ORIGINAL ARTICLE

ANALYSIS OF THE TYPE AND AMOUNT OF SOLID WASTE GENERATED AND ADOPTED DISPOSAL METHODS BY THE RESIDENTS OF BONGA TOWN

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ABSTRACT

BACK GROUND: *In many parts of Ethiopia, there are many sanitation problems of which the most intractable is solid waste. Piles of Vegetables and other organic wastes appear around the streets, riverbanks, and market places, which will have contacts with human beings directly at several stages in the waste cycle. People living close to waste disposal facilities, waste workers, preschool children are the risk groups. The main objective of this study was to determine the type and amount of solid wastes generated and to assess the common disposal methods practiced by Bonga town residents.*

METHODS: *A cross- sectional study was conducted from January 20 to February 18/2002 to determine the type and amount of solid wastes generated on 130 sampled households at Bonga town, Kaffa Zone. The study populations, 130 houses, were determined by sampling procedures from all the residential house of the town. Data was collected using structured questionnaire and registration format.*

RESULTS: *The study revealed that the common solid waste components were:-dust (28.0%), leaves and grasses (24.86%), tin cans and glasses (6.0%), ash (20.0%), food stuff peelings (9.43%), Chat leaves (6.87%), and textiles (1.4%) by weight. The per capita and total amount of solid wastes generated were 0.35kg/day and 4671 kg/day respectively. Statistical correlation with some socio-demographic factors of the respondents to the generation rate of solid waste and to their disposal methods were done. Family size and per capita per day solid waste generation showed statistically significant relation (x^2=15.78,Df=8, P<0.05) but literacy status to on-site storage container users didn't show statistically significant correlation. Open dump outside and inside the yard was common (64.6%), and the rest 23.8% and 11.5% were refuse pit and open burning respectively. There was no municipal service in the town and only 42.3% of the households used on-site storage containers, of those users 63.6% used sacks.*

DISCUSSION: *The problems associated with solid waste management in today's society are complex because of the quantity adverse nature of solid wastes. Waste generation is an activity that is not very controllable and in the future, however, more control will be exercised. 64.6% of the households disposed their wastes using uncontrolled methods such as open dumping outside and inside their yards. But this method of disposing wastes on the street, in drainage ditches, and at the back yard could lead to a variety of environmental problems like breeding of rats and other animals which are carriers of enteric pathogens by providing feeding stock and favorable environment. Ground and surface water pollution can also be resulted from uncontrolled dumping of solid wastes.*

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CONCLUSION: ***This study is the first to identify the type of solid waste components and the generation rate on daily basis in the town. Moreover, the data will be used as a baseline for further study.***

KEY WORDS: ***generation rate, open dump, biodegradable waste, combustible wastes, non-combustible wastes.***

INTRODUCTION

Bonga town is located 446 km South west of Addis Ababa. According to 1994 National population and housing census, the population of the town was 10,851 (1). The town is the capital of Kaffa Zone comprising three Kebeles and is administered by the town administration. There are 2007 residential houses. It has an average altitude of 1600m above sea level and an annual rainfall between 1200-1600 mm.

In many towns of Ethiopia, there are many sanitation problems of which the most intractable is solid waste. There appear piles of rotting vegetables and other organic wastes around the streets, riverbanks, and market places. These generated wastes will have contact with human beings directly at several stages in the waste cycle. The groups at risk are numerous and include: the population of unserved areas, workers in facilities produce infection and toxic materials; preschool children; waste workers; people living close to waste disposal facilities (3).

A study done in India on stool specimens from refuse workers indicated that 94% of this group were infected with selected parasites as against slightly more than 4% in the control group. The same study showed that the infection rate with worms and related organisms were three times that of the control group. Although it is certain that vector insects and rodents can transmit various pathogenic agents, contamination of this kind is liable to occur at all points where waste is handled.

Harm from waste products can arise from other causes: inflammability because of paper content or by spontaneous combustion when in heaps. Production of smoke, disgusting or nauseating smells and liquids during exposed fermentation in the open damp; the scattering of papers, plastic and dust by wind, and the breeding of flies and rodents is common situation in unsanitary handling. Rodents proliferate very rapidly in uncontrolled deposits of refuse, which provide their main source food. Through out the world there are periodic campaigns to exterminate rats and mice, but the presence of food wastes permits rats to persist and to migrate from dumps to human dwellings in the vicinity. This creates a serious health problem because the rat may be a reservoir of plague murine-typhus, leptospirosis, histoplasmosis, rat bit fever, salmonellosis, tularaemia, trichionsis, and many other disease(7).

Uncollected organic domestic wastes in particular poses health risk since they ferment, creating conditions favorable to the survival and growth of microbial pathogens and especially if they became intermixed with human excreta due to poor sanitation. Organic wastes also provided feeding stock and favorable environment for insects, rodents, and other animals, which are potential carriers of enteric pathogens. Uncollected solid waste can also obstruct storm water bodies, which became habitats and breeding place for water borne vectors of tropical diseases (4,5).

Sporadic surveys conducted indicate that about 50-70% of the diseases incidence in the urban centers of Ethiopia is attributed to poor sanitary conditions, of

which uncollected solid waste is one of the major causes of these incidents (2).

There are numerous sources and types of solid waste ranging from home to the farm and from garbage to radioactive wastes, junked cars, and industrial wastes. The volume occupied by solid waste under certain conditions determines number and size or type of refuse containers, collection vehicles and transfer stations. Transportation system and land requirements for disposal are also affected by the volume of solid wastes generated in a specific locality (8).

Information and data on the expected future composition of the solid wastes are important to plan effective solid waste management. In addition to technological changes in areas such as food processing and packaging, changes in the world economy have also affected the composition of solid wastes (5).

The main objective of this study is to describe the type and amount of solid waste generated from residential areas of Bonga town and to assess their disposal methods.

MATERIALS AND METHODS

Study period, site and design

Cross-sectional study was conducted from January 20 to February 18/2002. This period is believed to represent the solid waste generated in dry seasons.

Since the study was intended to identify the type and amount of solid waste generated, a sample size adequate to estimate this value with adequate precision was calculated from residential houses of the three kebeles in Bonga town. Accordingly 130 households were selected for the study and samples from each kebele were taken by proportional allocation inorder to make the larger kebele to contribute relatively more items to the sample. Hence, 43, 48, and 39 households were selected from Kebele 01, 02, and 03 respectively.

Data collection and Analysis

Data collection was done using well-structured questionnaire and registration format. Inorder to get a valid data sanitarians of Kaffa Zone were recruited after having a one-day orientation as how to manage the instruments and how to approach the respondents. During data collection sorting and weighing of solid waste was accomplished by the interviewers and data was recorded using registration format. The investigator assessed the quality of data and crosschecking of completed questionnaire was performed for consistency and completeness of data. After data compilation has been carried out manually, the results were expressed in rates, tables, and figures (graphs). Chi-square test was done for some of the variables.

RESULTS

Major solid waste components were identified from each sampled residential houses of the town. Some of these solid waste components were dust (28%), grasses and leaves (24.86%), ash (20.0%), food stuff peelings (9.43%), *Kat* leaves (6.87%) and tin cans and glasses (6.0%) (Table 1). Based on this study, the total daily generation rate of solid waste was calculated to be 4671 kg/day and the per capita of generation rate was 0.35 kg/day.

Table 1. Average daily generation of residential solid wastes (n=7 days) by type and weight, Bonga town, January 2002.

Type of solid waste	Generation rate (Kg/cop/day)	Percentage by Weight
Dust	0.098	28.0
Leaves and greases	0.087	24.86
Ash	0.070	20.0
Food stuff peelings	0.033	9.43
'Chat' leaves (Chate edulis)	0.024	6.87
Tin cans and glasses	0.021	6.0
Textiles	0.0049	1.40
'Tella' residue	0.0042	1.21
Paper	0.0040	1.14
Plastics	0.0038	1.09
Total	0.35	100.0

With regard to literacy status, the highest on-size storage containers users (19.2%) were observed in subjects who attended grades 7 and above. But this difference was not statistically significant (x^2 =3.1872, p>0.1).

Table 2. Educational status and on-site storage container users of the respondents, Bonga town, January 2002.

Educational status	On-site storage containers			
	Used	Not used	Total	p-value
Illiterate	14	27	41	X^2=3.1872 P>0.1 Df=3
Read and write	7	8	15	
Elementary (1-6)	9	6	15	
> 7 grade	25	34	59	
Total	55	75	130	

The base for estimating total solid waste generation is the number of population and per capita per day solid waste generation (2). Based on this the correlation between family size of the households and the per capita per day solid waste generation was done and found statistically significant (x^2 =15.781, p<0.05).

Table 3. Family size and per capita per day solid waste generation of the households, Bonga town, January, 2002.

Family size	Generation rate (gm/cap/day) <150 gm	150-300 gm	300-450gm	450-600 gm	>600gm	Total	P-Value
1-3	1	8	11	1	2	23	X^2=15.78 P<0.05 Df=8
4-6	2	7	41	9	3	66	
> 7	6	11	23	2	3	41	
Total	9	26	75	12	8	130	

From the total generated solid wastes, combustible solid wastes comprised 46% by weight and the rest 54% by weight was non-combustible solid wastes (Figure1 and Table 1).

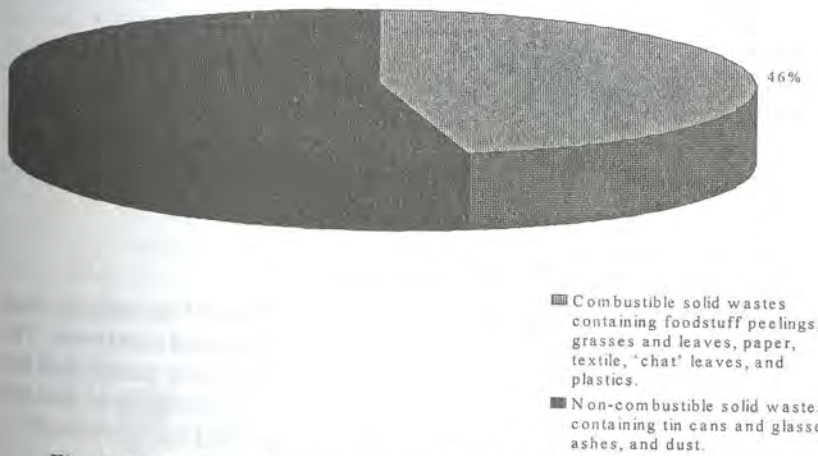

Figure 1. Percentage composition of combustible and non-combustible solid wastes in Bonga town, Kaffa Zone, January 2002

Concerning the biodegradability of the generated solid wastes, 72.9% of the waste was biodegradable and 27.1% was non-biodegradable wastes (Figure2).

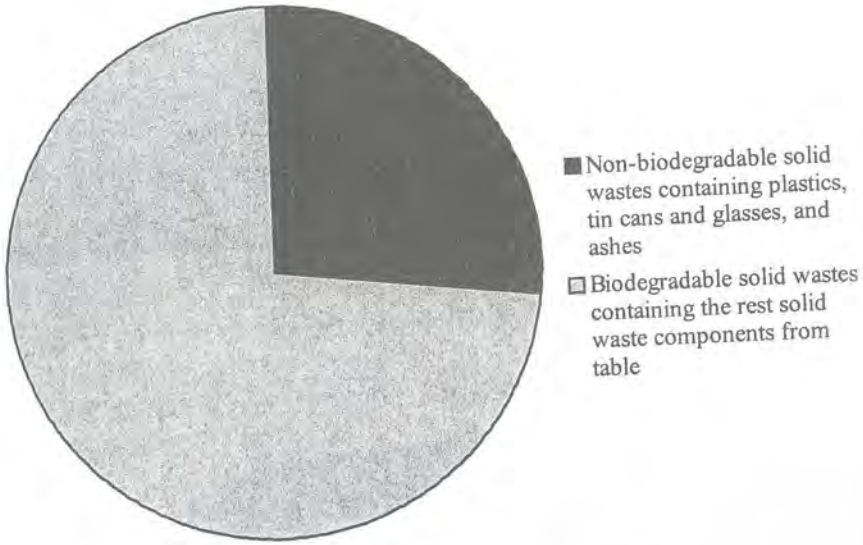

Figure 2. Percentage composition of biodegradable and non-biodegradable solid wastes in Bonga town, January 2002

Regarding the on-site waste storage containers, 75(57.7%) of the households do not have these storage containers. Only 55(42.3%) have such containers even though majority of them are with out proper covers. Of the 55 households, sack (63.6%) was the most used containers. The rest of the containers were plastic dust bin (14.5%), plastic bag (7.4%), metal dust bin (10.9%), and paper bag (3.6%) (Figure3)

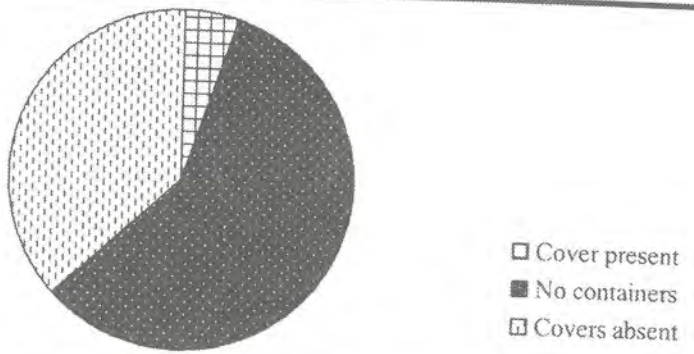

Figure 3. Solid waste storage containers at source by the residents of Bonga town, Kaffa Zone, January 2002

All households (100%) from those who have onsite storage container store all types of solid waste in the same containers. Out of the 14 washable containers (plastic dustbin, plastic bag, and metal dust bin) 57.14% is not being washed after the solid waste is emptied. All households who washed their storage containers pour the wastewater in their compound after washing.

According to the responses of the households, the number of days in which the solid waste was kept in the storage containers before disposal showed that 32 (58.2%) of the house holds kept for three days, 17 (30.9%) for two days, and 6 (10.9%) for four and above days. All of them stored all wastes in the same container (Figure4).

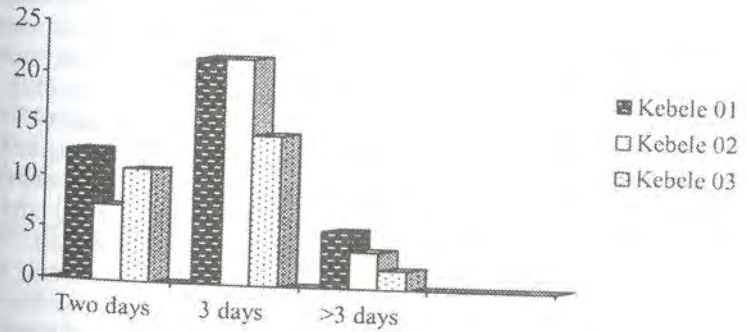

Figure 4. The responses and households to the number of days that the solid waste was kept in the on-site storage containers before disposal by the residents of Bonga town, January 2002

As table 4 shows, open dump outside the yard was the commonest (adapted) solid waste disposal method by the residents of the study area. It is about 46.15% from other disposal methods (Table 4).

Table 4. Solid waste disposal methods practiced by the households in Bonga town, Kaffa Zone, January 2002.

Disposal methods	Number	Percent
Open dump in the yard	24	18.50
Open dump outside the yard	60	46.15
Refuse disposal pit	31	23.85
Open burning in the yard	15	11.50
Total	130	100.00

DISCUSSION

The composition of solid waste generated is related to the culture and living standard of people (11). This study revealed that the total amount of daily generated solid wastes of the study area was 4 671 kg/day and the per capita of the generation rate was 0.35 kg/day. In developing countries the per capita rate ranges from 0.3-1.0 kg/day (4), thus the present finding agrees with that reported in literature.

Determining the quantities of solid waste generated and collected is of critical importance in the management of solid wastes, in selecting equipment, in designing waste collection programs, in material recovery, and disposal facilities (9).

As Bonga town is one of the urban areas in developing country, there is no any municipal service for waste collection and disposal and 64.6% of the households disposed their wastes using uncontrolled methods such as open dumping inside and outside the yard of their house. But in developed countries nearly 100% of the population has access to municipal services and collected waste is disposed of in controlled methods (9,11).

Of the all-solid wastes generated from Bonga town, majority (72.9%) was biodegradable wastes, which is favorable to composting process. The principal gases (>90%) produced from decomposition organic solid waste components are methane and carbon dioxide. Although most of the methane escapes to the atmosphere, both methane and carbon dioxide have been found in concentrations of up to 40% at lateral distances of up to 120m (400 feet) from the edges of land fills (5).

In this study, organic wastes consisting of food wastes, dust, paper, plastics, textiles, 'chat' leaves and grasses, and 'tella' residue constitutes the major part (72.8%). From those, food wastes and plastics are the main sources of inorganic chloride and hydrogen chloride emissions from the municipal solid wastes (12).

In this study around half (47.7%) of the households kept solid waste at on-site storage containers for two and above days (from container users). Food and other wastes placed in the on-site storage containers will almost immediately start to undergo microbial decomposition as a result of the growth of bacteria and fungi. If wastes are allowed to remain in the storage containers for extended periods of times, flies can start to breed and odorous compounds can develop (10).

In conclusion, findings of this study showed that there is no solid waste management system as well as municipal or any other organizational services in handling, storage, collection and disposal of solid waste in Bonga town. Moreover, households did not have enough amount and proper type of storage containers. As a result open dumping near roadsides and back yards were common which lead to deplorable environmental conditions.

RECOMMENDATIONS

Based on the findings and professional observations made in the area, the following recommendations are drawn

1. Onsite storage containers of proper type (cleanable or washable and with cover) have to be practiced by the residents of Bonga town.
2. There should be a municipal service at least by using a low cost horse drawn cart.
3. Since most components are compostable wastes, composting process is feasible in the area and encouraging the residents of Bonga town to compost the generated wastes might have an ecological advantage.
4. Creation of public awareness is important for sustainable proper solid waste management.
5. Common disposal site(s) which are appropriate and far from water sources should be selected by the town administration.
6. Since this study represents only the dry season solid waste generation of Bonga town, wet season study need to be done to find out seasonal variations

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