **B2**.

Table 3. Examples of detailed classifications of food waste

Food waste	Avoidable food waste	1. Unopened food	A1 Unopened ingredients	· fresh vegetables/fruits, raw meat, raw fish, grains, etc. contained in packages (including trays and containers) unopened · unopened dry noodles, raw rice, etc. (includes instant noodles) · mixed vegetables etc. among unopened frozen foods · processed meats, such as bacon, and processed seafood, such as fish cakes (unopened)
			B1 Unopened ready-to-be-eaten food	· deli foods, instant cup noodles, retort-pouched foods, frozen foods (excluding frozen ingredients), canned mackerel seasoned and cooked, pastry buns, sandwiches/rolls, snack food (an individually packaged piece), etc. in unopened packages
			B' Unopened drinks	· packaged (including containers) drinks (unopened)
		2. Food not in packaging or in opened packaging	A2w Whole unused ingredients	· a slice of bread, whole fruits and vegetables, a mostly-intact cluster of grapes, a single cherry tomato, a single banana, opened but untouched *natto*.
			A2wf Home-grown vegetables	· characteristically discarded in large amounts, these are vegetables that appear to have been obtained directly in fields, or persimmons that appear to have fruited in a household garden, based on uneven shapes/sizes or attached dirt.
			A2p Partly used ingredients	· raw rice, parts of fruits and vegetables (a quarter of an onion, half-a-cluster of mushrooms etc. grapes separated from their clusters, half of an unpeeled apple), meats without packages, cuts of raw fish, processed foods (chunks of dry noodles, half-a-piece of bread cut using a kitchen knife, half-a-tray-worth of tofu, part-a-bowl-worth of cereal, etc.), a bundle of dry noodles or a few dry noodles (no bags). · **food remaining enough to be cooked or used for cooking** · **The judgment as to whether enough remains for cooking is left to the investigator's discretion.**

		B2 Uneaten ready-to-be-eaten food	・a whole pastry role, a single pastry, dressed bread, a slice of pizza, a sushi roll, a slice of cake, etc. (no packaging) ・Partly used items left in opened packaging designed for further storage (larger than one portion) ・Boiled rice wrapped in clingfilm for later consumption ・**foods that do not show any traces on themselves of being eaten** ・**the judgment as to whether it is a single, whole piece of food is left to the investigator's discretion.**
	C. Leftover	C Leftover food	・home-made dishes, partly eaten pastry breads, etc. ・peeled and sliced apples ・all dishes without packaging ・partly eaten ready to be eaten food left in packaging that serves as plate/bowl (food that is designed to be eaten directly from packaging)
		C' Leftover drinks	・drink leftovers (opened)
Non-Avoidable food waste	D. Intentioally removed parts	De Possibly avoidable	・vegetable scraps (daikon skin, cores of leafy vegetables, the outer leaves of lettuce/cabbage), used cooking oils, skins of meats or fish, fat (tallow etc.), bread crust, etc. ・**parts that are edible but which the person cooking removed as parts not to be eaten** ・**the judgment as to whether it is edible is left to the investigator's discretion.**
		Di Inedible parts	・fruit skins, fruit cores, grape stems, the brown skin of an onion, corn husks and bare cobs, leaves and hulls of tomatoes/eggplants etc.. seeds, used coffee grounds or used tea leaves etc., bones, eggshells, seafood shells, etc. ・**the judgment as to whether it cannot be eaten is left to the investigator's discretion.**
	E. Unclassifiable	E. Unclassifiable	・ waste from kitchen sink strainers etc. or blended waste that is difficult to be sorted further

3-4. Sorting space layout (example)

Using buckets or basins placed on a large table, sort waste into **C**: leftovers, De: physically edible uneaten parts, Di: inedible uneaten parts, **A2w**: unused whole ingredients, **A2p**: unused partial ingredients, and **B2**: whole ready-to-be-eaten foods. Add **C'**: drink leftovers if there is extra space.

It is useful to have many buckets or basins. Use of a marker pen on adhesive tape will suffice for labelling.
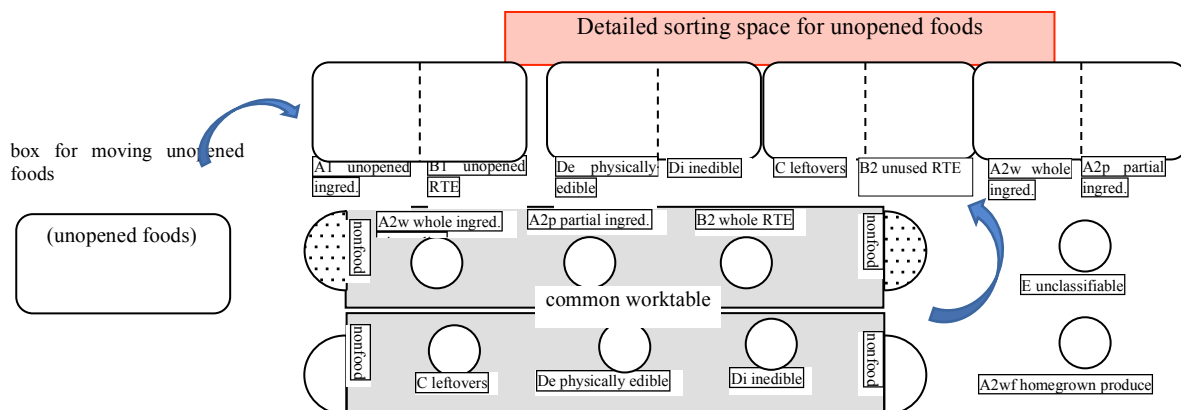

Figure 2. Sorting space layout example

3-5. Steps for sorting (example)

1. Collect sample waste (burnable /residual waste). Note: If possible, take samples from different types of residential areas (housing types).
2. Lay out material and equipment, such as plastic tarpaulin sheets and tables.
3. Lay out all sample waste.
4. Remove unsuitable samples (commercial waste, large amounts of vegetation waste, oversize waste, etc.).
5. Sort waste: It is up to the investigators making decisions regarding rough sorting, roles and placements, and postures (standing, sitting, etc.).
6. Take photographs of items that were difficult to decide how to categorise (be careful not to mix them with photographs of items that were not difficult to sort).
7. When all detailed sorting is completed, measure the amount (weight) per category.
8. Take photographs to record waste sorted into each detailed category, waste sorted by the larger classifications **A/B/C**, and the entire avoidable food waste.
9. Record the best before /use-by dates of foods for which packages remain. (optional)
10. Dispose of the sorted and weighed waste.

(Take photographic records of all stages.)

4. Examples of existing results of composition analyses

We have been able to put into practice the method suggested in this manual, thanks to cooperation of local authorities and subcontracted environmental consultancy companies.   The results of such composition analysis of household food waste are shown in this section.

Table 4. Results of household food waste composition analyses in Tokyo

Place of Analysis			Kodaira	Nagai	Seika		Kawaguchi			Koganei			District X		Setagaya		
Housing Types			Mixed	Mixed	Mixed		New Detached	Old Detached	Flats	Detached	Flats family	Flats single	Mixed		Detached	Flats	Mixed
Date of Analysis			Feb 21	Mar 20	Dec 19	Dec 18	Aug 19			Jun 19		Jul 19	Dec 18	Jul 18	Jan 21		Aug 19
Total Sample Waste[kg]			415	1507	300	306	104	105	97	181	224	133	82	70	259	258	131
Percentage of Food Waste[%]			33.5	40.1	52.0	44.8	27.8	32.3	37.9	44.8	54.6	25.9	41.5	44.3	27.3	21.4	32.1
Avoidable Food Waste	A: unused ingredients	A1:unopened	5.1	2.2	4.9	28.7	6.4	10.4	2.6	2.5	1.6	11.6	3.6	7.0	4.1	7.6	8.1
		A2w:whole	2.0	6.4	8.0		7.4	2.8	6.2	3.3	2.2	6.2	3.2		3.2	2.9	4.7
		A2wf:home grown	1.4	10.7	2.4		0.5	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
		A2p:partly used	7.8	6.8	13.6		5.8	4.5	9.1	6.0	2.9	10.0	3.6	5.9	7.2	13.0	7.4
	B:unused ready to be eaten food	B1:unopened	1.8	1.3	3.7	2.9	9.8	5.2	2.6	3.1	1.3	6.2	2.8	3.4	4.6	6.2	3.0
		B2:partly used	1.5	3.8	4.1		4.9	4.4	4.4	0.2	0.0	0.0	2.6	1.4	5.6	1.9	0.2
		B':drinks	0.1	0.0	0.0		0.0	0.7	0.0	0.0	0.0	1.5	0.0	0.0	0.5	1.4	3.2
	C:leftovers	C:food	9.2	12.9	13.7	18.3	20.6	15.4	25.1	17.2	7.0	27.0	15.1	9.8	17.4	25.3	14.5
		C':drink	0.0	0.1	0.1		1.0	0.5	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Non-avoidable FW	D:intentionally removed	De:edible	71.0	33.7	23.1	23.3	20.2	17.5	15.1	19.0	14.3	12.4	21.8	12.6	23.2	17.1	23.6
		Di:inedible		20.0	24.1	24.1	18.4	25.4	31.0	40.8	35.2	15.8	46.0	54.4	33.9	24.5	26.4
E: Unsortably Mixed Food Waste			0.0	2.2	2.4	2.7	5.0	3.2	3.6	7.6	35.5	9.3	1.3	5.4	0.2	0.0	7.9

Sampled waste is basically from the "burnable" collection of source-separated household waste.   Sample waste is picked up from collection points on the morning of routine collection day, before the usual collection vehicle came around.   Bags containing waste were put on to a flat-loading truck and brought to the place where the sorting analysis took place.   An exception is Nagai (Yamagata Pref), where a separate collection for compostable food waste is implemented.   Both the burnable and compostable waste were subject of sorting

analysis - the results indicate that the method is feasible for both mixed combustible waste and sorted food waste. With a labour force of about 10 staff, the sorting, weighing and recording procedure started in most cases around 9am, and could be completed by early afternoon.   With a couple of exceptions, the categorisation table of "level 5" was applied.   The results are shown in table 4, and figures 3, 4 below.
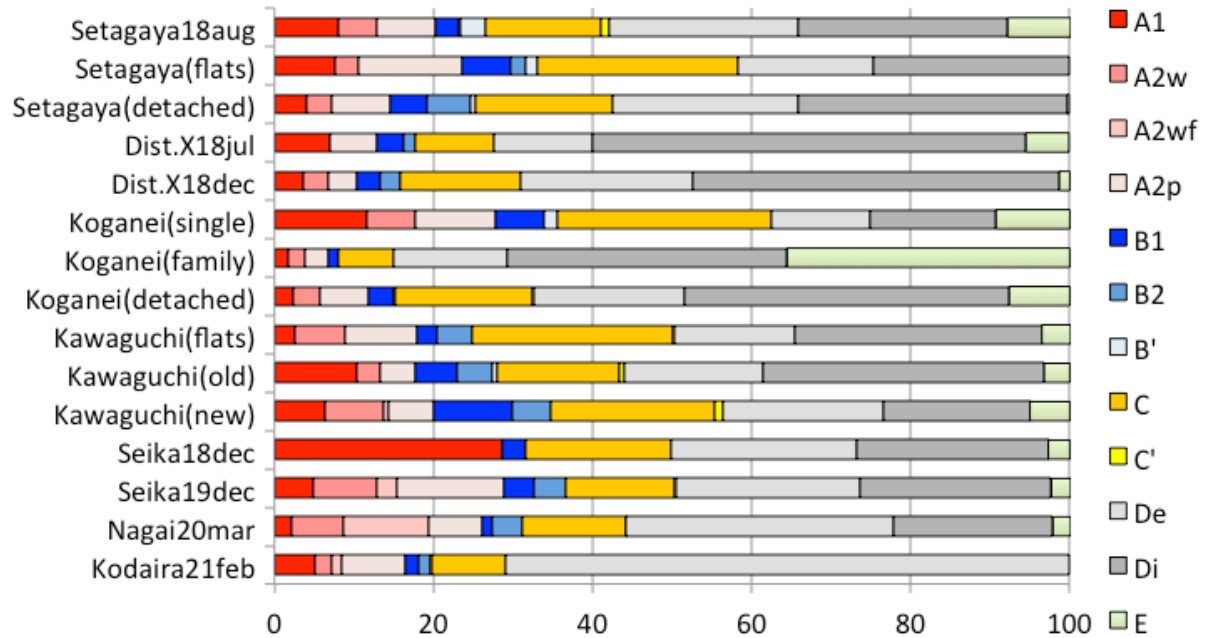

Figure 3. Composition of total food waste

As shown in figure 3, the proportion of "avoidable food waste" among "total food waste" were between 30-50%, and they basically agree with the Ministry of Environment (Japan) compilation average figure of 36% (2017).   If "excessive removal" (**De**) is added to the above, the values will be around 50-80%.
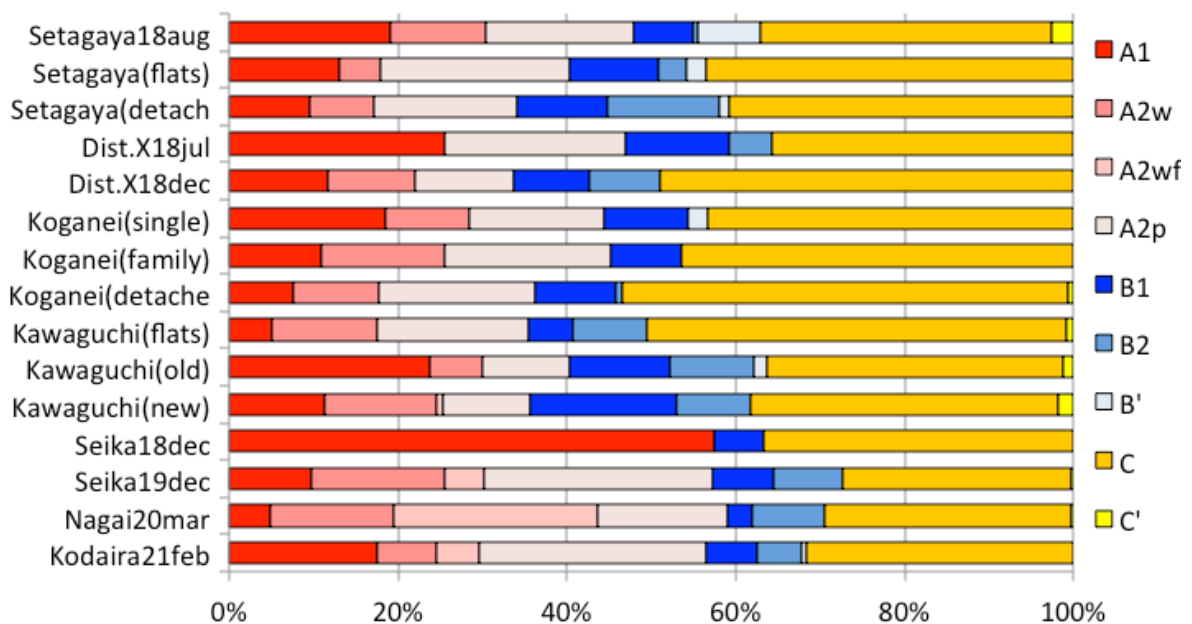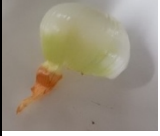

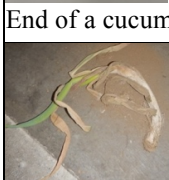Figure 4. Composition of Avoidable Food Waste

Figure 4 shows the ratio of each category item within "avoidable food waste". Unused / Uneaten food (**A** and **B**) constitutes about 60% and leftovers (**C**) 40%. If we include **De** ("possibly avoidable" fraction of intentionally removed parts) as avoidable, then **A** & **B** comprises about 40%, **C** 30% and **De** 30%. As a general tendency, samples from flats (apartment block areas) in highly urbanised areas tend to have a higher proportion of **B** and **C** categories, while in areas with a lower population density (detached housing, relatively rural areas), there is a higher percentage of **A** and **D**.

5. Examples of possibly confusing items

Table 5 shows some examples of items that could be confusing while conducting the sorting. Their photos and our basis of judgment are indicated..

Table 5. Examples of foods that investigators may find difficult to classify during sorting

Photograph	Candidate classifications	Final classification	Reason
Three sections of a sushi roll	B2: uneaten ready-to-be-eaten food C: leftover food	B2: uneaten ready-to-be-eaten food	Each single section could be considered a whole sushi.
burned spare ribs	B2: uneaten ready-to-be-eaten food C: leftover food De:possibly avoidable	B2 uneaten ready-to-be-eaten food	Should be judged as if it had not been burned / No trace of being eaten
The green parts of Japanese leek	A2p: Partly used ingredients De: possibly avoidable	De: possibly avoidable	They were considered to be edible, but not conventionally eaten, as it is customary to discard these parts in the Kanto region.
A single layer of an onion	A2p: partly used ingredients De: possibly avoidable	De: possibly avoidable	It was considered kitchen scrap, based on the assumption that it peeled off during removal of the brown skin (Di: inedible parts) and was discarded altogether.
A portion of an onion	A2p: partly used ingredients De: possibly avoidable	A2p: partly used ingredients	It was an onion sliced and partly missing, but it still had parts that could be used as an ingredient for cooking.
Radish (daikon) leaves	A2p: partly used ingredients De: possibly avoidable	De: possibly avoidable	Although eaten by some, parts of root vegetables exposed above ground are generally not considered as parts to be eaten.

 End of a cucumber	A2p: partly used ingredients De: possibly avoidable	De: possibly avoidable	It was decided that this piece was too small to be considered usable as an ingredient.
 A piece of Japanese leek	A2w: whole ingredients A2p: partly used ingredients	A2w: whole ingredients	Intact from roots to leaves, it is a single, whole ingredient (regardless of the volume of the bundle it was sold in).
 Sliced lemon	A2p: partly used ingredients C: leftover food De:possibly avoidable Di: inedible	De: possibly avoidable	Could be assumed that this was not intended to be always eaten, but still it is edible

6. Notes

The above-mentioned classifications are easily understood by housewives and people who regularly buy ingredients at supermarkets and cook at home.   This is likely because these people share a sense of distinction between food materials as ingredients for cooking and ready-made foods.   This reduces the chance of misunderstanding.   Conversely, people who do not regularly buy foods to cook at home may find it more difficult to judge how the waste should be categorised.   Careful briefing is necessary prior to sorting work for people who do not regularly buy foods to cook and also accustomed to the pre-existing classification schemes.