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Analysis of Socioeconomic Status of People and Generation Characteristic of Domestic Solid Waste Composition in Phnom Penh, Cambodia



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INTRODUCTION

- Solid waste management is one of the most challenging environmental issues faced by developing nation such as Cambodia.
- Solid Waste Management in Phnom Penh faces widespread difficulties in both the collection and disposal of solid waste (MoP, 2008).

INTRODUCTION (CONT.)

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- Surface and groundwater contamination, and soil pollution are also partly due to unsanitary Municipal Solid Waste Management (World bank,2003).
- **Effect:** High levels of mercury, cesium and cadmium have been found in the metabolism for the children scavenging the dump; around 500 people make their living on steung Mean Chey Disposal site (JICA,2005).

The information of solid waste is worth for local authority for management point of view, for private sectors for business point of view, and for academic sectors for research point of view.

OBJECTIVE

- **The specific objective of this study are:**
 - ▣ To characterize the solid waste physical compositions including moisture content and density of food, plastic, paper, and others waste.
 - ▣ To check the socioeconomic status of people through the survey on income, education, occupation, and family size in each household.
 - ▣ To analyze the correlation between solid waste composition generation with socioeconomic status.

LITERATURE REVIEW

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- The study on Solid Waste Management in the Municipal of Phnom Penh in the Kingdom of Cambodia (JICA,2005).
- Municipal solid waste management in Phnom Penh,Capital City of Cambodia (Seng et al.,2010).
- A Study on Household Solid Waste Characteristics in Phnom Penh City, Cambodia (Mongtoeun et al.,2012).

LITERATURE REVIEW (CONT.)

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□ Temporal change of typical composition of SW in Phnom Penh.

MSW Composition (%)	1999 ^a	2002 ^b	2003 ^c
Food/Organic materials	87	65	63.3
Plastic	6	13.2	15.5
Paper and Cardboard	3	3.8	6.4
Grass and Wood	-	-	6.8
Glass	1	4.9	1.2
Metal	1	1	0.6
Rubber, Leather	-	0.6	0.1
Textile	-	-	2.5
Ceramic and Stone	-	-	1.5
Other	2	11.5	2.1

^aMoE (2004)

^bKum et al. (2005)

^cJICA (2005)

□ Moisture content and density of waste from different sources (JICA,2005).

Type of sources	Moisture content (%)	Bulking density (Kg/L)
Household	68.8	0.24
Market	64.4	0.15
Commercial other shops	72.1	0.27
Commercial restaurant	67.3	0.32
School	44.4	0.13
Hotel	58.0	0.18
Street sweeping	19.1	0.19
Office	57.1	0.11

LITERATURE REVIEW (CONT.)

- **Relation of socioeconomic and municipal solid waste composition**
 - Several factors influence on consumption pattern are socioeconomic, environment and demographic condition (Keser et al.,2012).
 - Income level, family size, and education status is the major factors influence on solid waste generation.
 - (Davidson, et al.,1972) found that, high income family produced more waste than other rest household, while (Ali khant and Burney,1989) observed that the amount of total paper waste rise with income directly.

METHODOLOGY

Study Area

- Phnom Penh**—the capital city of Cambodia, consists of 12 districts in which new districts of Chroy Changva, Chbar Ampov and Prek Pnov, have been recently established (The Cambodia Daily, 2014).



Interactive map of Phnom Penh districts (MPP, 2013b)—Figure without scale.

Population growth rate in Phnom Penh city.

	1986 ^a	1993 ^a	1995 ^a	1998 ^a	2010 ^b	2015 ^b	2020 ^b	2025 ^b	2030 ^b
Growth rate (%)	11.3	5.4	2.7	-	4.56	3.67	2.53	1.47	0.71
Population (thousands)	561	810	854	999	1504	1835	2126	2334	2450

^a Mori (2000)

^b MoIAC (2011)

METHODOLOGY (CON.T)

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Materials

No.	Equipment Name	Functions
1	Balances of different scales (1 kg, 5 kg, and 30 kg)	Used to measure the density of MSW.
2	Density measurement containers	Used for measuring the volume of MSW.
3	Plastic bag	Used for household waste sampling.
4	Nitrile gloves, Mask	Used during fieldwork/activities engaged with MSW.
5	Hand sanitizer	Used for hand washing.
6	Safety glasses	Used for eyes' protection during activities engaged with MSW.
7	Others	Baskets, Bucket, Tent, and Sac



Sampling method and sample calculation

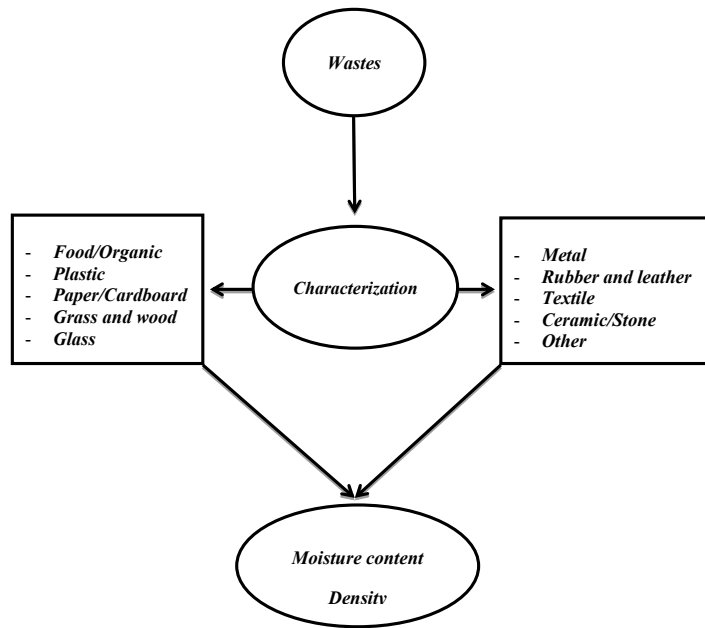
- Sample was performed with the use of **gridding system**; The map of Municipality of Phnom Penh was gridded horizontally and vertically with systematic interval 200m.
- 384 samples** was determined with the use of methodology for analysis of solid waste (SWA-Tool) by European Commission in 2004.

$$n = \left(\frac{t_{\alpha; n-1} \times \text{Var coeff} (x_i)}{\varepsilon_{\hat{\theta}, r}} \right)^2 \text{ for } f = \frac{n_{\text{sampling}}}{N} < 0.05$$

METHODOLOGY (CON.T)

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□ Schematic diagram for waste characterization

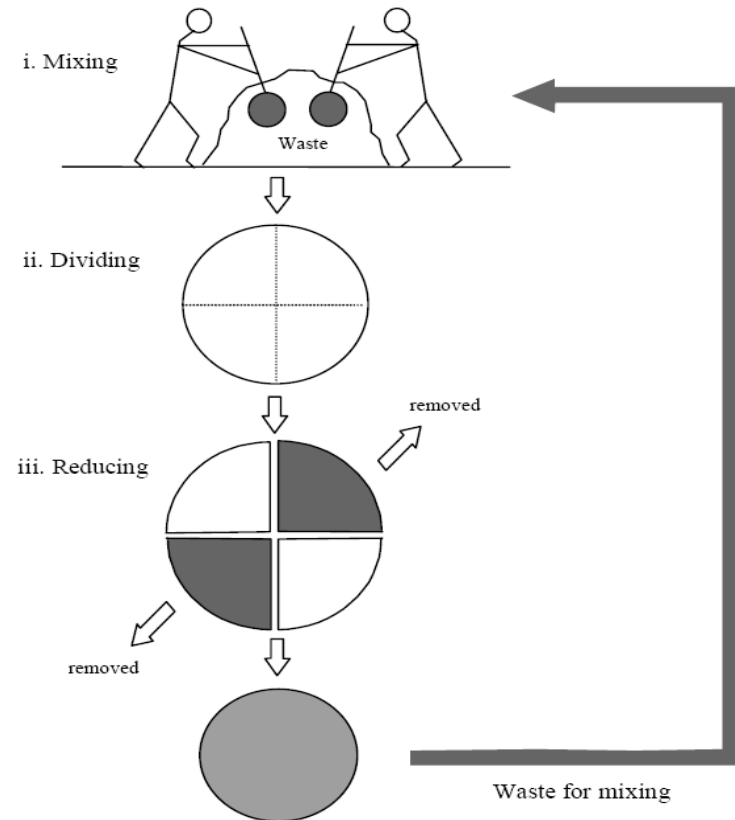


30cm

Density measurement



Moisture content measurement

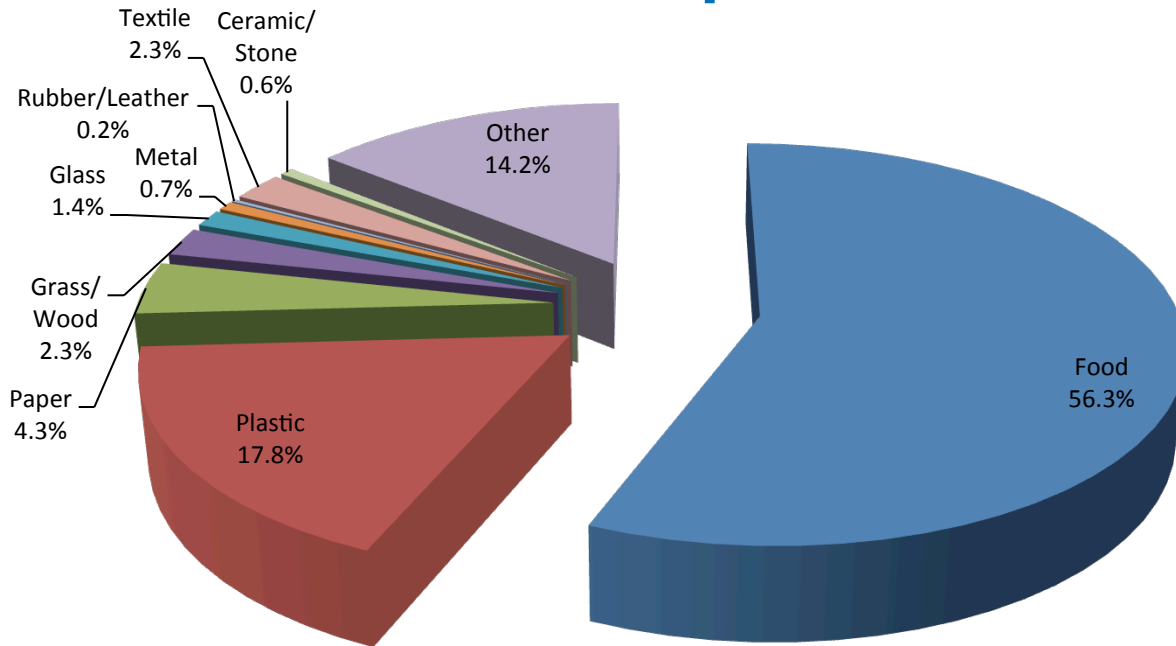


Reduction method (JICA,2005)

RESULTS AND DISCUSSION

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□ Solid waste composition in Phnom Penh



The largest proportion was **food wastes—56.3%** and rubber and leather was the smallest—**0.2%**, **plastic—17.8%**, paper—4.3% and other wastes—14.2%.

The percentage of **food waste (56.3%)** seem to be **slightly lower than** the previous study in **(Phnom Penh)—63.3% (JICA, 2005)** and the developing country—Nigeria (Abuja)—62.9% (Ogwueleka et al.,2013),however it was **significant higher than** in developed countries like **United States—12.5% (USEPA, 2008)**.

RESULTS AND DISCUSSION (CON.T)

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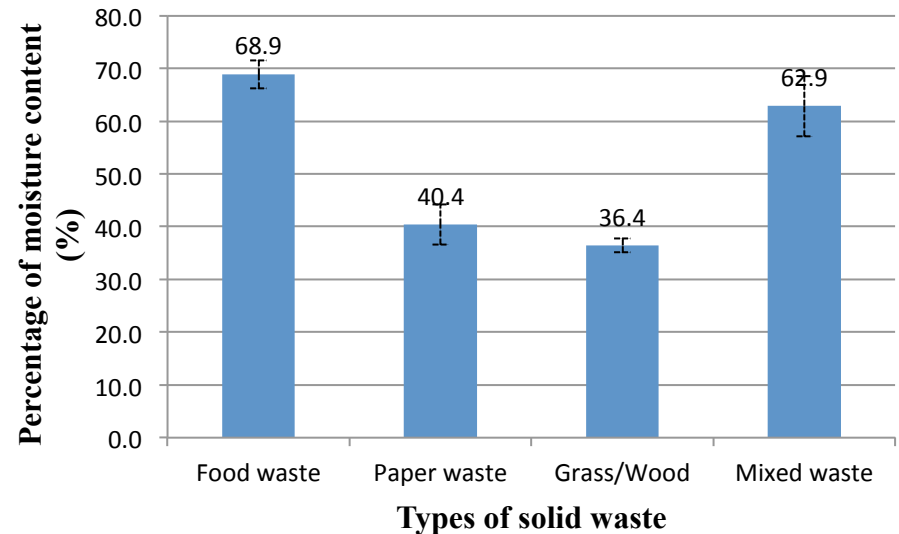
□ Density of household waste

(JICA,2005)—0.24 Kg/L

	Day							Average
	1	2	3	4	5	6	7	
Household								
Density (Kg/L)	0.22±0.13	0.24±0.07	0.28±0.09	0.35±0.09	0.31±0.17	0.31±0.15	0.37±0.04	0.30±0.05

□ Moisture content of household wastes

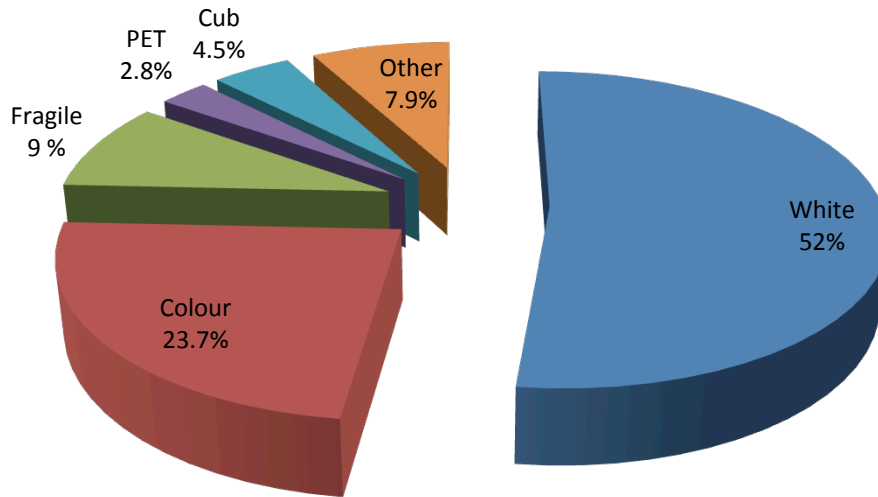
(JICA,2005)—68.8%



RESULTS AND DISCUSSION (CON.T)

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□ Composition of Plastic in Phnom Penh



White plastic was the highest portion—**52%** while the second largest was **color plastic**—**23.7%**.

The percentage of **plastic** seemed to **increase** from **15.5%** in 2003 (JICA,2005) to **17.8%** in present study. It is much higher than developing country—**Vietnam**—**6.13%** (Thanh et al.,2010) and developed nation—**Japan**—**9%** (Shekdar,2009)

RESULTS AND DISCUSSION (CON.T)

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□ Socioeconomic parameter:

Social demography variable	Frequency	Percent (%)	Cumulative percent (%)
Gender			
Male	106	28.34	28.34
Female	268	71.66	100
		100	
Household size (person)			
1-5 members	208	54.45	54.45
6-10 members	168	43.98	98.43
> 10 members	6	1.57	100
		100	
Occupation			
Government staff	72	20.11	20.11
NGOs staff	8	2.23	22.34
Company staff	34	9.5	31.84
Small business	141	39.39	71.23
Other	103	28.77	100
		100	
Education			
Below diploma	70	18.71	18.71
Diploma & higher	102	27.28	45.99
Bachelor & higher	202	54.01	100
		100	
Income			
Low income	35	22.29	22.29
Middle income	80	50.95	73.24
Upper middle income	16	10.19	83.43
High income	26	16.57	100
		100	

Socioeconomic is analyzed with the solid waste composition to determine its relations.

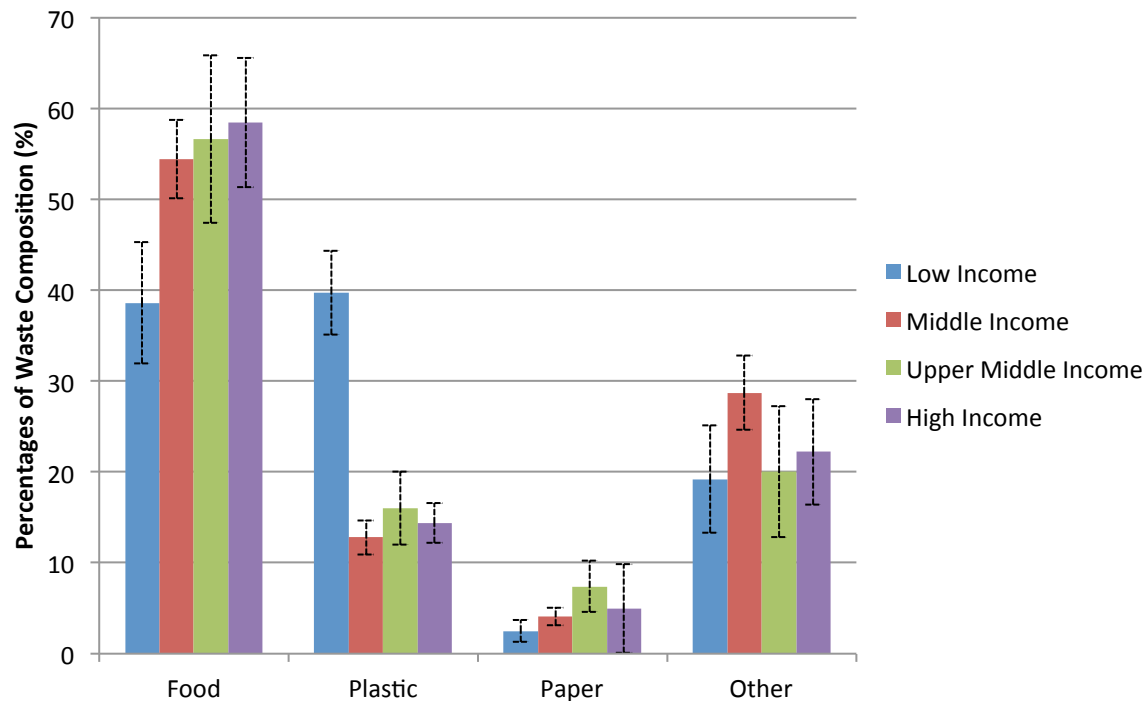
The socioeconomic parameters are:

- Income
- Education
- Occupation
- Household size

RESULTS AND DISCUSSION (CON.T)

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□ Solid waste composition by different income groups



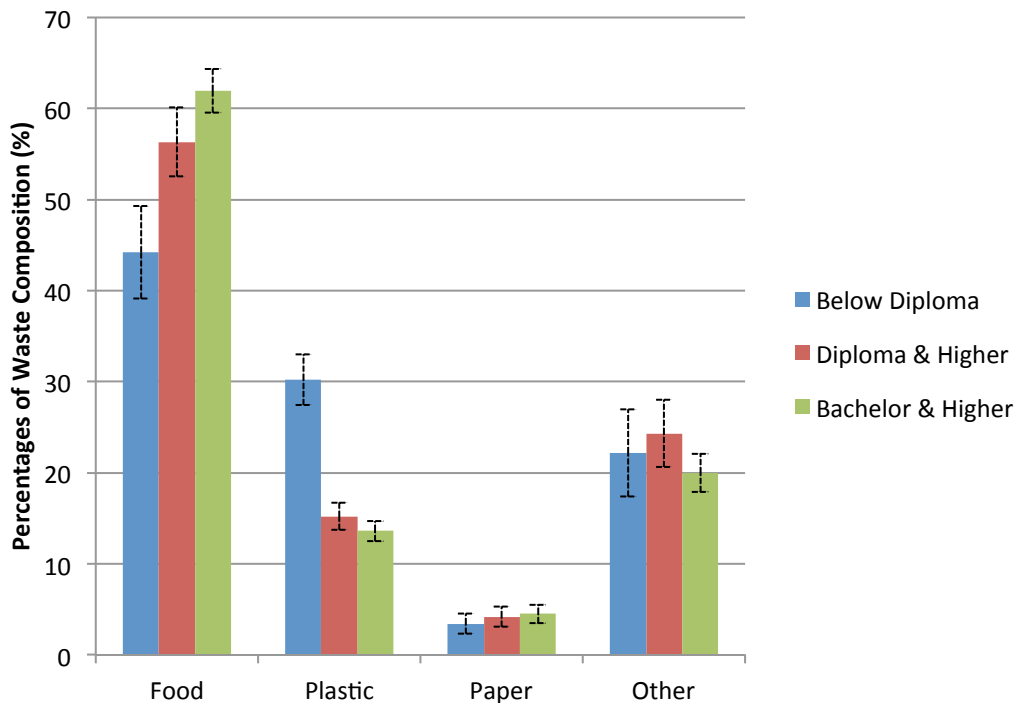
Plastic Composition:
High income—14.4% ;
Low income—
39.7%. The finding is **opposite** with the research in Iran—Ahvaz (Monavari et al., 2011).

Kitchen Waste: High income—58.4% ; Low income—38.6%. This result is **similar** with the study in Sri Lanka—Moratuwa (Bandara et al., 2007) and **contrast** with China—Beijing (Qu et al., 2009).

RESULTS AND DISCUSSION (CON.T)

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□ Solid waste composition by level of education



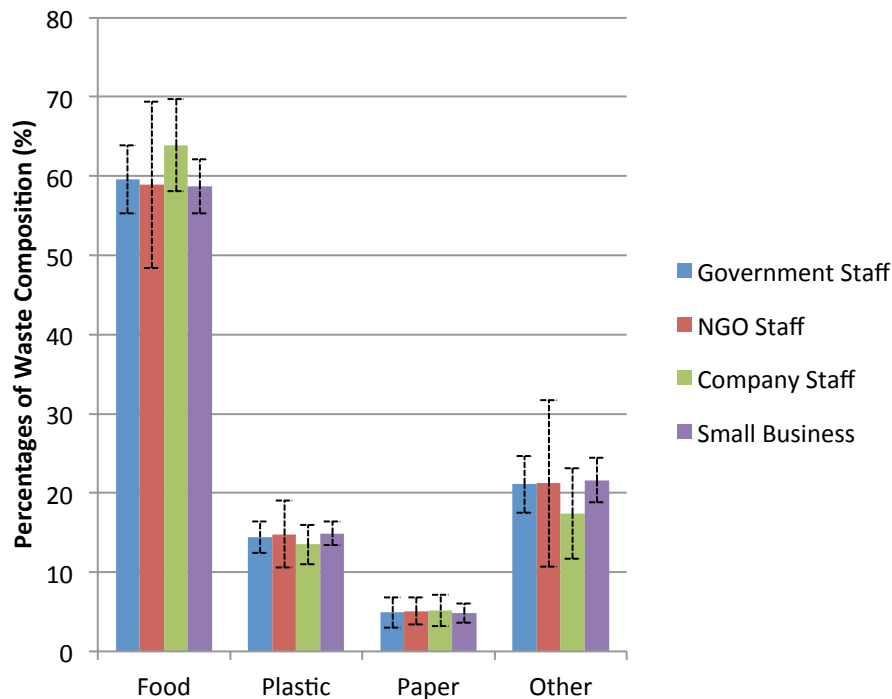
Plastic Composition:
High income—13.6% ;
Low income —
33.2%. This finding is **reverse** with the research in **China—Beijing (Qu et al.,2009).**

Kitchen Waste: High education—61.9% ; Low Education—44.2%. This result is **similar** with the study in **China—Beijing (Qu et al.,2009).**

RESULTS AND DISCUSSION (CON.T)

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□ Solid waste composition by employment groups

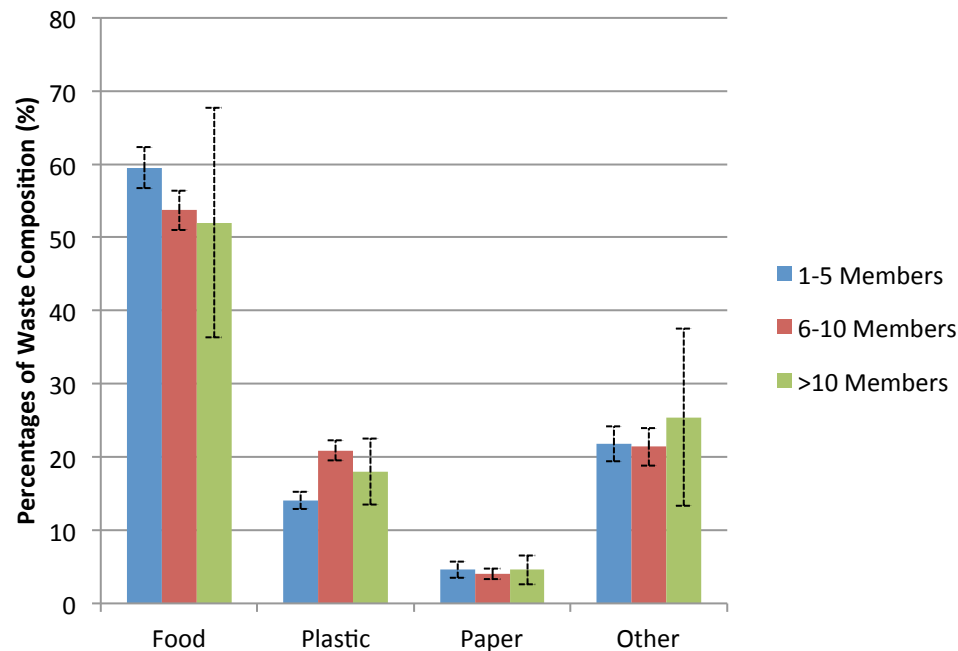


Kitchen Waste: Company Staff—63.9%, the rest group generates just between 58.7%—59.6%. The possible reason of high food waste from company staff household might be because their income inducing them to have meal at home.

RESULTS AND DISCUSSION (CON.T)

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□ Solid waste composition by family size



Kitchen Waste: Small family household usually generate the highest amount of food—**59.5%** follow by medium and large family, respectively with—**53%, 52%**. It can interpret that, It is hard to estimate all waste composition especially the kitchen waste base on family members since some large family household usually are too busy at work so they prefer having meal at work rather than at their home.

CONCLUSIONS

- The composition of household waste generated was dominated by food waste about **56.3%**, followed by plastics of about **17.8%**, other wastes of about **14.1%**, and paper waste of about **4.2%**. The moisture content of mixed waste was about **62.9%** and the density of waste was about **0.30 kg/L**.
- High income and high education level generates the largest amount of food waste, however **the composition of plastic** for low income and below diploma is **significant increase**.
- For paper composition, higher income produce more paper than the lower income.

Next..

- Thanks, the Asia Foundation for the project, and to look for more initiatives toward solid waste management
- Solid waste management and Green house gas emission in other urban area (Ex. Grant from AUN/Seed-Net JICA on gas emission on landfill from Siem Reap city KU, UT,..)
- GHG, air pollution such as from industrial, transport, waste water, open burning and incineration (ADB..?)



Thanks very much...