

Full Length Research Paper

Potentials and constraints of household solid waste segregation in Bauchi metropolis

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This research is motivated by the lack of adequate solid waste management system in Bauchi metropolis. The research is carried out to identify the potentials and constraints of solid waste segregation in Bauchi metropolis with a view to harnessing and integrating them into household solid waste management in order to achieve a healthy and clean living environment in Bauchi metropolis. Systematic random sampling technique was adopted for the selection of the samples and 4% of the study population was taken as the sample size. The major instruments used for data collection were questionnaire, interview and direct measurement of household solid waste at source and the data is presented in tables and charts. It is found that over 95% of sweeping, cooking and food preparation are exclusively reserved for women in the study area. The women dominate generation, storage and collection of household solid with 81%, 96% and 91% respectively within the study area and yet they not integrated in the management. It is recommended that segregation of household solid waste at source in the high density area should be adopted and women should be the key actors in the segregation, and there should be a law to enforce the mandatory segregation of solid wastes at source for all the households in the walled-city. This will not only improve the environmental quality but would also increase the income base of the family

Keywords: Solid waste, household, women, segregation

INTRODUCTION

Solid waste management practice has largely been focused on the technical issues of waste disposal with little or no attention paid to the social and economic aspects where potentials abound. The new demands for equitable rendering of community services require some paradigm shift in the approach of the service providers. Solid waste management is crucial for providing effective and acceptable health care service delivery.

Time and again, Ogunboye (2003) and Doan (1995) have observed that the failure to take cognizance of the crucial potential of women in the management of modern society results in a serious loss of efficiency and productivity, Willson, (2007). A wide range of development programs and projects that involved women were successfully implemented in recent decades. And many studies have been made on women situations and position in the control of urban environment. However urban managers in the developing countries are yet to accept women as active actors instead of victims and passive objects on which various approaches to women

and development are being applied. It is time to realize that if projects are to improve women environment, it is essential to identify and to integrate the potentials of women in the urban environmental management, especially in the aspect of sustaining environmental quality, in terms of waste management. (Moser, 2008).

The fact that men and women often play different roles in the society, suggests that we should start to recognize the need and importance of disaggregating environmental issues on the basis of gender. In Africa, including Nigerian, women have been in the frontline of most household socio-economic activities. Throughout the history of human civilization, the roles of women are particularly pronounced in domestic activities. Existing literatures on women and environment in African scene show that women actively participate more than men in solid waste relating activities in domestic environment. Moser, (1988), enumerated four women's activities that are related to solid waste generation. Firstly, women are identified as managers of traditional environment, in other

words, in the areas where they are working to maintain the environment as it already exists. Secondly, women as rehabilitators of the domestic environment –repairing and taking preventive action to underpin sustainable development which is both rural and urban phenomenon, thirdly, as innovators in the use of new more appropriate technology in the creation of clean and healthy domestic environments and finally as protectors and caretakers of domestic environment.

Waste management in Bauchi metropolis is performed in three stages by different agencies. Bauchi State Protection Agency (BASEPA) manages the waste at the metropolitan level while community based organisations non-governmental organisations, trade unions in collaboration with BASEPA take care of the waste at community level. The household members mainly women are in charge of the waste management at the lowest level which is the household level.

However the management at the metropolitan and the community levels have not been efficient, as more and more new heaps of solid waste emerged on the surface of residential areas in addition to the old ones that have refused to disappear. Recently farmers have began to reject the municipal solid waste, which was highly patronised as organic manure, but now complaining that it contains high proportion of indecomposable materials e.g. leather and plastics and injurious objects e.g. broken bottles, sharp objects. Secondly the prevalence of scavengers despite its health hazard, public harassment and low social status.

The poor solid waste management at these levels originated from the house hold, the sources of the waste as reported by Chwuang, (2007) in his work, 'an appraisal of refuse management in the Makama housing upgrading project, Bauchi town'. He identified the neglect of household (women folk), especially their traditional roles at the household level, as a major factor responsible for poor solid waste management in the area. No direct partnership exists between BASEPA and the household members that produces and can easily segregate the solid waste. If BASEPA will partner with household for appropriate strategies, the problem of solid waste management would be solved in Bauchi metropolis.

The Role of Women in Solid Waste Management

Recognition of the role women can play in transforming society and building capacity must be recognized in regards to integrated pollution and waste management. Usually, women first notice deterioration of environmental conditions, as they are usually associated with responsibility for cleanliness of the home and for the health of the family. They observe a direct impact of the

unsanitary conditions such as infectious diseases and childhood diseases, accumulating waste, and lack of sanitation. Since they are responsible for the maintenance of the living space and the health of children, they have a strong sense of civic responsibility and a desire to improve their living conditions and health situation. This is why women seek collective solutions for improving the environment. They are found at the root of many initiatives on health care, waste collection, supply of drinking water, and environmental awareness programs, Bulle (1999). The division between the household and community waste stream is defined by the point at which discarded objects pass from the individual property of the household to the community's waste stream. This boundary, also a gender boundary in relation to waste, often defines the limits of women's autonomy and control of waste materials. Urbanization creates systems to manage waste outside of the household, rather than within it, which could involve reusing, burning, burying, composting, feeding to animals, etc. Usually it is the responsibility of women to take the waste to the point at the boundary of the household at which ownership of the waste actually passes from the household to the community or city.

In a number of the African countries underprivileged women are employees of the waste collection services as street sweepers and cart-operators with such physically challenging tasks as handling refuse, covering long distances, and working long hours in addition to the time spent on their domestic tasks. Often they are uneducated individuals facing difficult family circumstances (e.g., divorced mothers with children) so they treat the waste collection employment by a means of surviving and bringing in an income for their family. For example, four women in 10 employed by the municipal waste collection firm "Les Linguères" in Dakar are divorced, Bulle (1999). They are less hesitant than men when it comes to accepting a job which is underpaid and disrespected by society. As they have little education or are often illiterate, women carry out duties that do nothing to improve their status, such as street sweeping. The women are not involved in decisions about the management of the service they provide because they work long hours and, more importantly, they lack proper training.

In Ouagadougou (Burkina Faso), the community based organization at first only employed men, maintaining that garbage collection was a "typical" man's job. It was only when the high turnover of male collectors began to diminish the effectiveness of the collection service that the organization agreed to employ women. It turned out that women were very reliable employees. These women, from situations of extreme poverty, were bent on doing good work, as they saw this as their only job opportunity, given their lack of employment skills (UWEP, 1998). An example of community recycling of

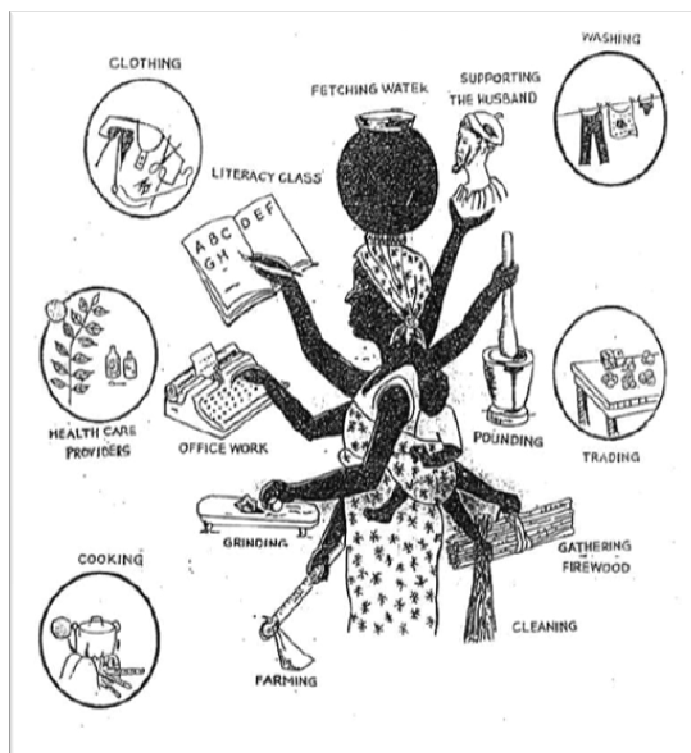


Figure 1. The Work Load on Women in Africa

domestic waste by women comes from the Set-Setal settlement in Dakar, Senegal, which has a population of 45,000 (UN-HABITAT, 2001). Before the initiative involving women began, the municipal services could only collect 35% of the 263 cubic metres of waste produced per day, while 51% of households had no toilet facilities and 76% had no convenient systems to process used waste-water which was consequently poured onto the streets. Unemployment rate for men was 28.6% and 24.1% for women. The settlement had a prevalence of infectious diseases such as typhoid and malaria. This situation was worsening by lack of proponents for urban poverty reduction and absence of skills training for urban women. There were no working relationships between the key partners before the project involving women was initiated. The objectives of the project were to clean up of the urban environment through simple processes ranging from the treatment of waste at home to final elimination or final treatment; generation of income for women through creation of jobs in waste recycling.

Research has shown that small scale traders, and especially women, place a high value on a secure and stable income, Everts (1998). They will not put their present business at risk through expansion, but rather prefer to diversify into small scale different activities. This attitude (or business acumen) has saved an MSE providing a waste removal service in Dar es Salaam from

collapse, when they lost their municipal cleaning contract. They had already diversified to the collection, cleaning and sale of recyclables.

In African context, responsibilities are assigned on the basis of gender disparity. Activities like cooking, sweeping, gardening, childcare, washing are traditionally reserved for women as in figure 1. This long held view has tied women to domestic activities that generate over 90% of household solid waste in Nigeria, Bogoro, (2008)

In Nigeria just as in any African traditional society, socio-economic activities are shared on the basis of gender and age structure and women are responsible for domestic cleanliness as in table 1. Women in most societies are responsible for the domestic work, which include many tasks such as childcare, shopping, cooking, cleaning and wellbeing of their husbands (World bank, 1999).

Stages of Harnessing the Potentials for Solid Waste Management Planning

It has been suggested by Moser (1988), that the solid waste planners should always consider the effect of demography of the households as an integral part of planning when designing a domestic waste management system. Particular attention should be given to the effect

Table 1. Women Daily Activities in Jos Metropolis

Sex	Sweeping	Storage	Collection	Evacuation
Male	32.47	24.50	78.70	80.08
Female	67.53	75.50	21.30	19.92
TOTAL	100.00	100.00	100.00	100.00

Source:- Zira, 1998

of gender on the choice of a collection system and the design of equipment. *Generation:* Waste segregation is an activity undertaken at the generation stage to facilitate recycling and disposal and thus entails household resources such as time, space and efforts in the same manner as waste recycling, Kamel (2004). This household activity that consists basically of the separation or sorting of wastes into recyclables and non-recyclables, and storing these wastes in separate containers to facilitate recycling and disposal is feminine. *Collection:* Moser, in 1988 reported that in Ouagadougou (Burkina Faso), a community based organization at first only employed men maintaining that garbage collection was a "typical" man's job. It was only when the high turnover of male collectors began to diminish the effectiveness of the collection service that the organization agreed to employ women who improved the collection.

Disposal

In Asia, a community downstream who uses the canal for irrigating their paddy fields was disturb by the quantity of solid waste that floats in to their paddy fields. WASPA project team found that around 70% of the waste is organic material, so they introduced a home composting and home gardening to housewives along the canal in the form of live fences (a low cost composting bin system). The project was able to dispose of 50% Of the solid waste at sources.

METHODS AND MATERIALS

Metropolis, the headquarters of Bauchi State, is located between latitudes 9° 00' and 9° 30' North of the Equator and longitudes 10° 25 and 11° 20' East of the Greenwich Meridian It occupies a total land area of 3, 604.0 hectares. It is about 128km North-east of Jos and 150km West of Gombe town. Bauchi metropolis, being the study area, has a total population of 318,038 people as at June 2010, population census NPC, (2006). Furthermore, based on the average household size of 8 persons per household as revealed by the 2006 census there are

39,675 households in the metropolis which formed the target population of the research. The data are sourced through Primary source and Secondary source. The following methods of data collection are used; questionnaire method, interview method, measurement method and observation method. After the field survey, information obtained from questionnaires, interview guide and observation guide were collated and coded in a summary sheet. The data were further presented in tabular form in frequency distribution tables and percentages. Pie chart and bar charts were used for graphical description, comparison and assessment of the existing condition of refuse evacuation in the area.

The study area was divided into twelve wards (Gunduma) which form the sample frame. From each ward a proportionate unit of household was selected for the purpose of administering questionnaire and interview. Ball and Gall, (1971) suggested that for a social study like this, for a target population of 1000 units, a sample size of 20% should be adopted, 10% sample size for 5000 population and 5% for a population of 50,000. The sample size of this research was determined based on the target population size. Since there are 39,675 households in the study area, 4% of 39,675 households were taken as the sample size which is 1587 households. For a heterogeneous environment like Bauchi metropolis, where population density, income level and probably occupation which to a great extent determined solid generation and characteristics, are quite varied, systematic random sampling techniques was adopted for the selection of the samples. These techniques are the most appropriate for a social survey because they are scientific and easy to apply.

RESULTS

Projected from 2006 census, the population of Bauchi metropolis stood at 318 038 in June 2010, using the National growth rate for urban centres, which is 4.5%. The survey revealed that female dominated with 50.6% (160 972) of the total population see table 2. The table above indicates that there are more women than men. Bauchi is a Hausa/Fulani community and by their tradition, it is the responsibility of the woman to sweep,

Table 2. Age-sex Distribution of the Population of Bauchi City

				Total		
Age	No		No	%	No	%
Less than14	52158	16.4	50886	16.	044	32.4
15-	2896	9.4	31168	9.8	61063	19.2
25-34	25443	8.0	15443	8.0	50886	16.0
35-44	22899	7.2	22581	7.1	45479	14.3
45-	1940	6.1	19082	6.0	38483	12.1
55 and above	7315	2.3	11767	3.7	19082	6.0
Total	157111	49.4	160972	50,6	318038	100.0

Source: National Population Commission 2010 Census).

cook, and clean the surrounding while the children carry the stored waste to the collection centres. The high number of women in the metropolitan area and the tradition could be a potential for segregation of solid waste at the household level. Based on the research carried out, it is revealed that within the walled-city, over 40% of the respondents have koranic education as their highest qualification while in the low density areas like the GRAs the respondents with secondary education dominates. However, on average koranic education accounts for 25.9% in the whole metropolis which is the highest and the least is university education which is 4.0%. Only 12.3% did not acquire any form of education and that shows that the literate population of the metropolis is very large. The high level of western education indicates that Bauchi metropolis has enlightened women that should easily and readily co-operate in achieving a healthy living environment through good solid waste management.

Income level plays a vital role in solid waste generation vis-a-vis its evacuation. In Nigeria, civil servants on GL 01- 05 are referred as low income, whose monthly earnings ranges between ₦5000.00 to 15,000.00, 33.7% of the respondents are within this category. Only 5.8% fit into the high-income group with monthly income of ₦45, 000.00 and above.

In a situation where one has very low income or no gainful employment at all, he will be ready to spend her time in sorting and segregating solid waste which can generate income for her instead of throwing it. The household size directly influenced the amount of solid wastes generated as the higher the household size, the greater the amount of solid wastes generation. It could be seen from table 4.3 below that 50.3% of the households surveyed have 6-10 persons per household, and 15.4% have 11-15 persons per household, based on that The average household size stands at 8 persons per household. This high household size is a typical characteristic of Hausa tradition.

In terms of solid waste handling, large household size though generated more waste, but can also be

advantages where the family members can sort and segregate the waste themselves. The large household size can provide free and cheap labour for solid wastes evacuation to collection centres and it also encourages community effort toward evacuation of refuse from collection centres to disposal sites.

Solid Waste in Bauchi Metropolitan Area

Quantitatively, the amount of solid waste generated in Bauchi metropolis is 0.16 kg lower than the national average per capita. The average solid waste generated in high density residential areas at 0.79 kg/capita/day; 0.89 kg/capita/day for medium density residential areas and 1.03 kg/capita/day low-density residential areas. The general average per capital solid waste generated was 0.86 kg/capita/day as in table 3. This research revealed that income level of a society determines the type of its solid waste. In general the higher a country's level of industrialization the higher its income level and the larger its proportion of toxic, non-organic and nonbiodegradable. More than 50% of the waste generated is garbage and ash as figure 2

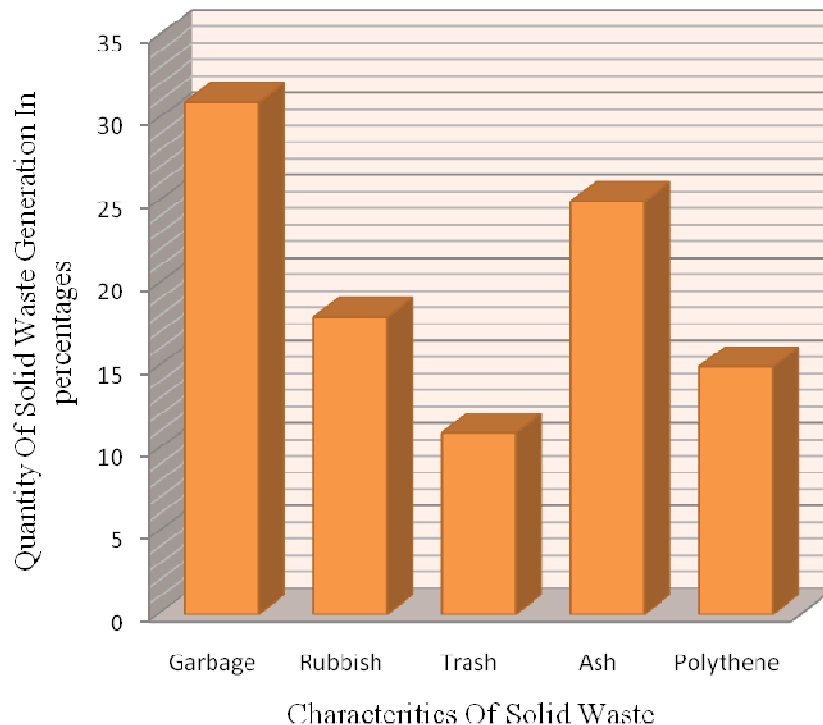
Distribution of Household Activities That Generate Waste

Traditionally, some activities that generate solid waste at the household level have been gendered, for example, sweeping, cooking and food processing tend to be exclusively reserve for women. This research discovered that in terms of manual processing of grains is 100% done by women and over 95% of sweeping, cooking and food processing is still the responsibility of women. Men perform more hectic work like weeding, raking, etc., as shown in table 4. Since women dominate over 90% of the household activities that produce solid waste at household level, it becomes expedient and justifiable to integrate them in to any programme or strategy that

Table 3 Per Capita Solid Waste Generation In kilogramme (Kg)

Nassarawa	High	0.37	0.75	0.50	1.34	0.54	3.50	0.70
Dan Kade	High	0.52	0.67	0.71	1.54	0.80	4.24	0.85
Dawaki	High	0.41	0.82	0.49	1.66	0.61	3.99	0.80
Dan Amar	High	0.52	0.54	0.62	1.47	0.48	3.49	0.70
Hardo	High	0.61	0.47	0.51	1.21	0.69	3.49	0.70
Total (kg)		8.75	9.49	9.20	12.0	11.31	50.74	
Average (kg)		0.73	0.79	0.77	1.00	0.95		

Source: Field Survey June 2011

**Figure 2.** General Characteristics of waste Generated in Bauchi Metropolis**Table 4.** Distribution of Activities

Activity	Male	Female
Sweeping	2.47	97.53
Cooking	8.51	91.49
Food Processing	1	99
Manual Grain Processing	0	100
Raking	57.91	42.19
Weeding	90.43	9.57
Washing	28.62	71.38

Source: Field Survey, June 2010

relates to solid waste management at the household level for it to be successful.

Frequency of Daily Household Activities

The research discovered that these activities that relate

to solid waste at the house level are performed not only once. Apart from food processing, the women carry out other activities more than once as shown in table 5. Considering the number of times the activities were being performed, it clearly indicates that a typical woman in Bauchi metropolis spent most of her time either

Table 5. Frequency Of Daily Household Activities

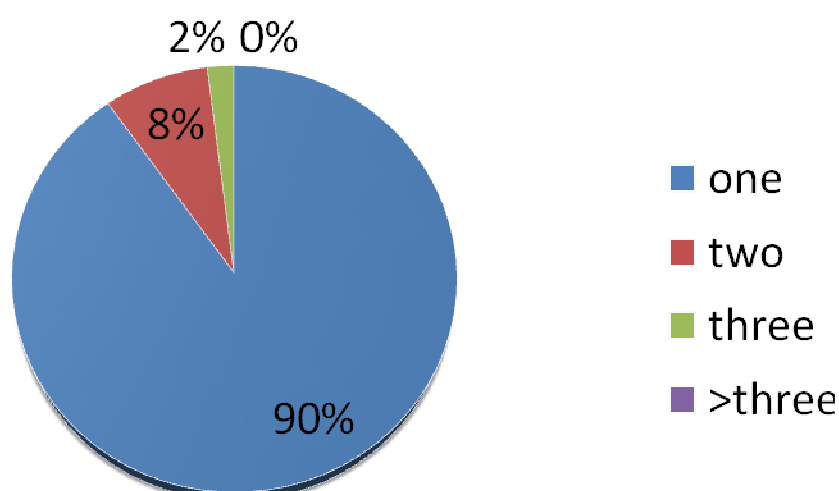
Activities	Once	Twice	Thrice
Sweeping	43	53	4
Cooking	12	62	26
Grain Processing	50	38	12
Food Processing	87	10	3

Source: Field Survey, June 2010

Table 6. Average Time Spent For Household Activities in minutes

Activity	Time Spent
Sweeping	30
Cooking	150
Grain Processing	40
Food Processing	30

Source: Field Survey, June 2010

**Figure 3.** Number Of Solid Waste Storage Containers in the House

producing or handling solid waste.

In assessing the average time spent daily by women to carry out their traditional household activities, it was discovered that over two hours is spent daily in cooking as in table 6. In trying to determine the available time for the sorting and segregation of the solid waste, it was found that in the high density and some medium density wards, over 60% of the women have more than one hour free while 63.9% of the low density areas claimed to have less than 30 minutes free time as in table 7. The amount of free time, especially by women in the walled city, is great potential to be exploited and utilized for waste segregation at the household level which is their traditional place of stay.

Availability of Storage Containers

Every household is supposed to have a container for temporary storage of the solid waste generated in the house. From the survey it was discovered that more than 90% of the households have storage containers only less than 10% either burn or throw away their solid waste as soon as it is generated. However, only 10% has more than one storage container as shown in the figure 3. With only one solid waste storage container it could be impossible for household to segregate the solid waste generated; this could be one of the reasons why most households in

Table 7. The Amount Of Free Time By Women

Ward	< 30 min	30 min to 1 hr	Over 1 hr
Old G R A	58.7	37.1	4.2
New G R A	70.5	23.5	6
F/Mada	62.4	25.3	12.3
Yelwa	21.8	51.1	27.1
Dan Iya	33.5	45.8	20.7
Makama	30.2	52.5	17.3
I/ Bako	29.1	40.5	30.4
Nassarawa	10.3	33.7	56
Dan Kade	8.8	30.9	60.8
Dawaki	15.6	20.3	64.1
Dan Amar	10.2	27.8	62.7
Hardo	4.7	37	58.4

Source: Field Survey, June 2010

Table 8. Segregation At Household Level In percentages

Ward	Segregation	Resources Recovery	No Segregation
Old g r a	2	21	77
New g r a	0	13	87
F/ mada	2	30	68
Yelwa	1	40	59
Dan iya	3	36	61
Makama	3	42	55
I/ bako	7	36	57
Nassawa	0	65	35
Dan kade	1	70	29
Dawaki	0	82	18
Dan amar	0	90	10
Hardo	2	91	7
Average	2	51	47

Source: Field Survey, June 2010

Bauchi metropolis do not segregate their solid waste at the household level.

Segregation at Household Level

Currently the level of solid waste segregation in the study area is poor, especially in the high density area of the walled-city. Some wards like Dawaki and Dan amar have zero level of segregation as shown in table 8. The respondents have different reasons for not participating in solid waste segregation. Up to 67.8% claimed that it is because they have only one container as in table 9. All the reasons given above, except 'no time', could be harness as potential to introduce solid waste segregation in the study area. The respondents gave an encouraging response regarding their willingness to segregate their solid waste at the household level. As high as 89.5%, indicated their willingness to segregate their solid waste at the

household level as shown in table 10. From the survey carried it was discovered that very few households participate in partial segregation of solid waste at the household level for different reasons as shown in the figure 4. It is clear that the few that segregate their waste could be low income who wants to reuse or sell valuable materials picked from the waste; however few of them see the need for environmental cleanliness as a good reason for waste segregation which should be encouraged.

Women Participation in Household Solid Waste Handling

The results of the data analysed above indicated that the women gender are in the forefront when it comes to general handling of household solid waste either because of socio-cultural or economic reasons. Women dominate the generation and storage of household solid waste with

Table 9. Reasons for not practicing Waste Segregation

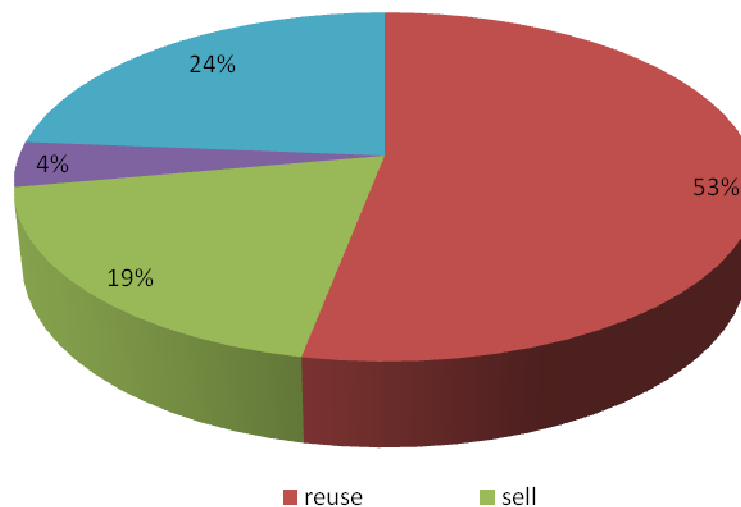
Reason	Frequency	Percentage
No need	52	3.3
one container	1076	67.8
No time	348	21.9
No space	111	7.0
Total	1587	100.0%

Source: Field Survey, June 2010

Table 10. Willingness to Segregate at Household Level

Willingness	%
Willing	89.5
Not Willing	7.2
Undecided	3.3
Total	100.0

Source: Field Survey, June 2010

**Figure 4.** Reasons for segregation at household level

81% and 96% over men. When it comes to carrying waste to collection centers still it is the women as in the figure 5

Test of Hypothesis

This research intends to determine the differences in terms of participation in segregation of solid waste at household level at 0.05 significance level between women that do not have free time (A) and those that have free time(B)

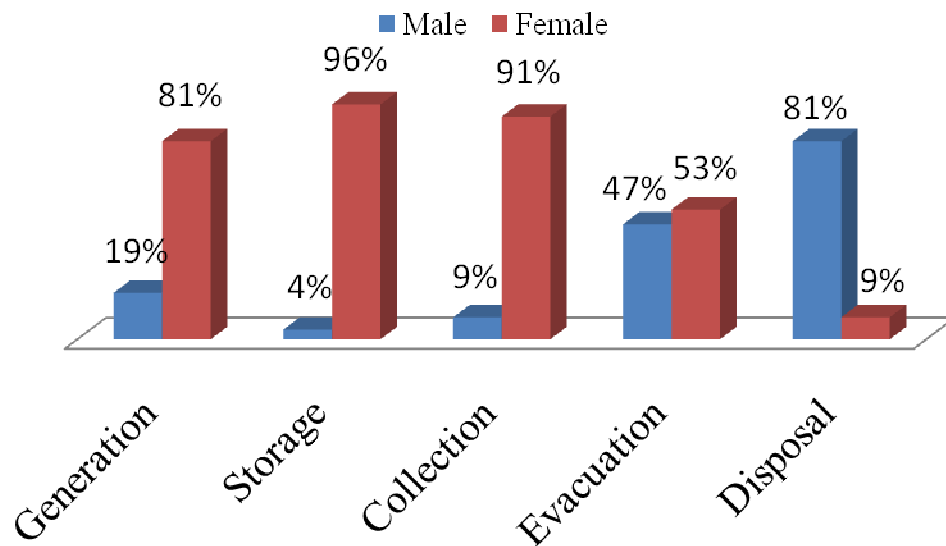
Therefore:

$$U = n_1 n_2 + \frac{n_1 (n_1 + 1) - R_1}{2}$$

$$= (5)(7) + \frac{5(5+1) - 28.5}{2} = 21.5$$

$$m_U = \frac{n_1 n_2}{2}$$

$$= \frac{(5)(7)}{2} = 17.5$$



Source: Field Survey, June 2010

Figure 5. Distribution of Responsibilities Based On Gender

$$\sigma_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

$$= \sqrt{\frac{(5)(7) + 5(5+7+1)}{12}} = 2.16$$

$$z = \frac{U - m_U}{\sigma_U}$$

$$= \frac{21.5 - 17.5}{2.16} = 1.85$$

Thus, the sum of ranks of the first sample (women that have no free time) in the one-tailed p -value table = 0.0350. Since the p -value is less than 0.05, the null hypothesis (H_0) that says there is no significant difference in terms of segregation of solid waste at household level between women that have free time and those that do not have free time would be rejected, thus accepting the alternative hypothesis (H_1) that says there is significant difference in terms of segregation of solid waste at household level between

women that have free time and those that do not have free time.

DISCUSSION

Projected from 2006 census, the population of Bauchi metropolis stood at 318 038 in June 2010, using the National growth rate for urban centres, which is 4.5%. The survey revealed that female dominated with 50.6% (160 972) of the total population who are traditionally responsible for cooking, sweeping and general cleaning of the environment. Over 50% of the household heads were found to be employed with the state and local government whose level of payment is relatively low. Teenagers, formed more than 50% of the entire population, this can be exploited for segregation at household level and organising community labour for evacuation of accumulated solid waste and clear filled drains.

The study found that, out of the 12 wards in Bauchi metropolis, 7 wards are fully enlighten, since up to 40% of the respondents have secondary education and above. However despite the high level of education, the household size is still as high as 8 persons per household and the level of income is relatively low. The findings exhibited a contrary situation where an educationally enlighten society is characterized by low income and high household size. Probably, the situation could be attributed to the type of occupation (mostly civil servants) that dominated in the area.

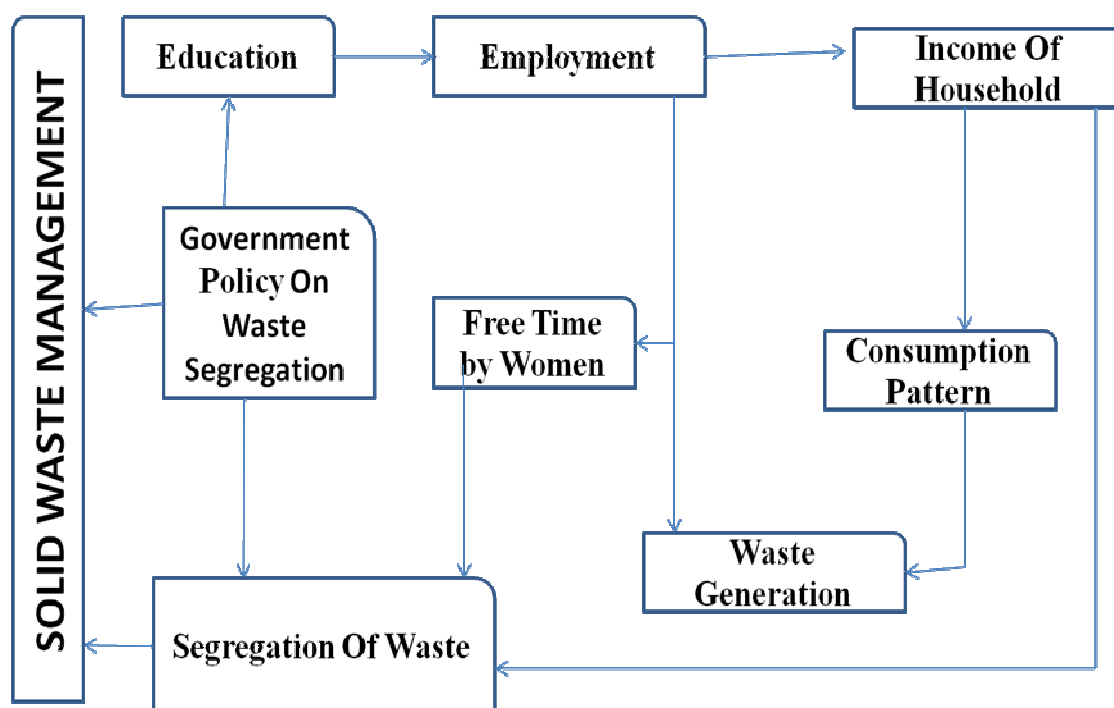


Figure 6. Analysis Of Factors Determining Solid Waste Segregation

Bauchi metropolis generates 274 metric tonnes of household solid waste daily with an average of 0.86kg per/capita/day, That means those responsible for waste management have a total quantity of 104 476 tonnes of household solid waste to manage every year. Garbage and ash constitute up to 66% of the waste stream in the metropolis. Income of the household has been found to have the most significant effect on the quantity and composition of the waste generated. High income earners generate more of non- biodegradable solid waste than the low income.

After identifying the daily household activities that produce solid waste, it is discovered that it's the women folk that perform those activities. For example, 100% of manual processing of grains is done by women, and over 95% of sweeping, cooking, childcare and food preparation are exclusively reserved for women in African tradition as their responsibilities

The women testified that not less than two and half hours is spent in cooking daily, and over an hour on food and grain processing while more than thirty minutes is used for sweeping daily. Occasionally, household activities like washing, mopping and general cleaning of the house and its surroundings take half of the day every week.

Probably because of the low level of westerns education, over 60% of the women in the walled-city (Nassarawa, Dan Kade, Dawaki, Dan Amar and Hardo

wards), were found to be unemployed in any gainful occupation. That is why they have more than two hours free time after performing their daily routine, while those in the medium and low density areas said they do not have more than 30 minutes free time daily because most of them are either employed in the civil service or in private sector.

The research discovered that educational qualification, employment status and amount of free time are significantly related as shown in the chart figure 6. It was found that most of the educated women were mostly engaged in gainful employment and have no much free time whereas reverse is the case in the walled-city.

In all the wards it was discovered that over 90% of the household have storage facilities, except Yelwa and Fadaman mada that have 72% and 89% respectively. However up 90% of those who have the storage containers, have only one container for all categories of solid waste generated in the house.

The segregation practice in the metropolis is very poor, as only 2% that manage to segregate their solid waste at sources. Fortunately, more than 65% of the respondents said it is because they have only one container for the storage but indicated willingness to segregate their solid waste if given more containers. When the probit model for econometric analysis was applied in all the wards to investigate the probability of solid waste segregation at source, the result of the

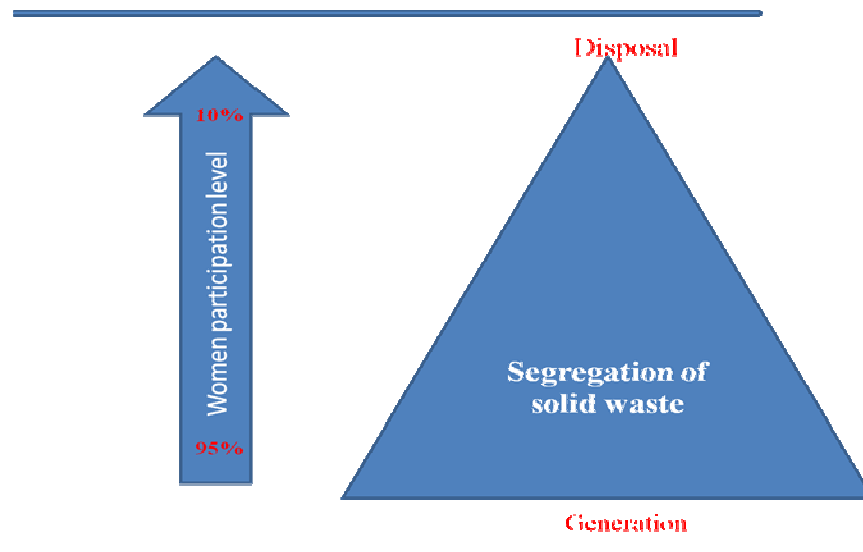


Figure 7. Segregation Pyramid

analysis revealed that there is a high probability for wards in the walled-city to participate in the solid waste segregation at source, as 87% indicated positive response. The result was weak in the medium income earners like Yelwa ward, Dan iya ward, Makama ward, and Ibrahim bako ward, while in high income areas there was no significant indication that solid waste can be segregated at sources. The probability that high income earners would participate in solid waste segregation at source was only 0.2, even the 0.2 could be due to community waste management-related variables like ordinances and penalties.

Segregation Pyramid

Segregation pyramid refers to the reduction in terms of the efficiency of women participation segregation of solid waste, as the participation moves upward (from the point of generation to point of disposal) their efficiency reduces from 95% at generation point to just 10% at disposal level, as shown in figure 7. It is found that segregation at source is more efficient, cost effective, less hazardous and requires little time than at the disposal level. This is because women can only participate effectively if it is done within the house than outside. Chuwang (1997) reported that sex and age are the main determining factors in household refuse handling, particularly carrying the filled storage facilities to collection centres. He further asserted that women and girls gather, store and evacuate the refuse in the household, a responsibility which he attributed to African culture irrespective of income level. In the same vein, this study observed women dominate the handling of solid waste at household level and that low-density areas specially employed the service of hired labourer especially women

or/and maids to carry the refuse to collection centres. It implies that with improved income level more labourers would be required for waste collection and hence a clean environment would be achieved. The research found that women dominate generation, storage and collection of household solid with 81%, 96% and 91% respectively within the study area while men were much involve in the disposal. The involvement of men in the disposal is up to 81%. This study found that potentials abound that could be harness for optimum integration of women in the household solid waste management through segregation at source. It is revealed that there are more women (50.65) than men in Bauchi metropolis, especially in the walled-city because of the high unemployment rate of the women, it was found that over 60% of the women have more than one hour as free time every day, again, the Hausa tradition reserves some domestic activities (sweeping, cooking, food processing, etc.) relating to household solid waste handling as women sole responsibilities and 89.5% are willing to segregate their solid waste at source. However, the major constraint could be the low level of their education which may affect their appreciation for personal hygiene and environmental health, through creating awareness this can be corrected. Another problem is the cultural factor that deters women from participating in any programme without the permission of the husband. Unless the husband agrees, the women would not go for any awareness even if she is free.

Potentials and Constraints of Integration of Women into Solid Waste Management

It is time to realize that if projects are to improve women environment, it is essential to identify and to integrate the

roles of women in the urban environmental management, especially in the aspect of sustaining environmental quality. The fact that men and women often play different role in the society, suggest that we should start to recognize the needs and importance of disaggregating environmental issues on the basis of gender. In Africa, including Nigerian, women have been in the frontline of most household socio-economic activities in most societies. Throughout the history of human civilization, the roles of women are particularly pronounced in domestic activities. Existing literatures on women and environment in African scene show that women actively participate more than men in solid waste generating activities in domestic environment. Major potentials abound that could be exploited in the integration process of women in the household solid waste management.

In this study, it was discovered that the women folk in Bauchi metropolitan area dominate the gender. The women population accounts for up to 50.60% of the total population, this large number can be of great advantage in terms of labour needed for the integration of the household solid waste more so that it is expected to be performed at the household level.

Secondly, another potential is the availability of time the women had. Especially in the walled-city, because of the high unemployment rate of the women, it was found over 60% of the women have more than one hour as free time every day, this confirms the assertion earlier made by Bogoro (2001) that over 80% of the women in Bauchi traditional city are full-time housewives. This free time is sufficient for the segregation of household solid waste generated at the household level on daily basis.

Thirdly, the Hausa tradition reserves some domestic activities (sweeping, cooking, food processing, etc.) relating to household solid waste handling as women sole responsibilities. In the study carried out, it was discovered that up to 81%, 96% and 91% of solid waste generation, storage and collection respectively, were carried out by women as their traditional responsibility in the house.

Finally, the women interviewed in Bauchi metropolis indicated high degree of willingness (89.5%) to segregate their solid wastes in order to improve the environmental quality and increase their income base by selling the sorted materials.

However, in the course of the study some constraints that could militate against effective integration were identified. First and foremost is the low education level of the women. It was found in the study that over 60% of the women did not have formal education where environmental health and personal hygienic taught. This can be corrected by creating awareness and enlightenment to the women on the importance of cleanliness. Another problem is the cultural factor that deters women from participating in any programme without the permission of the husband. Unless the

husband agrees, the women would not go for any awareness even if she is free.

SUMMARY

In this study, the strategists used in solid waste management in Bauchi metropolis were appraised with a view to identifying their strength and weaknesses. There has been failure to take cognizance of the crucial and important roles of women in the solid waste management in Bauchi metropolis which results in a serious loss of efficiency and productivity on the side of the management agencies. The roles of women were identified and integrated into the solid waste management strategists through segregation of household solid waste at source which has been neglected. This is with a view to achieving a clean and healthy living environment in Bauchi metropolis.

CONCLUSION

Bauchi metropolis generates 286 metric tonnes of household solid waste daily with garbage and ash constituting up to 66% of the waste stream. BASEPA, which is the only agency that is responsible for the disposal of solid waste in the metropolis, only evacuates 184 metric tonnes (62.41%) daily, leaving 102 metric tonnes (37.59%) of the household solid waste uncollected.

Women who are traditionally responsible for cooking, sweeping and general cleaning of the environment dominated with 50.6% (160 972) of the total population. Despite the high level of education, the household size is still as high as 8 persons per household and the level of income is relatively low. The findings exhibited a contrary situation where an educationally enlighten society is characterized by low income and high household size. Probably, the situation could be attributed to the type of occupation (mostly civil servants) that dominated in the area. 100% of manual processing of grains is done by women, and over 95% of sweeping, cooking and food preparation are exclusively reserved for women, these are waste generating activities. over 60% of the women in the walled-city were found to be unemployed, that is why they have more than two hours free time after performing their daily routine,

The probit model for econometric analysis revealed that there is a high probability for wards in the walled-city to participate in the solid waste segregation at source, as 87% indicated positive response, while in high income areas there was no significant indication that solid waste can be segregated at sources. The probability that high income earners would participate in solid waste segregation at source was only 2%. It is found that as

educational level increases, the income levels also suppose to rise and those with high income generate more solid waste than those with low income. There is significant relationship between employment status and the amount of free time by women in the study area; women without employment have more free time, also there is significant difference in terms of segregation of solid waste at household level between women that have free time and those that do not have free time, those with free time would actively and readily participate in the segregation at the household level.

RECOMMENDATIONS

There are three global options for dealing with waste. The first option is to collect the waste and transport it to a legal and well-protected dumpsite, where it can be disposed off. In this case waste remains as waste. The second option is to re-use waste, or recycle it. This includes composting of any waste that can rot. In this option waste becomes something useful again, as was already explained earlier in this session. The third option is the treatment of waste. This includes controlled burning and controlled burying of waste. In this case waste can become a source of useful energy for example in the form of heat or gas for cooking. However, the last two options are the latest and the best options that recommend segregation at sources as a necessary requirement for effective solid waste management.

Based on the results of the findings by this research, immediate and long-term measures are being recommended for proper integration of women in to household solid waste management in Bauchi metropolis. A strong legislation is also recommended for enforcement of the proposal.

Now that many collection centres are already overflowing, and many unauthorised dumping sites have emerged, an immediate joint action should be adopted to evacuate the wastes accumulated in order to restore environmental sanity in the metropolis. This can be achieved by establishing a strong joint-action team comprising of staff of BASEPA, heads of the communities, private organization, community based organizations, non-governmental organizations, trade unions and youth organisations. A one-month sanitation exercise should be declared in the metropolis to be observed during work free days. 'Stop' notices should be placed on all unauthorised dumping sites and a monitoring team comprising staff of the agency and representative of the communities should supervise the collection and disposal of waste.

For immediate evacuation, BASEPA should contract the evacuation of outside walled-city to private contractors to be completed within one month, meanwhile the agency would mobilised all its resources

(equipment/vehicles and staff) and concentrate on the walled city.

Bauchi local government should source fund from National Ecological Fund to procure refuse handling equipment in order to resume its statutory function of solid waste collection. The local government should limit its service within the walled city where heaps of solid waste are indiscriminately scattered around, this will compliment the work BASEPA within the walled-city. However the agency would constantly offer technical assistant and professional advice to the local government when the need arise.

Segregation of household solid waste at source is a panacea for effective management of solid waste.

Segregating wastes at the source of generation can be more cost-effective at residential land use than in other land uses because the participation of a solid waste generators can be augmented by free time and tradition responsibilities. Since from the survey it was revealed that only the walled-city has high probability for participating in the solid waste segregation at source; because as high as 87% indicated positive response. The result was weak in the medium income earners like Yelwa ward, Dan iya ward, Makam ward, and Ibrahim bako ward, while in the high income areas there was no significant indication that solid waste can be segregated at sources. The probability that high income earners would participate in solid waste segregation at source was only 0.2, even the 0.2 could be due to community waste management-related variables like government ordinances and penalties on solid waste management.

It is therefore recommended that segregation at source should be practiced only in the walled-city. The exercise should be carried out in three stages as follows: The first stage should be the separation of toxic waste from non-toxic waste. The toxic waste like batteries, chemicals, paints and others should be carefully be separated from other wastes and stored in a covered storage facility and kept out of reach of children.

At the second stage, the non-toxic waste which contain recyclable and non-recyclable materials should also be sorted into two groups. The non-recyclable materials which comprises of ash, garbage, food scrubs and other biodegradable materials should be taken to communal collection centers for onward evacuation to disposal site. The final stage should be the separation of the recyclable materials into metallic and aluminium materials in one container and polythene and plastics on the other container. Three temporary storage containers of different sizes and colours that can contain all the solid waste that can be generated in a week, at household level; one with cover for toxic waste, one for metals and aluminiums and the other for plastics and polythene should be kept at the household level as in figure 8

The provision of the new law that requires households to divert at least 50% of solid wastes generated within the

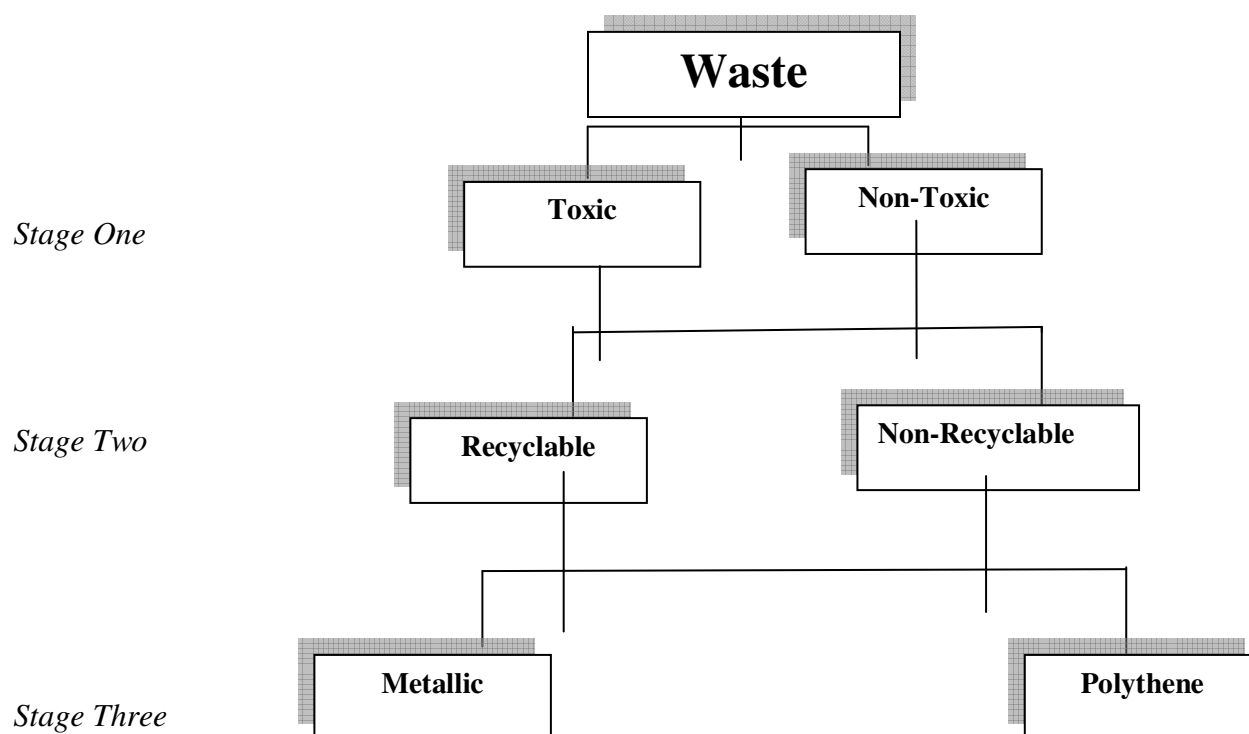


Figure 8. Stages of Solid Waste Segregation At The Household Level

next five years. The law should require the community heads to undertake very aggressive resource recovery and recycling programs in their respective communities. The law should, however, provide for mechanisms to help the communities this waste diversion target, one of which is the mandatory waste segregation at source. This provision is intended to directly support and promote waste management practices that reduce the volume of wastes brought to final disposal sites. Some of these practices include waste minimization, reusing, recycling and composting. The survey results of the present study indicate that mandating households to segregate their wastes through local ordinances are important to promote compliance. In addition, it is necessary that the community residents are made aware of the benefits of waste segregation for them to engage in a waste management program. It is important too, that the problems in implementing waste segregation and resource recovery are considered when designing other community programs

There is room for promoting increased resource recovery at the household level, particularly in the area of composting of biodegradable wastes and recovery of recyclable materials, such as aluminum cans, paper-based wastes (other than old newspapers) and plastic wastes.

A good baseline information on waste management-related concerns should be made available for effective waste management and decision-making at the all levels. The following information – quantity and composition of wastes generated, collected and disposed; quantity of wastes diverted by households, waste collectors and other agents; amount of wastes illegally dumped; amount and types of materials re-processed in recycling plants. In designing their solid waste management programs, government must be aware that waste management is an activity that requires time and effort on the part of the household. The SWM program therefore, must emphasize the benefits to the community as well as to the household, of the adoption of improved solid waste management practices. It would be useful for households that embark on waste segregation and resource recovery programs, to estimate the potential economic savings they can derive from their activities, and use this information to solicit the assistances of the government. They must stress to the residents that any financial resources saved would mean available resources for non-SWM basic services such as health and education. At the household level, the SWM program should demonstrate the benefits of waste segregation and composting in terms of cleaner household premises that promote better

health conditions of household members.

A high level of awareness and education on sanitation, environmental health matters and benefits of segregation at household level should be created to the entire public so that they can appreciate the need for a clean living environment and actively participate in the segregation exercise. Bauchi Radio Corporation, Bauchi Television Authority and the FM Station should transmit programmes organised by the agency on environmental health, highlighting on the roles of individual and at community level in Hausa and English languages with emphasis on the role of women in the segregation of household solid waste at sources. Posters and handbills should also be printed to create more awareness.

Since women, especially those in the walled-city, were found to be in charge of over 80% sweeping, cooking, childcare and other household activities that produce solid waste at the household level, up to 74% of them are unemployed and have more than one hour as free time every day, the task of solid waste segregation at household level should be their responsibility.

Legislation

There should be an ecological legislation on Solid Waste Management to be enacted largely in response to the growing and emerging heaps of solid waste on the urban land and scarcity of disposal sites, particularly in the traditional city. The law should emphasize on solid waste avoidance and volume reduction through source reduction and waste minimization measures, with the protection of public health and the environment as the primary goal. The following provisions of the law that are of interest to the present study are listed below.

a) The law should establish a mandatory, solid waste diversion rate of 45% within the next three years at the household level. This will require each ward within the walled-city in the next three years to divert annually, on the average, 15% of its solid wastes away from waste disposal facilities into resource recovery activities such as reusing, recycling and composting.

b) The law should enforce the mandatory segregation of solid wastes at source to include all the households in the walled-city.

The wastes will be segregated and properly marked as can-be-composted, non-recyclable, recyclable or special wastes. Segregation and collection of biodegradable, can-be-composted and reusable wastes shall be conducted at the ward level, while collection of non-recyclable materials and special wastes shall be the responsibility of Bauchi Local Government and Bauchi State Environmental Protection Agency.

c) The law should provide for establishing recycling and composting programs, including an inventory of

existing markets for recyclable and can-be-composted materials, the establishment of materials recovery facilities at the local level and setting up of drop-off locations for recyclable materials. Standards for non-environmentally acceptable products and packaging will be developed and imposed on all household solid waste.

d) The already existing law on monthly sanitation, which is observed on every last Saturday of the month, should be maintained right at the household level to the entire metropolitan area.

The residents are required to bring their segregated garbage to specified drop-off points that are situated in most of the street corners. Each drop zone should have a covered drum for can-be-composted wastes, trash hangers with four plastic sacks for recyclable papers, cartons, bottles and steel, and a garbage cage made of plastic net, steel and round bars to store disposable wastes to prevent animals from scattering the trash. The can-be-composted wastes are collected from 6am to 8am daily, while the recyclables are brought to the redemption center for storage until there is sufficient for sale. Although economic incentives and educational programs are imperative in cultivating sustainable waste management practices, the role of enforcement is also crucial. Especially at the outset of a SWM program that seeks to alter public behavior, penalties have to be associated with failure to comply. If the desired course of action (i.e. segregation-at-source) has to compete with the option to dispose of waste for free at anytime and anywhere without reprisal, success of the program will be extremely difficult. It is probable that many people will not change their waste disposal habits if the way of disposing of waste familiar to them is available as a free option. All perceived options should be associated with relevant benefits and costs. To this end, it would be useful to find creative ways to involve all members of the community in helping invoke change in people's waste disposal behavior. Along with strict penalties, the wards involved a group of community volunteers that helped make sure people followed the new rules as set out by the local council. This will be a group of community members who will believe in the value of a clean neighborhood and are willing to donate their time toward this end. A similar volunteer group could be formed at the municipal level in Bauchi. Their role in the community could range from watch dogs reporting on improper disposal activities, to educators helping raise awareness of the benefits of a clean environment.

This project has highlighted important aspects that need to be taken into consideration in the design and delivery of domestic solid waste services. The ideas raised emphasised the fact that solid waste services should be managed in context. This requires a paradigm shift from the traditional approaches that are technological biased and often prejudice to the socio-economic aspects of the community. The need to shape

the operation of domestic waste services to accommodate the socio-cultural and economic realities in the communities is inevitable. The concrete facts are that:

- Solid waste management services forms the core of municipal services and cannot be sustained without community cooperation and participation in all operations. The designed system should be user friendly and sustainable. To this end, efforts are needed to assess the profiles of each community as each one is unique and so are the needs, aspirations and challenges. The understanding of the demographic characteristics of communities within the local authorities' operational area is vital for the delivery of accessible, affordable, relevant, acceptable and effective services.

- Gender relations are equally important. Women form the larger proportion of society worldwide and constitute the most vulnerable population groups to inappropriate service system designs in particular, solid waste collection systems. One of the short comings of the current solid waste collection systems is their male bias regardless of the fact that women constitute the majority of the service recipients.

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