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Solutions for food waste management improvement of Ulaanbaatar city

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Abstract-Municipal solid waste has become one of the major challenges facing Mongolia over the years. According to the report published by the Ministry of Construction and Urban Development (MCUD) in 2024, approximately 2.9 million tons of solid waste are generated annually in Mongolia, out of which approximately 1.2 million tons are in Ulaanbaatar. However, only 17-20 percent was recycled while the rest was dumped directly into the landfills polluting the soil and adversely affecting livestock, animals and the health of the people. In Ulaanbaatar, food waste accounts for 41% of the total household waste in summer and 36.2% in winter. Statistical data released by the Mongolian National Statistical Office show that as of 2023, over 1.7 million people which account for over half of the Mongolian population reside in Ulaanbaatar, the capital city of Mongolia. Due to the growing population, the amount of waste generated in Ulaanbaatar has increased sevenfold in the last 3 years. If solid waste generated from variable sources are mixed with food waste, it can be difficult to recycle the mixed waste. Food waste sorting at source brings numerous benefits such as putting it into economic circulation through recycling, mitigating the adverse effects on the environment, and producing organic products. Therefore, in this study, we aim to raise awareness and understanding of waste, biodegradable waste, and the ways of sorting out and improving food waste. Moreover, we aim to publish a guidebook on Food Waste Management Improvement using the data gathered as a result of this study.

Key words: Waste management, Solid waste, Biodegradable waste, Recycling

1.INTRODUCTION

Since the time when humans evolved, grew and created civilizations, we have been producing large amounts of garbage that adversely affect the environment and pose major public health threats. The World Bank estimates that by 2050, global annual waste generation is expected to reach 3.4 billion tonnes, a 73% increase from 2020. The growth of global municipal solid waste will mainly affect the poorest countries where waste management practices and systems are poor or non-existent [1].

According to the latest studies, global municipal solid waste and industrial waste generation is expected to grow to over 4 billion tonnes per year and waste generation is expected to account for about 20 percent of greenhouse gas emissions, the main cause of global warming. Moreover, the researchers have found out that billions of people are infected with infectious diseases caused by soil pollution. Although the Government of Mongolia is taking and implementing specific actions to regulate waste management with the aim of alleviating the environmental problems, waste management is still a challenging issue for Mongolia.

The first law for overall waste in Mongolia was the Sanitation and Hygiene Law (1998) that aimed to ensure healthy and safe working and living conditions. Until the 2000, solid waste-related activities were regulated by (i) the Law on Import, Ban of Trans-border Delivery and Export of Hazardous Waste (2000); (ii) the Law on Domestic and Industrial Wastes (2003); and (iii) the Law on Ban of Some Plastic Bags Consumption (2009). The Law on Household and Industrial Waste, which came into enforcement on 1 July, 2004, and a part of the Waste Law 2003 was the first designated law on solid waste management in Mongolia. This law governed waste collection, transportation, storage, and landfill of the household and industrial waste, reuse of the waste as secondary raw material, and ensured effective measures to prevent the negative impacts of wastes on public health and the environment. In 2012, the new Law on Waste was passed by the State Great Hural. It emphasized the introduction of the 3R principles to improve solid waste management and forms the regulatory basis of waste segregation at source. In 2017, the Mongolian Parliament approved the Revised Law on Waste [2].

Under the “Improvement of Waste Management in Ulaanbaatar City Project" implemented in the periods of 2006-2013 by the Japan International Cooperation Agency (JICA) with the financing from the Japanese Government Grant Aid, the Narangiin Enger, a centralized disposal site for disposal of municipal solid waste, was built and equipment such as waste collection vehicles and heavy machineries were procured. The implementation of the small-scale pilot projects aimed at promoting waste reduction and separation at generation source in the khoroos of some districts and the establishment of waste sorting plants greatly contributed to the successful introduction of the latest waste management and technology at national level and the change in mentality and behavior of the policy makers, the entities engaged in waste transportation and recycling, and the public. These activities laid the foundation for the successful implementation of the waste management projects.

The aim of the study is to mitigate the adverse impacts caused by waste on the environment by encouraging food waste management like sorting, and recycling and raising awareness about food waste management among the citizens and the entities. Currently, Mongolia has no adequate regulatory framework for food waste management and small and medium sized entities engaged in waste recycling lack industrial experience, machinery and equipment. In addition to these, corporate social responsibility activities carried out by the public and private sector in relation to food waste management are relatively weak.

2. LITERATURE REVIEW

2.1 Current state of waste management in Mongolia

Waste is defined as any unwanted and unusable material that is of no use or industrial residues, but at the same time it is regarded as raw materials as well. Human life is dependent on nature. Although everything that mankind uses is obtained from nature, only two percent is properly used and the rest is just wasted. We, the humans, are polluting our world without realizing depleting natural resources and overwhelming amounts of waste generation.

On average, waste generated per capita per day is estimated at 0.197 kg, meaning that Ulaanbaatar, which is home to 1.619.721 people [3] produces 319.085 kg waste per day and 116.466 tonnes of food waste per year. It should be noted no specific studies have been conducted with regard to Ulaanbaatar city food waste management yet, however a few similar

studies have been undertaken previously. The previous studies are given below. First, In 2019, the "Ulaanbaatar household waste composition study" was conducted by the Ulaanbaatar City Mayor's Office in collaboration with the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, the United Nations Environment Programme, and the Asia Foundation. As part of the household waste composition study, a total of 1487 waste samples were collected from 132 households that participated in the study [4]. Second, "Waste volume and composition study I" ("The Study on Formulating Master Plan for Solid Waste Management Improvement of Ulaanbaatar City in Mongolia") the JICA, the Kokusai Kogyo Co., LTD (Waste data collection in winter, December, 2004). Third, "Waste volume and composition study II" ("The Study on Formulating Master Plan for Solid Waste Management Improvement of Ulaanbaatar City in Mongolia") the JICA, the Kokusai Kogyo Co., LTD (Waste data collection in summer, June, 2005) [5].

At present, the "Ulaanbaatar Community Food Waste Recycling Project" funded by the ADB with the financing from the Japan Fund for Poverty Reduction is being implemented with the purpose of converting food waste to composting [6]. The project is to be implemented in 2020-2023. Although this is the first food waste-related project implemented in Mongolia, in this study, we aimed at presenting possible solutions to the conversion of food waste to convert into other products except composting. Additionally, the study aims to mitigate the adverse impacts caused by waste on the environment by encouraging food waste management like sorting, and recycling and raising awareness about food waste management among the citizens and the entities.

Three main waste disposal methods widely used in Mongolia are as follows.

First, Incineration is a process of burning solid waste materials at a high temperature and converting into ash, flue gas and heat. The very high temperatures used by incinerators remove toxic substances and chemicals in waste materials and the heat generated by incineration is used in producing electricity. Incineration is regarded as highly effective, as hazardous and toxic substances that have negative impacts on the environment are removed and destroyed during this process [7]. Germany and Austria lead the world in incineration technology. German company Steinert, one of the world's top manufacturers of waste recycling products, is interested in entering the Mongolian market by offering its products. One of the most distinct advantages of incineration is that it can reduce the volume of any waste by 70-80 %, thus the amount of waste sent to landfills will be decreased as well.

Second, Landfilling, one of the most widely employed methods for waste disposal, is a process of transporting and dumping segregated waste directly to a waste disposal site and burying it in the ground. Hazardous waste is segregated prior to landfill. Landfilling is viewed as the least desirable option, but many developing countries widely use this method nevertheless. One of the disadvantages of landfill is that it causes soil and air pollution and some persistent organic pollutants may result in release of dioxins and furans into the environment [7].

Third, Today resource reuse is regarded as the most effective way of reducing waste as it has numerous positive impacts on energy, economy, and environment. Recycling, the third component of the "Reduce, Reuse, and Recycle" waste hierarchy, has many benefits such as reducing the amount of wastes sent to landfills, preventing water pollution, and lowering greenhouse gas emissions [8].

Food waste management: According to the study on household waste composition, food waste accounts for 20-30% of the waste sorted at source. Food waste is one of the biodegradable waste that can be found in solid waste. Food waste management refers to the processes of making products made from food waste, recovery, recycling, and disposal.

Ways of recycling food waste:

- Food waste reduction at source
- Food waste recycling
- Composting
- Incineration
- Landfilling

Since the natural resources are limited, resources and materials that we are using in our life will run out one day. Therefore, recycling is important to reduce the use of natural resources. Increasing resource efficiency, preventing waste

generation and using waste as a resource are important strategies to switch to the circular economy, a model which shows how to convert waste into final products [9].

Legislation: There are no special provisions regarding food waste in the law on Waste and all waste except hazardous waste is defined as municipal solid waste. Additionally, Mongolia has no law regulating liquid waste. Therefore, a special chapter governing all relations concerning food waste should be included in the existing law.

Characteristics of food waste: Almost 30-40 percent of food is lost and wasted before it reaches the consumers. Food waste occurs for a variety of reasons such as short-dated products, spoilage, products damaged during production and transportation, poor hygienic conditions and incorrect labeling.

Food waste generation: Studies show that an economic state of the country affects food waste generation. When countries experience a financial crisis, food waste generation tends to drop whereas rapid economic growth leads to higher food waste generation.

In general, the developed countries generate much higher quantities of waste per capita compared to the developing countries of the region.

Main sources of food waste generated in Mongolia are given below.

- 44% from households,
- 33% food processing and service companies, and
- 23% from other sources /Industrial sector/

Waste collection: Collecting food waste at source is crucial. Frequency of waste collection may be increased depending on the waste generation and the size of waste storage containers of the entities and organizations.

Waste transportation: Unlike other waste, food waste is likely to emit odors and gas. Thus, it is required to put waste disposal coolers in dump sites or to create the conditions and the temperatures suitable for bacteria to grow and decompose wastes effectively. Food waste must be transported with garbage trucks equipped with a temperature monitoring system.

International best practices and studies in food waste prevention: The newly revised legislation on waste adopted by the EU in scope of its circular economic strategy has introduced a number of targets and provisions aimed at preventing and implementing the sustainable management of bio-waste. Bio-waste is the largest single component of municipal waste in the EU, accounting for 34 % of the total volume of waste generated. Recycling of bio-waste is vital to meet the EU target to recycle 65 % of municipal waste by 2035 [10].

Denmark has succeeded in reducing its food waste by 25 percent in 5 years as a result of a series of actions and campaigns designed to reduce food waste. Denmark, one of the world leading countries in the fight against food waste, is setting a good example for the European countries with high consumption. In 2017, Denmark opened its first “Wefood” supermarket, a chain of shops selling surplus foods, in the capital city Copenhagen. By opening this supermarket, over 700.000 tons of food are prevented from being wasted annually.

Japan generates energy and gas by recycling waste, particularly food waste. The growing waste volume causes increasing water consumption used in recycling. Thus, it started establishing biomass power plants. Biomass is organic materials that come from trees, plants, and agricultural and urban waste. It is used for heating, electricity generation, and transport fuels. Biomass power plants use organic materials such as waste or residue from logging or agriculture to generate electricity [11]. Sweden leads the world in waste-to-energy technology. Waste is a fuel used in the Swedish heating system. Although around 2 million tonnes of waste is burned annually to generate energy, it is not enough for its waste-to-energy plants, therefore it imports about 1.3 million tonnes of garbage from Norway, Ireland, and the UK.

2tonnes of garbage incinerated with the Swedish waste-to-energy technology generate power equivalent to 1tonne of coal. Coal is a valuable mineral whereas garbage has no value, thus, the waste-to-energy plants operate profitably. The Swedish government offers tax incentives for the companies operating in the waste recycling sector [12].

In the past 8 years, the Favela Orgânica, a pioneer initiative originated in Brazil, has prevented over 37000 tons of food from being wasted and reaching landfills and distributed 110 million plates of food to the people in need. According to Regina Tchelly, the founder of Favela Orgânica, the aim of the organization is to change the relation between the people

and food and making consumers aware of each stage of the food cycle, from purchase through preparation and disposal of food.

According to the World Resources Institute (WRI), Brazil annually delivers 41 thousand tons of food to landfills, making the country one of the top ten food-wasting countries. Moreover, a report published by the Food and Agriculture Organization of the United Nations (FAO) shows that food insecurity has increased in the country. The number of people who were food insecure was 4.9 million in 2010, yet the figure rose to 5.2 million in 2017.

Favela Orgânica promotes a change in the culture of consumption and waste by hosting lectures, catering events with recovered and healthy foods, and training kitchen and cafeteria staff to value typically-wasted parts of food as part of a healthy lifestyle. Through a partnership with vegetable markets, the organization collects vegetables that are discarded in Rio's markets and teaches the residents some of their over 500 catering recipes that utilize watermelon rinds, banana peels, broccoli stems, and other commonly discarded vegetable parts. As a result of these activities, many local residents now understand that if they use vegetables fully, it is possible to buy less and cook more with the same amount of food [13].

SWOT analysis has been made to determine and conduct comparative analysis of both external and internal factors contributing to food waste.

Table 1: SWOT analysis

Strengthens - Production of end products made from certain types of food waste - Locations suited to logistics - High-potential market opportunities - Ongoing projects and programs on food waste recycling	Weaknesses - No specific legislation and regulations regulating waste food - No specific legislation and regulations regulating liquid food waste - Citizens are not accustomed to a culture of proper food waste sorting and have no knowledge about food waste - A lack of suitable infrastructure facilitating waste food sorting
Opportunities - Environmentally friendly products - Less spending on landfilling and incineration - Citizens provided with the opportunities of selling compost and fertilizers made from waste food - Active public participation in waste management	Threats - Quality of products made from food waste is poor - Low consumer trust - Goods imported tend to have good quality - The public are not familiar with food waste management and not aware of its importance

TOWS analysis: To gain better understanding of the strategic choices that we have, the TOWS analysis is conducted in the following manner by comparing the strengths and weaknesses, opportunities, and threats.

Table 2: TOWS analysis

External environment	Internal environment		
	Opportunities	Strengths & Opportunities	Weakness & Opportunities
		● Fully processed and re-used food waste ● Good project outcomes ● Export substituting goods and materials	● Pass a law on food waste ● Encourage citizens to sort food waste ● Develop infrastructure for food waste sorting
	Threats	Opportunities & Threats	Weakness & Threats
		● A decrease in sales of recyclable products ● Adverse environmental impacts	● A product with no demand ● Low public trust ● Challenging issues related to food waste

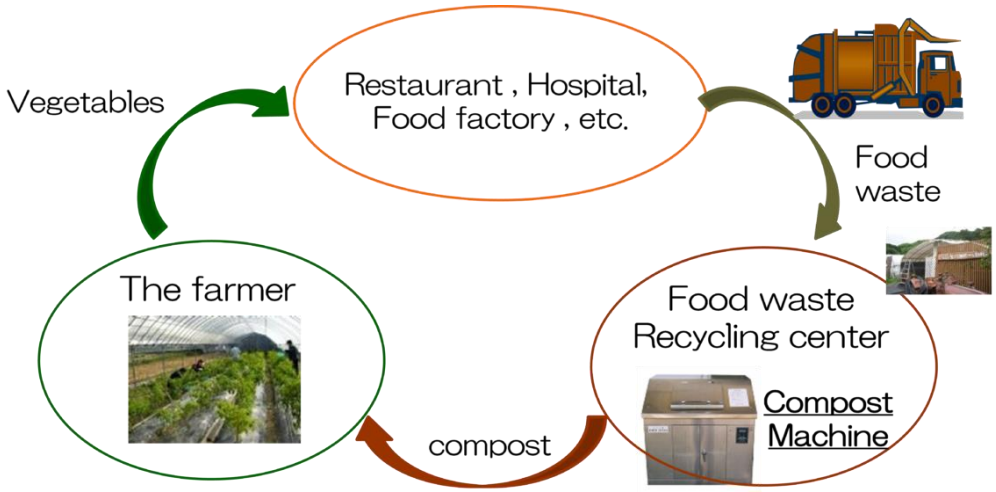

Fig 1. Scheme of food waste recycling

3. RESEARCH DESIGN

Research area: The study was conducted in the city of Ulaanbaatar covering all its 6 districts. **Research methodology:** A questionnaire with 24 questions was taken from a total of 384 participants and data analysis was performed by employing the SPSS 26 software program.

Research objective: 3 proposed hypotheses were proven by the research findings. The findings show it is required to establish food waste collection and disposal infrastructure facilities that enable the Ulaanbaatar city residents to sort out food waste.

The research hypotheses of this study are as follows:

H1: Food waste sorting has a positive effect on making compost.

H2: The residents of the apartments and ger districts generate the same amount of food waste.

H3: Inadequate and poor infrastructure facilities for food waste affects household food waste sorting.

4. RESEARCH RESULTS

4.1 Quantitative research

As part of the study, we conducted data collection employing both quantitative and qualitative surveys. A quantitative survey questionnaire containing 24 questions assessing household food waste sorting was carried out involving 384 participants selected at random while a qualitative survey conducted in the form of an interview involved 3 experts. The survey was carried out online via the Google form and in-person interviews. As of 2022, the population of Ulaanbaatar city is 1.639.172 and this number has been determined as the population. Therefore, with a 95% confidence level, a standard deviation of 0.5, and a confidence interval (margin of error) of 5%, the sample size is 384. In the study, we used the SPSS 26 software program for data processing analysis and the research reliability determined the consistency and the

relationships between factors of sorting food waste, putting garbage in a waste bin, and making compost by using a Bokashi bucket.

Statistical analyses employed in this study are as follows.

- Reliability analysis
- Factor analysis
- Correlation analysis
- Factor correlation analysis
- Regression analysis

The survey involved 384 participants residing in 6 districts of Ulaanbaatar city. 79.2% are female and 20.8% are male. 19.5% of the survey participants are aged 20-30 whereas 78.1% of the respondents are aged 30-40. 2.4% of the people surveyed are between the ages of 40-50. In terms of education background, 52.1% or the highest percentage of the respondents have a complete secondary education. 36.5% have higher education while 3.9% have obtained vocational education. 24% of the respondents have Ph.D. and MA degrees. In terms of employment, 45.8% of the respondents work for the private sector and 7.3% are self-employed. The people who responded as unemployed account for 6.5% whereas students and pupils account for 36.5% and 3.9% are sole-traders. In terms of income, the highest percentage or 36.5 % are the respondents with an income of 1000.001-2000.000 whereas 16.9% are the people with an income of 2000.001- 3000.000. 7.8% of the people surveyed have an income of 3000.001-4000.000 and 8.9% have an income of over 4000.000. 13% have an income of 420.001-1000.000 while 16.9% of the respondents have an income of over 420.000.

Table 3: Summary statistics-Descriptive statistics

Demographic profile of respondents		Total	Percent	
		By number	By percent	Cumulative percent
Gender	Male	158	41,2	20,8
	Female	226	58,8	79,2
Age	20-30	75	19,5	19,5
	30-40	300	78,1	78,1
	40-50	9	2,4	2,4
Education	Primary education	5	1,3	1,3
	Secondary education	200	52,1	52,1
	Vocational education	15	3,9	3,9
	Higher education	140	36,5	36,5
	PhD and MA	24	6,2	6,2
Employment status	Unemployed	25	6,5	6,5
	Self-employed	28	7,3	7,3
	Private entities	176	45,8	45,8
	Sole trader	15	3,9	3,9
	Students and pupils	140	36,5	36,5
Average monthly household income	Up to 420’000	65	16,9	16,9
	420’001-1’000’000	50	13	13
	1’000’001-2’000’000	140	36,5	36,5
	2’000’001-3’000’000	65	16,9	16,9

	3’000’001-4’000’000	30	7,8	7,8
	Over 4’000’000	34	8,9	8,9
Family members	Single	17	4,4	4,4
	With children	13	3,4	3,4
	With parents	176	45,8	45,8
	With a spouse	34	8,9	8,9
	With a spouse and children	37	9,6	9,6
	With grandparents	5	1,3	1,3
	With friends	5	1,3	1,3
	With a brother (sister)	69	18	18
	With a younger sibling	28	7,3	7,3
Family size	1	10	2,6	2,6
	2	50	13	13
	3	75	19,5	19,5
	4	120	31,3	31,3
	5	69	18	18
	6	35	9,1	9,1
	Over 6	25	6,5	6,5
District of residence	Bayangol	107	27,8	27,8
	Songinokhairkhan	89	23,1	23,1
	Sukhbaatar	37	9,6	9,6
	Bayangol	58	15,1	15,1
	Khan-Uul	58	15,1	15,1
	Chingeltei	35	9,3	9,3

Reliability analysis: Cronbach's alpha measures reliability, or internal consistency of survey questions and ranges between 0 and 1, with higher values indicating that the questionnaire is more reliable. (Gliem, 2003). The questionnaire with 24 questions the citizens' understanding of “Household food waste” and the reliability of each question was assessed and confirmed. The questionnaire with 24 questions the citizens' understanding of “Household food waste” and the reliability of each question was assessed and confirmed.

Table 4: Cronbach’s alpha-Reliability analysis

Test	**Number of items**	**Reliability level**
Questionnaire on household food waste	24	0.797

The overall Cronbach's alpha coefficient for the questionnaire survey on household waste food was over 0.79 as demonstrated in Table 4, indicating a reliable level.

Factor analysis: When performing the Factor analysis, we set the absolute value to be greater than 0.5. KMO values can be interpreted as per the following table:

Table 5: KMO

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.881
Bartlett's Test of Sphericity	Approx. Chi-Square	2855.383
	df	.276
	Sig.	.000

As shown in Table 5, the KMO value was 0.881, indicating that the sample size was well suited for factor analysis.

Table 6: Factor analysis

	Variables	Rotated Factor Matrix			
		1	2	3	4
Food waste sorting knowledge, information and awareness of the citizens	2. What percentage of the following accounts for your household food waste? [A. Egg, egg shell] [B. Fruits, fruit peel] [C. Vegetables and vegetable peels] [D. Meat or meat residue] [E. Flour waste] [F. Leftover bones] [G. Used cooking oil] [H. Others]			.575	
Whether a respondent sorts food waste or not?	7. Does your family sort waste?	.721			
	7.1 Of the following, what is the reason for not sorting food waste?	.668			
	7.2 Do you face any problems associated with food waste sorting?	.525			
	8. In your opinion, what factors would greatly contribute to regular food waste sorting?	.524			
	10. I will put trash in a sorting bin if the issues related to food waste sorting are resolved.	.606			
Whether a respondent makes or knows about technological and manual composting?	11. I know that compost can be made from food waste. 12. Have you ever made compost using a Bokashi bin?		.740 .684		
Food waste infrastructure facilities and management	13. What do you do to prevent food waste?				
	14. Do you think that the joint collaboration of the state, the private entities, and the citizens will improve waste management provided they all sort out waste and improve infrastructure?				.560 .612

In performing the factor analysis, we included all variables to examine the factor loadings for each of the variables. As a result, some of the variables were extracted and the factors illustrated in the table above remained.

Table 7: Factor correlation analysis

	Waste sorting knowledge, information and awareness of the citizens	Whether a respondent sorts food waste or not?	Whether a respondent makes or knows about technological and manual composting?	Food waste infrastructure facilities and management
Food waste sorting knowledge, information and awareness of the citizens	1	0.843**	0.689**	0.608**
Whether a respondent sorts its food waste or not?		1	0.571**	0.874**
Whether a respondent makes or knows about technological and manual composting?			1	0.367**
Food waste infrastructure facilities and management				1

Correlation analysis: Since every factor was examined by employing ordinal and nominal measurement scales of the Likert scale, we used Kendall's tau (τ) coefficient. If the p-value is ≤0.05, we can assume that the correlation is statistically significant. Since we used ordinal and nominal measurement scales, the correlations were calculated with Kendall's tau (τ) coefficient which examined the factor correlations. Kendall's correlation was tested with linear factor correlation. There is a very high positive relationship between waste sorting knowledge, information and awareness, and whether a respondent sorts food waste or not. There is a very high positive relationship between whether a respondent sorts food waste or not, and food waste infrastructure facilities and management. There is a high positive relationship between waste sorting knowledge, information and awareness of the citizens, and whether a respondent makes or knows about technological and manual composting. There is a high positive relationship between waste sorting knowledge, information and awareness of the citizens and food waste infrastructure facilities and management. There is a high positive relationship between whether a respondent sorts out food waste or not, and whether a respondent makes or knows about technological and manual composting.

There is a moderate positive relationship between whether a respondent makes or knows about technological and manual composting and food waste infrastructure facilities and management.

H1: Food waste sorting has a positive effect on making compost. This H1 was tested and found to be very high positive, thus approved.

Table 8: Mann Whitney U test

		N	Mean Rank	Sum of Ranks
Average daily food waste generation rate per person	Apartments	192	26.44	634.50
	Ger districts	192	22.56	541.50
	Total	384		
Food waste generation rate per day	Apartments	192	27.15	651.50
	Ger districts	192	21.85	524.50
	Total	384		
Total weight of food waste generation in 7 days /gram/	Apartments	192	27.17	652.00
	Ger districts	192	21.83	524.00
	Total	384		

Table 9: Food waste generation rate per person U test

	Average daily food waste generation rate per person	Food waste generation rate per day	Total weight of food waste generation in 7 days /gram/
Mann-Whitney U	241.500	224.500	224.000
Wilcoxon W	541.500	524.500	524.000
Z	-.959	-1.309	-1.320
Asymp. Sig. (2-tailed)	.338	.190	.187

The Mann-Whitney U-test was employed in testing research hypotheses. Since the p-value of two independent variables is higher than 0.05, food waste of x=the food waste gathered by the apartment households and y=food waste generated by the ger district households are equal, thus, H2 was proven.

Table 10: Model Summary Regression analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.574[a]	.596	.547	.805
a. Predictors: (Constant), Food waste infrastructure facilities and management				

Table 11: ANOVA

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	83.960	1	83.960	115.480	.000[b]
	Residual	36.040	57	0,639		
	Total	120	58			
a. Dependent Variable: Sorting food waste						
b. Predictors: (Constant), Food waste infrastructure facilities and management						

We employed regression analysis to determine the statistical relationship between the predictor variables and the response variable. The results showed ($F=115.480$, $p<0.001$) indicating that our regression model fits the data and it is statistically significant.

Table 12: Regression analysis

Coefficients [a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.241	.211		2.565	.007
	Food waste infrastructure and management	.849	.064	.811	9.339	.000
a. Dependent Variable: Sorting food waste						

The regression analysis showed a higher significance level of hypothesis 3. The results of ($F=115.480$, $p<0.001$) indicated that food waste sorting had positive effects on food waste infrastructure and management. H3: Households do not sort food waste due to poor infrastructure facilities. It can be seen from Table14 that *Food waste sorting* is calculated as *1.241+0.849 (food waste infrastructure facilities and management).* Thus, it can be assumed that due to poor infrastructure facilities food waste is not sorted and proper waste management is undertaken, thus the proposed 3 hypotheses were accepted.

4.2 Qualitative research

A qualitative survey was conducted in the form of an interview by involving 3 food waste and soil specialists with over 15 years of working experience. At the qualitative interview, the participants were asked to share their views on how the current state of food waste management of Ulaanbaatar would change in the future. Food waste management involves the processes of waste sorting, collection, transportation, dumping at disposal sites or recycling plants, as well as waste recycling or disposal. At every stage, all measures are taken to ensure that all these processes have no negative impacts on both public health and the environment. It requires that waste be managed:

- without endangering human health and harming the environment
- without risk to water, air, soil, plants or animals
- without causing a nuisance through noise or odors
- and without adversely affecting the countryside or places of special interest

5. SOLUTIONS TO FOOD WASTE MANAGEMENT IMPROVEMENTS

In order to improve food waste management of Ulaanbaatar, we propose the following solutions for each phase of food waste generated in the capital city.

5.1 Food waste sorting process

After investigating the research hypotheses, we found that the households and organizations surveyed are more likely to undertake waste sorting and recycling activities if waste management like waste collection, transportation, and recycling shows tangible results. Biodegradable bags play an important role in food waste sorting as a habit of putting food garbage in biodegradable bags will have a positive effect on the environment. South Korea, one of the top recycling countries in the world, imposed a ban on dumping food in a landfill in 2005, and introduced compulsory food waste recycling using special biodegradable bags in 2013. An average four-person family pays $6 a month for the bags, a fee that helps encourage home composting and reduce food waste generated.

5.2 Food waste collection

The Government should adopt holistic approaches to waste collection and transportation management by taking the country's extreme continental climate into consideration. Using waste food disposal coolers during the warm seasons when the temperature remains at 0°C can be one of the effective ways to reduce waste. It is, nevertheless, cost-ineffective. Thus, general garbage bins for putting food waste should be placed. During the warm seasons, food waste in general garbage bins may rot and emit odors. Therefore, food waste should be collected 2-3 times in a week depending on bin fullness, and the waste volume. It is needed to place additional food waste bins at every waste collection point located at the apartment residential areas.

5.3 Food waste transportation and unloading process

One of the problems in current waste transportation is all types of waste are mixed together and then transported to a waste disposal site. A waste collection vehicle has a packer blade used for compacting and pushing the waste to the rear of the vehicle, making it impossible to recycle wastes as garbage is mixed and crushed. All garbage, except food waste, can be transported by reducing the volume. Transporting food waste in compliance with relevant waste transportation regulation will make it possible to recycle and produce recyclable products.

5.4 Food wast incineration process

An incinerator is a furnace for burning waste materials at high temperatures under very carefully controlled conditions. As there is no such incineration plant in Ulaanbaatar, in some places, open burning of waste is very common. Open waste burning poses great risks to the environment and public health as it releases numerous hazardous chemicals and other toxic substances into the air. Hence, to prevent open burning, it is needed to establish incineration plants and facilities in Ulaanbaatar.

5.5 Landfill management in Ulaanbaatar

Although landfilling is the most common and widespread waste management in Mongolia, it is improperly managed not meeting the relevant health and safety regulations. It is mostly related to the fact that food waste is not sorted at source. Even if it is sorted, it is not segregated from other waste and not put into a waste garbage bin. Hence, apart from educating the public on recycling, the possibilities of making compost, it is important to establish food waste recycling facilities. One of the disadvantages of landfill is that it greatly contributes to soil and air pollution and in some cases some persistent organic pollutants may occur on the ground posing a serious threat to animals and plants. Since the establishment of waste recycling plants in the larger cities can require high costs, the most effective way to address this issue is to solve logistics problems. Thanks to the improved logistics, it will be possible to transport waste to the central disposal sites after sorting at source and reducing waste volume and size.

5.6 Waste composting in Ulaanbaatar

Making Bokashi compost at home: A Bokashi bucket uses beneficial microbes to ferment fruit and vegetable scraps into a fertilizer. Liquid that is formed during the fermentation process is full of nutrients and used as a nutrient-rich fertilizer for the soil. Currently, about 10 recycling companies that make compost and animal feed from food waste are operating in Ulaanbaatar. Even if those factories operate at full capacity, they recycle only 10 percent of the 116.466 tonnes of food waste generated from the UB households alone. Thus, there is a need to establish a plant that meets international standards.

5.7 Creating a new market space for the sales and purchase of final products made from food waste

Purchasing recycled products enables and encourages the private sector to invest in waste collection, transportation, and recycling activities. Therefore, it is required to raise public awareness on the benefits of using recycled products in fertilizing smallholdings and feeding livestock.

6. CONCLUSION

According to the study conducted as part of the “Ulaanbaatar Community Food Waste Recycling Project", it is estimated that the households living in the city of Ulaanbaatar generate 116.466 tonnes of food waste per year. The estimate was derived on the basis of the following methodology. First, food waste samples collected from waste produced by a total of 60 households in a week were analyzed to estimate the amount of food waste. Next, the total amount of food waste was then divided into the number of the household members who had a meal on the same day to define waste generated per capita per day. Since food waste produced by a person a day was 197 grams, it was multiplied by 365 days. Finally, the total was multiplied by the total of the citizens of Ulaanbaatar city.

If food processing and service companies, manufacturers and small-scale food producers are added, this figure is expected to reach 200.000-300.000 tonnes per year.

Depending on the areas of residence, the survey participants have made certain proposals such as increasing the number of waste sorting bins, raising public awareness on waste sorting and improving the waste management infrastructure facilities. The study findings also showed that the people do not sort their food waste properly since there are no inadequate and poor infrastructure facilities to manage food waste.

The findings of the study show that it is possible for the citizens to sort food waste, yet, due to the inadequate infrastructure no sorting is done. It was proved by the proposed hypotheses in the study. Supporting the establishment of waste recycling plants is key to waste management improvement. To do so, the state should take proper measures to encourage "Startups" engaged in waste management, and to encourage recycling factories by providing financial incentives and subsidies. Such economic incentives can attract many start-up companies to do businesses in this sector. Since many private companies enter this sector, they will face fierce competition among themselves that leads them to explore the possibility of improving waste management.

If food waste is properly and fully used, it can be converted into a valuable raw material. An effective way of raising public awareness about food waste management is to educate them through mass media campaigns and other social networks. Reusing and recycling waste in an efficient and environmentally friendly manner have numerous advantages such as protecting the environment, reducing the amount of waste that will need to be recycled or sent to landfills and incinerators, and allowing products to be used to their fullest extent. Therefore, waste management specialists, scholars and experts engaged in waste management are striving to find the proper ways of reusing and recycling bio-waste generated in Ulaanbaatar, the capital city of Mongolia as well as other vegetable residues and waste produced by livestock such as manure and bones by closely collaborating with the state and national waste recycling organizations.

Hence, the government should open up all possibilities for private companies to establish recycling plants and take the initiatives to raise the value of products produced from food waste and promote sales and purchases of recycled goods. In order to encourage the private sector engagement in solid waste management and to encourage the private companies offering recycled, recovered raw materials and products, the government should take measures such as selling fertilizers produced from recycled food waste to farmers at discount price and using them in the "Billion Trees" nationwide campaign initiated by the President of Mongolia which will greatly contribute to combat against desertification.

Furthermore, the government should create favorable economic conditions that encourage the private sector to engage in waste management by introducing financing mechanisms and incentive systems in the waste management sector.

Food waste management in Ulaanbaatar city is defined below.

REFERENCES

[1] Kaza, S., Yao, L.C., Bhada-Tata, P. and Van Woerden, F. (2018) What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development. World Bank, Washington DC. https://doi.org/10.1596/978-1-4648-1329-0

[2] Mongolia National Waste Management Improvement Strategy and Action Plan 2017-2030. https://www.rrcap.ait.ac.th/Publications/MongoliaWMStrategy2017.pdf?utm_source=chatgpt.com

[3] https://www.1212.mn/

[4] http://ubservice.ub.gov.mn/wp-content/uploads/2020/01

[5] https://openjicareport.jica.go.jp/pdf/11849833_02.pdf

[6] https://mongolia.gov.mn/news/view/24410

[7] Sarangoo.I, 2. (2020). Landfilling and incineration are not eco-friendly methods for humans and the environment.

[8] Erdene.B., (2018). Waste management

[9] European environment agency, 2020).

[10] Bio waste in management Europe-turning challenges into opportunities, p. 2.-2. (2018).

[11] Field experiences at the Fukushima biomass power plant, 2020)

[12] Pham, T. P. (2014). Food waste-to-energy conversion technologies-current status and future directions.

[13] Favelaorganica. (2022). https://favelaorganica.com.br/pt/#.

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