

Solid Wastes Produced in a Turkish State Hospital Kitchen

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Abstract

Waste is defined as a disposed material that is unwanted in some place or that has no value in the eyes of its producer. It is generated amply in industry, transportation, agriculture, tourism, food sector etc., in the process of production or service. These materials are distinguished from the concept "garbage" due to their economic and environmental value. It is necessary to decrease wastage at its source, and to re-gain and re-use or dispose the inevitable wastage in the manner least harmful to the environment.

Keywords: Solid waste; Environment; Garbage; Consumption

Introduction

Solid wastage is generally classified according to its qualities and these are [1,2]

- Organic wastage (fruits, vegetables, food waste etc. that nature can dissolve on its own)
- Recyclable wastage (plastic, glass, paper, metal, aluminum etc.)
- Medical wastage (all waste that has been in contact with the patient, injector, blood bag, etc.)
- Agricultural wastage (pesticide residue etc.)
- Dangerous wastage (self-inflammatory wastes, wastes that exhales flammable gases in the case of contact with water, poisonous and toxic wastes)
- Special quality wastage (radioactive wastes, batteries, power supplies, oils and excavation wastes which profess special importance in terms of their removal) [3-6].

Food Wastage

The increased world population, parallel to the increased demands; derogation of the physical conditions of the world and waning of natural resources has brought the problem of incapacity in satisfying the needs of nutrition [7]. Food and Agriculture Organization of the United Nations (FAO) reports that it is necessary to increase agricultural production by 60% until 2050 in order to satisfy the increased population's food demand [8]. Studies on "sustainable agriculture and food" has gained pace in order to safely sustain the nutrition demand of the growing population and in order to leave the following generations a livable planet [9,10]. On the other hand, the relation with environment, that is to say the negative pressure of global warming on natural resources caused by pollution is seen as the most important problem that jeopardizes agriculture and food sustainability [8]. Environment is the primary step and the most important resource in sustaining mankind's basic need of nutrition [11]. Food industry is a branch of industry which takes its raw materials from agriculture industry and transforms the agricultural produce into food through a

series of processes. Hence food production and agricultural production are directly related: Environment is essential for food production.

In the production of any food both basic natural resources such as soil and water; and energy-in terms of preserving its freshness is utilized. Considering the abundance of energy world requires, it is an obligation to consume the produced food as efficiently as possible and it is important and imperative to re-use the waste produced after this efficient consumption [12]. A research indicates that 64% of the waste produced in the catering industry is avoidable and 18% may be avoidable whereas only 18% is unavoidable.

As in all branches of the industry, in the food industry as well, production of packaged goods has gained pace, as well as the generation of packaging waste due to their consumption. According to European Union package and packaging waste directives; packaging waste is defined as "the totality of the material both recyclable and unrecyclable used to deliver, protect, preserve and put on the market any good from the stage of raw material to the consumption good and from the delivery of that good from the producer to the consumer or utilizer" and package is the material which preserves the product so that it is delivered to the consumer in a healthy state; which introduces and effects the selling of the product [13]. Shampoo bottles, fruit juice cartoons and bottles, oil cans are examples of packaging waste produced in households. Being produced with different materials, these packaging wastes have an effect on the environment and pollution.

In all the world, within the approach of sustainable development, management strategies of transforming wastage which professes threat to human and environmental health into an economic input are developed [2,4,14]. In terms of the wastes that can be utilized as secondary raw materials, from their production to disposal, responsibility and due diligence resides both at the producer and the consumer [15].

Waste management approaches are linked to the sustainable usage of resources. It is a humanitarian duty for individuals to consider the following generations in their necessary consumption of finite natural resources. Recycling gradable wastage is beneficial both for the economy and the environment. Materials such as plastic, glass, metal,

paper, ceramic, textile, bone and wood can be utilized as secondary raw materials [15,16].

Methods

Research is conducted by the accumulation of wastage generated in the process of preparation and service of all the food prepared for the patients, attendants and staff in a state hospital with 618 bed capacity in Eskisehir, through the 20 workdays of 2015 January. Data is recorded as “solid wastes produced” and “solid wastes collected” throughout the study. The solid wastes produced are calculated according to the food registries generated on the basis of the menus that are used in the production and service of food. The organic waste and the packaging waste of the service material and the food is weighed separately with digital precision scales. The solid wastes collected on the other hand is recorded by gathering and weighing all the waste produced at the end of consumption in two distinct areas (inside the kitchens, halls and clinics) by staff who trained by the researcher in waste sorting. Then the solid waste categorized according to their kinds and amounts, and registered in daily log sheets are summed up to reach the total amounts. At the end of the research the total weight of solid waste is found and classified.

Results

The aim of this study is to identify the kinds and amounts of solid wastes produced in a hospital kitchen and to understand the environmental and economic value of this wastage. Table 1 reports the mass of solid waste produced and the percentage of those eligible for collection. Collectable waste is approximately 2/3 of total produced waste.

Kind of Waste	Solid Waste Produced (kg)	%
Collectable	4948.9	68.4
Not collectable*	2289.6	31.6
Total	7238.5	100

Table 1: Total amount of waste produced during the study according to their eligibility for collection, in weight (kg) and percentage (%). *Toothpicks and their wrappings, tea bags, cling film, cooked egg shells etc.,

In Table 2, total amounts of produced and collected wastes according to their kinds; the discrepancy in between the amounts produced and collected and the amount and percentage of loss is reported. It has been detected that the total amount of waste produced is 7 tons and 238.5 kg. 41.6% of the total mass of waste is organic (raw), 15.6% is paper-cardboard, 12.5% is porcelain, 7.0% is composite, 3.8% is metal, 2.3% is glass and 1.8% is wood. Whereas the total amount of waste collected is detected to be 4 tons and 422.3 kg; and 66.6% of this is organic (raw and cooked), 7.3% is plastic, 7.2% is paper-cardboard,

Kind of waste	Unit Cost	Solid Waste Produced		Solid Waste Collected		Solid Waste Lost		Net Profit (TL)
	(TL)	TL	\$*	TL	\$	TL	\$	
Plastic	0.75	829.6	306.1	242.9	89.6	586.7	216.5	242.9
Metal	0.5	136.0	50.2	102.7	37.9	33.3	12.3	102.7

9.7% is porcelain, 1.9% is composite, 4.6% is metal, 1.9% is glass and 0.8% is wood. 70.7% of plastic waste, 24.5% of metal waste, 71.9% of paper-cardboard waste 83.5% of composite waste and 74.7% of organic waste could not be recollected.

Kind of Waste	Amount of Solid Waste Produced		Amount of Solid Waste Collected		Amount of Solid Waste Lost		The Discrepancy (The Loss)
	kg	%	kg	%	kg	%	
Plastic	1106.2	15.3	323.8	7.3	782.4	70.7	
Metal	272	3.8	205.4	4.6	66.6	24.5	
Paper-Cardboard	1132.8	15.6	318.5	7.2	814.3	71.9	
Composite	509.4	7	83.8	1.9	425.6	83.5	
Wood	132	1.8	36.3	0.8	95.7	72.5	
Glass	165.1	2.3	83.5	1.9	81.6	49.4	
Porcelain	907.4	12.5	427.4	9.7	480	52.9	
Organic waste (raw food)	2036	28.1	516	11.6	1520	74.7	
Organic waste (bone)	977.8	13.5	632	14.2	345.8	35.4	
Organic waste (cooked food)	-	-	1795.7	40.6	-	-	

Table 2: The total weights (kg) and percentages (%) of produced and collected solid wastes during the study; solid waste loss amount (kg) and solid waste loss percentage (%).

Table 3 shows the economic value calculations for the solid wastes acquired via unit prices received from the subcontractor company which collects the recycling/recovery wastes in Eskisehir’s Tepebasi country where the study has been conducted. These financial values have been acquired through the amounts of solid wastes (for example: Amount of plastic waste produced 1106,2 kg x 0.75 TL=829,6 TL). It has been detected that while the total amount of solid waste professed financial value of 829,6 TL, 586,7 TL is lost due to the amount of waste uncollected. As it is seen in the table, while 1431,8 TL could have been earned from the total amount of solid waste, net profit is 525,4 TL. Moreover, the highest unit price of the recyclable wastes belongs to plastic wastes (0.75TL/kg). Unit price of recyclable metal waste is 0.5 TL and the amount earned from the production is 136,0 TL. The only profit earned from organic wastes has been acquired through bone waste, which is 95 TL.

Paper-Cardboard	0.25	283.2	104.5	79.6	29.4	203.6	75.1	79.6
Wood	0.15	19.8	7.3	5.4	2	14.4	5.3	5.4
Glass	0.1	16.5	6.1	0	0	16.5	6.1	0
Bone	0.15	146.7	54.1	94.8	35	51.9	19.1	94.8
Total		1431.8	528.3	525.4	193.9	906.4	334.4	525.4

*1 dollar = 2.71 TL Central bank midday/18 June 2015

Table 3: Economic value of solid wastes recycled/recovered (TL/\$).

As it can be observed in Table 4, in order to produce 1 ton (1000 kg) paper, 17 mature trees, 55.4 m³ water, 2717.5 kwh electricity and 342.0 cm³ natural gas is required [7]. In Table 4 it has been calculated and shown that through the 1132.8 kg paper waste produced in this study 16 mature tree, 55.0 m³ water, 2625.3 kwh electricity and 265.1 cm³

natural gas can be economized. Simultaneously, this means that from the 1132.8 kg of paper waste produced, 944.0 kg paper can be re-produced. It is also indicated that from the 318.5 kg cardboard waste collected during this study, 4.5 mature trees, 15.6 m³ water, 738.1 kwh electricity and 74.5 cm³ natural gas can be economized.

	Source	Raw Material ¹	Su (m ³)	Electricity (kwh)	Fuel (natural gas)
					(sm ³ /ton)
Utilization of paper-cardboard waste in terms of raw material, water, electricity and fuel	Amount necessary for producing 1 ton of paper	17 mature tree (2.4m ³ wood)	55.4	2717.5	342
	Amount necessary for producing 1 ton of paper	1.2 ton waste paper-cardboard	6.5	400	108
	Amount economized by producing 1 ton of paper utilizing paper waste	17 mature tree (2.4m ³ wood)	49.1	2317.5	234
Utilization of paper-cardboard waste produced and collected at the end of research in terms of raw material, water, electricity and fuel	Possible savings generated by the utilization of 1132.8 kg paper-cardboard waste produced during the study	16 mature tree (2.3m ³ wood)	55.6	2625.3	265.1
	Savings that will be generated by the utilization of 318.5 kg paper-cardboard waste collected during the study	4.5 mature tree (0.6m ³ wood)	15.6	738.1	74.5
	Savings lost due to the uncollected (lost) 814.3 kg paper-cardboard waste	11.5 mature tree (1.6m ³ wood)	40	1887.2	190.6

Table 4: Cost Comparison for Raw Material Usage and Paper Produced with the Collected Waste.

Recovery of plastic wastes, as it can be observed in Table 5 economizes 16 barrels of crude oil and 5.9 kwh electricity per 1000 kg of plastic waste [6]. From the 1106.2 kg plastic waste produced in this

study, 17.7 barrels of crude oil and 6.5 kwh electricity can be economized. Besides, it has also been found that due to the lost plastic waste, 12.5 barrels of crude oil and 4.6 kwh electricity is wasted.

Raw materials and energy necessary for production ¹	Savings acquired through recycling 1 ton of plastic waste	Savings acquired with 1106.2 kg plastic waste during this study	Savings acquired with 323.8 kg plastic waste collected during this study	Savings lost with the uncollected 782.4 kg plastic waste
Crude oil (barrel*)	16	17.7	5.2	12.5
Electricity (kwh)	5.9	6.5	1.9	4.6

Table 5: Evaluation of the plastic waste produced at the end of the study in terms of raw materials and electricity. *1 barrel=159 L.

The amount of wastes that are recycled and that could have been recycled during the 20 workdays in the kitchen of this hospital with 618 beds in which the study has been conducted is given at Table 6. The total amounts of recovered/recycled solid wastes are 6331.1 kg and utilization percentage of this amount is 25.3%. 3317.3 kg of these wastes are packaging waste and the utilization percentage is 29.2%. Compost-material wastes are 3013.8 kg and 21.0% of this amount is utilized.

Wastes that can be recycled/recovered	Amount of waste generated	Waste utilized	
		kg	%
Packaging waste*	3317.3	967.7	29.2
Compost waste**	3013.8	632	21
Total amount	6331.1	1599.7	25.3

Table 6: Recovery rates of the solid wastes produced and collected in the kitchen.*Porcelain waste is not included,**Cooked food waste is included.

Throughout the twenty workdays in this hospital with 618 beds, the total recyclable waste produced is 6331.1 kg; meaning 0.51 kg waste per bed is produced per day. Of this amount, 0.27 kg/bed/day is recoverable packaging waste and 0.24 kg/bed/day is recoverable organic waste.

Discussion

Waste production per person increases everyday due to the changes in dietary habits [5]. Within a sustainable development approach, waste management strategies that transform waste from a threat to human and environmental health into an economic input should be adopted through the globe [16]. Sortation of solid wastes at their production site, their collection and the overall increase in the amount of waste brought to recycling benefits economy and environment. Furthermore, storage of methane (CH₄) gas which is known to be 21 times more harmful than carbon dioxide (CO₂) in systematic storage facilities and its transformation into electric energy; and the reduction of greenhouse gas emissions serve significantly to the protection of human and environmental health [18]. This research has been conducted in a state hospital kitchen, which is a public establishment; and it has been observed that organic and packaging wastes are generated amply. In a previous study in a large hotel [17]; solid wastes produced in all the departments were identified and it has been found that wastes generated in the catering departments were glass, paper-cardboard, plastic, metal, wood and organic. In the same study, it has been indicated that in restaurants, food halls, canteens and cafeterias both large amounts of food and beverage wastes, and wastes generated due to packaging such as boxes, cartoons and cases are produced in large amounts. In our day, packaged products have also increased along with the developed food industry. Products such as glasses of water in disposable bags have become common in food halls and especially in hospitals. Considering that the raw materials for such plastic packages are petroleum, the necessity for recycling would be admitted beyond dispute.

It has been found that in the food production department of this 618-bed capacity hospital, the amount of organic waste is less than the amount of packaging waste. The scantiness of food waste is pleasing

considering the insufficiency of food. However, the same situation simultaneously causes the amount of packaging waste to swell. It is considered in this study that the cardinal reason of this situation is the increased usage of packaged frozen vegetables in food production. In this case, the best route is the recollection of packaging wastes. At the same time, it is fairly important to be attentive not to waste consumable produce in the production of non-frozen foods. In European countries 30 to 40% of the total mass of waste is composed of organic waste, whereas in Mediterranean countries this percentage increases towards 80% and the more developed countries are; the less amount of organic waste they produce. In Turkey, an average of 26 million tons of domestic waste is produced and it is reported that this amounts to 1 kg per day, per person [7]. It is calculated that the amount of waste will increase due to population increase and economic affluence, that it will double in 20 years and that in 2030's household waste will exceed 50 million tons [18]. In many reports, examples are given in order to facilitate the comprehension of this amount. For example, in a research conducted by Izmit Waste and Residue Incineration and Recycling Corp., it is calculated that 1 ton of household waste occupies 1 m³ and 26 million tons of garbage would constitute 4000 soccer fields (65x100 m) if 1 meter in depth [18].

In a study named WRAP (Waste & Resources Action Program) conducted in United Kingdom; it has been tried to determine the proportion of organic waste in household waste and it has been found that only for the year of 2009, this amount is 8,3 tons [19]. Similarly, in a study conducted in France it has been found that in the year of 2007, 9713 tons of organic waste has been sent to scrapheap.

In our country, compost production from organic wastes which is used for the enrichment of soil is regarded as the most important method of utilization. Yet in our country as well as other developing countries, organic waste is thrown into garbage without such treatment. The abundance of organic waste especially in catering businesses and their suitability for compost production displays the necessity of the conduct of waste management.

On the basis of waste management comes the prevention of waste production; and then reduction, recycling, recovery or composting [9]. In this study, existing food production process is transformed in order to decrease the amount of eatable organic waste and through preventing consumable food being wasted; organic waste amount is decreased by 150 kgs. Furthermore, it is important to know the amount of waste produced by a catering business in order to prevent waste generation. In this way, both during purchasing and after the preparation of food, waste production can be decreased. Plus, in terms of the waste that is inevitably produced, it will be known beforehand how many tons will be delivered to compost factories, animal farms or stray animals etc. and what kind of transportation will be required [9].

1.3 billion tons, that is to say one third of all the food produced for human consumption in the world, is thrown away [20]. According to a study of the World Bank (WB), this amount is predicted to increase to 2.2 billion tons in 2025. Solid waste generation is expected to more than double in low-income countries and globally it is expected that expenses will rise from 205 billion dollars to 375.5 billion dollars. As of 2004 China has taken over the position of the country that produces the most waste from United States of America (USA); and it is predicted that by 2030 China will produce double the amount of waste USA produces (6.22). The scope of food waste and the losses through the food production chain is not clearly known in Turkey. In the European Union (EU) it is known that on the one hand the population which receives food aid has grown while on the other hand organic

waste has reached significant levels [21]. 79 million people live below the poverty line in the EU and 16 million of this receives food aid. It is determined that the amount of food thrown to garbage in the EU every year is 89 million tons in total and 179 kg per person [14]. It is predicted that this amount will reach to 120 million tons in 2020. 43% of food waste is produced by households, whereas the share of food industry in the wastage is 39%; of transportation 5% and of restaurants etc., 14% [22]. In the United Kingdom 8.3 million tons of food is wasted [19], 7 million of which generated by households; 4.2 million of which still consumable meaning every week 6 plates of food is thrown away. In Europe within the 7. Environment Project "Food Use for Social Innovation by Optimizing Waste Prevention Strategies (FUSION)", 6000 people were fed in Brussels by volunteers who peeled and cut 750 kg of oversupply of vegetables. It is estimated that in Switzerland 1.5% of all tilled land is wasted due to food waste; and in USA that more than 25% of drinking water and 300 million barrels of oil is wasted the same way [23].

Conclusion

Nowadays, all branches of industry should meet their energy demands from renewable sources, population increase should be stalled, natural resource consumption should be decreased to a minimum and efficiency from these resources maximized, and a production system in which the generated waste is reused as raw material should be adopted. It is claimed that through these strategies the amount of waste emitted to the habitat will be decreased and through the activity of nature's self-renewal process environmental problems will be minimized. Simultaneously, for the solution of the paradox of precarious and insufficient food supply on the one hand and food waste on the other, food waste should be decreased and what is nevertheless generated should be recycled efficiently. In this study, through the investigation of the amounts and kinds of the wastes produced in a hospital kitchen that offers collective catering services, and through the research on the damage inflicted on the environment and its economic scope; the necessity to minimize the amount of waste production and the importance of the following recycling process is demonstrated.

References

1. Cepel N (1992) Nature, environment, ecology and ecological problems of humanity. Golden Books Press, Istanbul, Turkey.
2. Hanay O, Kocer N (2006) Elazig city solid waste recycling potential determination. *Firat University Science and Engineering Science Magazine* 18: 507-511.
3. Pongracz E (2002) Redefining the concepts of waste and waste management evolving the theory of waste management, Oulu University Press, Oulu, Finland.
4. Keles R, Hamamci C (2005) Environmental policies, Imge Press, Istanbul, Turkey.
5. Lamb G, Fountain L (2010) An Investigation into food waste management.
6. Yilmaz A, Bozkurt Y (2010) Urban solid waste management practices in Turkey and Kutahya solid waste association example. *Suleyman Demirel University Journal of Faculty of Economics and Administrative Sciences* 15: 11-28.
7. Altuntop E, Bozlu H, Karabiyik E (2014) Gaining domestic wastes economy
8. Dolekoglu C, Gun S, Giray H (2014) Poverty and food spillover.
9. FAO (2013) Toolkit reducing the food wastage footprint.
10. Ekici O (2005) Sustainable agriculture: Protect the world while producing food. *Sci and Tech Magazi* 530: 61-65.
11. FAO (2014) Food and Agriculture Organization, Building a common vision for sustainable food and agriculture, Roma.
12. Bayazit AH (2009) The role of consumer education in achieving sustainable consumption behavior. *AEUDEM* 10: 143-151.
13. OECD (2012) Organization for Economic Co-operation and Development, FAO-Food and Agriculture Organization, Achieving sustainable agricultural productivity growth pp: 50.
14. CEVKO (2014) Environmental Protection and Packaging Waste Recovery and Recycling Trust Foundation in Turkey.
15. Skordilis A (2004) Modelling of integrated solid waste management systems in an island. *Resour Conser and Recyc* 41: 243.
16. Palabiyik H, Altunbas D, Marin C (2004) Urban solid wastes and management, contemporary approaches to environmental problems: ecological, economic, political and managerial perspectives. Beta Press, Istanbul, Turkey.
17. Ozgen I (2005) Waste management in large scale hotel enterprises and Iberotel Sarigerme Park example, Dokuz Eylul University, Izmir, Turkey.
18. Ozkan A (2008) The use of different decision making techniques in the construction of urban solid waste management systems, Anadolu University, Eskisehir, Turkey.
19. WRAP (2012) The Waste and Resources Action Program, Household food and drink waste in The United Kingdom, Final Report.
20. FAO (2013) Food and Agriculture Organization, Food waste harms climate, water, land and biodiversity-new FAO report.
21. EESC (2014) European Economic and Social Committee, Prevention and reduction of food waste.
22. EESC (2013) European Economic and Social Committee, Prevention and reduction of food waste, Pp: 11.
23. Buzby JC, Hyman J (2012) Total and per-capita value of food loss in the United States. *Food Policy* 37: 561-570.