A SURVEY OF POSSIBLE HOUSEHOLD PARTICIPATION PATTERNS IN SOLID WASTE SOURCE SEPARATION IN GABORONE

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Public support for source separation schemes in developing countries is still subject to a continuing debate and limited work has been directed at understanding its manifestations. The purpose of this survey was to assess existing and potential levels of household participation in waste source separation as well as establishing the role they could play in future source separation schemes in Gaborone. Questionnaire-based surveys were used to elicit information from households about their awareness of recycling and recycling initiatives, attitudes and willingness to participate in source separation schemes. The survey involved 17 households who participated in a pilot source separation scheme and 284 households who did not. The results showed that the majority of households are aware of recycling and recycling initiatives, but this awareness does not necessarily translate into participation in recycling activities in the absence of incentives and 'visible' recycling systems. It was also found that the majority of households are willing to participate in future source separation schemes, however, such willingness was primarily limited to separating materials that at the time had known available markets and were easy to separate.

Key words: ***Source separation, household awareness, household participation, recycling, Gaborone***

1 INTRODUCTION

In recent times, systematic and formally run source separation of household waste schemes sponsored by municipalities has become popular in many developed countries. Several reasons are often advanced for embarking on such schemes, but the overriding factor is often to fulfil national governments statutory targets of municipal waste diversion from disposal through recycling [1,2]. The waste diversion targets are usually included in national legislation and policy as a result of concern over adverse environmental impact of waste disposal and overuse of resources. These developments have not gone unnoticed by environmental NGOs and governments in developing countries. National governments, municipalities and NGOs in these countries have also developed interest in developing source separation schemes as the key to addressing their waste management problems through optimising diversion of recyclables from disposal [3].

However, there is continued debate over the appropriateness of household waste source separation schemes in developing countries [4,5]. Critics of source separation schemes in developing countries are of the view that they may lack wider public support [5,6,7,8]. Public participation is considered be the touchstone for the success of household waste source separation schemes. Households are usually expected to participate in source separation schemes and do the separation correctly according to the required components [2,8]

Studies on household support for source separation schemes in developing countries are few and far between. Chung and Poon [8] found that in Guangzhou, China, the majority of people (84 percent) were willing to participate in voluntary source separation of household waste schemes. It was also found that the majority of people were willing to separate materials that are easy to separate such as paper, metal cans and rigid plastic. Noor [7] found that the majority of general public (83 percent) in Petaling Jaya, Malaysia were willing to participate in voluntary source separation schemes that involved kerbside collection of recyclables. El- Hawi [9] found that only 32 percent of households in Gaza Strip were willing to participate in source separation schemes. In India, it is reported that the majority of people (70 percent) were against source separation of household waste because they considered it inconvenient, time consuming and dirty [10]. Even though some of the studies are not based on statistically designed surveys, the general results pertaining to public support for source separation schemes are equivocal.

This paper reports findings of household questionnaire-based surveys conducted in Gaborone in July 2000. The purpose of the survey was to assess the perceptions and attitudes of households and the role they could play in source separation schemes. The main parameters investigated by the survey are awareness of recycling and recycling initiatives, the impact of awareness on practicing recycling, attitudes of households towards source separation and willingness of households to participate in future source separation schemes. The paper is organised into background to the study area, methodology, results and discussions and concludes by outlining policy and strategic implications of the household survey.

2 BACKGROUND

Gaborone is the financial and administrative capital of Botswana. It is also the headquarters of the Southern African Development Community (SADC). Gaborone has a population of 186 000 and at an annual growth rate of 3.4 percent [11]. The average household size is 4.8 persons per household. The average real GDP

growth was estimated at 6.4 percent in 2002 [12]. The main economic activities in Gaborone are civil service employment, construction, wholesale and retail trade. In 2002, national unemployment rate was estimated at 15.8 percent [13]. Industrial activity is limited, with manufacturing representing 1.1 percent of economic activities [14]. Manufacturing is mainly dominated by light industrial activities such as clothing and fabrication of metal products excluding machinery.

Gaborone City Council is the designated waste collection and disposal authority. It collects waste from household and commerce that are the main waste generators. The city council provides two basic types of collection service: door-to-door collection in most residential areas; drop-off collection systems in areas where skips have been provided such as some low-income areas and commercial areas. Most of the waste collected is disposed of at the Gaborone landfill.

The waste generation rate for household and commercial waste is 27144 tonnes/year, which is equivalent to 0.40 kg/capita/day [15]. Of this generation rate, 82.5 percent is household waste, while 17.5 percent is commercial waste. Within this total waste stream, 20.5 percent is potentially recyclable, which is equivalent to a recyclable content of 12.6 tonnes/day. The recyclable content is made of paper (37%), glass (18%), metals (17%), plastics (25%) and textile (3%) [15].

The policy and legislative framework that designate waste management authorities and set proposals on how waste should be managed are:

- Botswana's Strategy for Waste Management of 1998 [16] – this strategy adopts the Waste Management Hierarchy as its main guiding principle, with recycling as a one of its major components.
- Waste Management Act, 1998 [17] – requires the local authorities to prepare, as part of their waste management plans, a waste recycling plan for solid waste in their areas of jurisdiction.

The spirit of both the policy and regulatory instruments is to direct the local authority towards setting up household waste source separation schemes.

Prior to the above policy and regulatory instruments, waste recycling in Gaborone has been the responsibility of the private sector operating in a relatively unregulated environment with profit being the main motive of engaging in such activities. The material is collected mainly from commercial enterprises with prior arrangement with commercial operators to set them aside. The recovered material is collected, sorted and bailed for export to Zimbabwe and South Africa. Other recycling activities are undertaken by Segwana (PTY) LTD and Collect-A-Can, Botswana. Segwana collects refillable beverage glass bottles for reuse through a deposit refund scheme while Collect-A-Can operates a buy back centre for steel beverage metal cans. Collect-A-Can is an initiative of the South African Steel and Canning Industry. Informal recycling is mainly limited to a few waste pickers who pick metal cans from the landfill to sell to Collect-A-Can. In addition, there was an attempt by a company based in Gaborone from 1993 to 1996 to operate a voluntary drop-off centre for glass bottles with 21 bottles banks strategically located in schools and shopping areas. The scheme was not successful and its failure was attributed to general public apathy towards recycling [18].

Following the Waste Management Act and the Waste Management Strategy, a local environmental NGO, Somarelang Tikologo in collaboration with Gaborone City Council piloted a source separation scheme for household waste from November 1999 to July 2000 [19]. The pilot scheme required 39 randomly selected households to separate metal cans, glass bottles and paper for recycling. The initial objective of the scheme was to assess the quantity of these recyclables in the waste stream. At the end of the pilot period, the NGO evaluated the scheme as successful as far as raising the environmental awareness of the participation households. On the basis of that, the NGO continues to lobby the local authority to engage in a large-scale pilot source separation scheme with a view of expanding it to a fully-fledged scheme if it proves to be successful.

3 METHODOLOGY

Questionnaire-based surveys were used to elicit information from households on the key variables investigated. Instead of assuming that all households have attitudes about household waste source separation regardless of their prior contact with it, two sampling frames were used.

1. The first sampling frame was that of households who had not participated in the pilot source separation programme, who are referred here as *'general households'*. The objectives of this survey were to:
   - Assess households awareness of recycling and recycling initiatives
   - Assess the impact of awareness on practising recycling
   - Assess households' willingness to participate in future source separation schemes
2. The second sampling frame was that of households who participated in a pilot source separation project that was carried out by Somarelang Tikologo in collaboration with Gaborone City Council, who are referred to here as *'specific households'*. The pilot scheme, which took place from November 1999 to July 2000, had 39 households participating. Households who participated in the pilot scheme were identified using contact information obtained from Somarelang Tikologo, which included house numbers and names of contact persons within the

household. By virtue of participating in the pilot source separation scheme, these households are likely to have some knowledge about source separation of household waste and presumably have formed an opinion about it. The objectives of this survey were to:

- Assess the impact of awareness on practising recycling
- Assess households' willingness to participate in future source separation schemes
- Assess households' attitudes towards source separation schemes based on their experience with the pilot project

3.1 Structure and aim of the questionnaires

Two sets of questionnaires were used between *'specific households'* and *'general households'*. The questionnaires were designed around the key variables investigated as outlined above. The main distinction between the two questionnaires was that questionnaire administered to *'specific households'* contained an additional section on households attitudes. Prior to the design of the questionnaire, key informant interviews were conducted with the Chief Technical Officer (waste management) of Gaborone City Council and a representative of Somarelang Tikologo (an environmental NGO) to provide operational definitions of the study variables. The specific sections of the questionnaire covered information as detailed below.

Questionnaire 1: This questionnaire was administered to *'specific households'*. The questionnaire is divided into five sections:

Section A:	Personal information to be correlated with the variables in the other sections.
Section B:	The objective of this section is to explore general issues in household waste management.
Section C:	This section assesses the awareness (knowledge) of recycling by households and how the awareness translates into practising recycling.
Section D:	The section assesses households' attitudes to source separation. Respondents were asked to express their opinion in relation to the pilot source separation scheme in which they had previously participated, on a scale of; strongly disagree (SDA), disagree (DA), don't know (DK) and strongly agree (SA).
Section E:	This section assesses the willingness of household to participate in future source separation schemes.

Questionnaire 2: This questionnaire was administered to *'general households'*. The questionnaire is divided into four sections:

Section A:	Personal information to be correlated with the variables in the other sections.
Section B:	The objective of this section is to explore general issues in household waste management.
Section C:	This section assesses the awareness (knowledge) of recycling by households and how the awareness translates into practising recycling.
Section D:	This section assesses the willingness of household to participate in future source separation schemes.

3.2 Sampling and administration

Stratified random sampling was used as a means for conducting the survey for *'general households'* [20]. The basis for stratification was household income. It was assumed that low-income households live in self-help housing areas (SHHA), medium-income households live in Botswana Housing Corporation (BHC) low-cost houses and high-income households live in BHC medium and high cost houses. This assumption was cross-checked by directly requesting information on household-income and was found to be reasonably accurate.

The size of the sample for *'general households'* was determined by using the formula (1) applicable to estimating proportions [20].

$$n = \left[\frac{z_{\alpha/2}\sqrt{p(1-p)}}{E} \right]^2 \qquad (1)$$

where n is the sample size
$z_{\alpha/2}$ is the value of the standard normal distribution with an upper-tail probability of $\alpha/2$
p is the proportion of success
E (short for error) is the level of precision desired

A maximum error of 5% with a confidence of 90% was set as the desired reliability. Since nothing was known about the population, p was assumed to be 0.5 to determine the upper bound limit of the population [20]. The required sample size was 272. The calculated sample size was increased by 5% to 284, allowing for some missing cases that might occur due to technical or other errors during the survey. The sample size was

distributed on the basis of the proportion of each housing unit type in the study area as shown in Table 1.

Table 1: Number of households sampled as a proportion of income categories

Income category	Total number of housing units	Proportion of total housing units (%)	Number of sampled households (Column 3x284/100)
Low-income (SHHA)[21]	11303	43	122
Medium-income[22]	7913	30	85
High-income[22]	7343	27	77
Total	26559	100	284

The pilot source separation project took place from November 1999 to July 2000 [19] and interviews were conducted during the months of July and August 2002. An attempt was made to interview all 39 of *'specific households'*. This was not possible because of the long time lapse between the pilot project and the conducting of interviews with most of them having relocated to new areas. Among the 39 households who participated in pilot scheme, only 20 were identified. Of the 20 identified households, 3 did not want to be interviewed. They were unhappy that despite having agreed to source separate their materials, no one came to collect them. The unhappiness by households as a result of failure to collect the source- separated materials could limit their continued participation. This could undermine the sustainability of source separation schemes.

Four enumerators administered questionnaires to a single member of the household who was willing to be interviewed. Because of the cohesiveness of the household unit, the views of the interviewee were deemed to adequately represent the views of the household.

4 RESULTS AND DISCUSSION

The data obtained from the two household surveys were coded and analysed using SPSS version 11. The variables investigated were awareness of recycling and its impact on practising recycling, willingness to participate in source separation and households' attitudes. Since most variables are nominal, the Pearson Chi-square statistic (χ^2) was used to measure the relationships between variables, with a value of less than 0.05 considered significant with 90 percent confidence for *'general households'*.

4.1 Awareness and its impact on practising recycling

The questions in section C of the questionnaire were designed to establish awareness and the level of participation in recycling activities by both *'specific and general households'*. Awareness refers to having information about an event or an activity. It can give an indication of how the information was acquired and how useful the information is from the households' perspective. In this study, awareness was established using two distinct questions (questions 8 and 13 in the questionnaire) in parallel being:

- Have you heard or read about recycling before?
- Segwana LTD currently has a scheme where you can return your beverage bottles to the store from which you bought them for a fee. Are you aware of the scheme?

The second question was chosen mainly because the deposit refund scheme was the most visible reuse/recycling activity in Gaborone, with most stores accepting empty beverage bottles from consumers to refund their deposit.

The survey found that 97.1 percent of the sampled general households had heard or read about recycling. This could be attributed to the fact that Somarelang Tikologo and Department Sanitation and Waste Management (DSWM) had been actively raising awareness on recycling through print media and the radio. Apart from that, since the Rio Declaration of 1992 environmental issues such as recycling have been part of the school curriculum. It was also found that 98.1 percent of the sampled general households were aware of the deposit refund scheme operated by Segwana LTD for beverage bottles. This could be attributed to the monetary incentives of returning the beverage bottles. These results showed that households were generally aware of recycling and some recycling initiatives.

Awareness of recycling and recycling initiatives was found to be statistically related to education and age. The proportion of respondents with lower education standard who had heard or read about recycling is significantly different from respondents with higher education who had heard/read about recycling with a Pearson Chi-square of 0.000. The relationship is

shown in the cross-tabulation of education by heard or read about recycling in Table 2. Of the 198 respondents who had heard or read about recycling, 17.7 percent had primary education and below while 82.3 percent had secondary education and above. The direct relationship between awareness and education level means that as education level increases so does access to the range of media outlets that carry information about recycling. This means that programmes aimed at creating awareness about recycling and recycling activities should be spread across different information media to cater for the different educational levels.

The relationship of education and heard or read about recycling explains why 61 percent of the respondents who had heard or read about recycling, have heard through education-related media. Of the 61 percent who had heard or read about recycling through education related media:

- 31 percent had heard or read about recycling through newspapers, magazines, newsletters, and billboards
- 28 percent have heard through their school curriculum (which was part of other media).

However, 24 percent of the respondents had heard of recycling through the radio, which is the highest percentage recorded by a single information dissemination medium apart from school. This could be explained by the fact that generally most people have access to radio. The radio is also the main means of information dissemination by government and non-government agencies, and the dissemination is done for free on the main government owned radio station, Radio Botswana One (RB1).

The proportion of younger people who had heard or read about recycling is significantly different from older people who had heard or read about recycling with a Pearson Chi-square of 0.023 (which is less than 0.05), with the majority of younger people having heard or read about recycling. This can be explained by the fact that there is high literacy among the younger generation, and as pointed out earlier, since the Rio Declaration of 1992 environmental issues such as recycling have been part of the school curriculum. The relationship is shown in a cross-tabulation of age by heard or read about recycling in Table 3

Table 2: Cross-tabulation of education by heard/read about recycling

Education	Heard or read about recycling		
	Yes (row%, column%)	No (row%, column%)	Row Total (%)
None	12 (57.1, 6.1)	9 (42.9, 12.2)	21 (7.7)
Primary	23 (47.9, 11.6)	25 (52.1, 33.8)	48 (17.6)
Secondary	114 (76.5, 57.6)	35 (23.5, 47.3)	149 (54.8)
Tertiary	49 (90.7, 24.7)	5 (9.3, 6.8)	54 (5.8)
Column Total (%)	*198 (72.8)*	*74 (27.2)*	*272 (100)*
χ^2	**Value**	**Df**	**Significance**
Pearson	27.419	3	0.000

Table 3: Cross-tabulation of age by heard/read about recycling

Age	Heard/read about recycling		
	Yes (row%, column%)	No (row%, column%)	Row Total (%)
16-24	108 (81.8, 53.5)	24 (18.2, 31.6)	132 (47.5)
25-34	47 (63.5, 23.3)	27 (36.5, 35.5)	74 (26.3)
35-49	35 (67.3, 17.3)	17 (32.7, 22.4)	52 (18.7)
50-64	10 (62.5, 5.0)	6 (37.5, 7.9)	16 (5.8)
65+	2 (50.0, 1.0)	2 (50.0, 2.6)	4 (1.4)
Column Total (%)	*202 (72.7)*	*76 (27.3)*	*278 (100)*
χ^2	**Value**	**Df**	**Significance**
Pearson	11.305	4	0.023

Despite the majority of households generally being aware of recycling and recycling initiatives. The following discussion shows that this awareness does not necessarily translate into practising recycling.

Practising recycling was established by asking *'specific and general households'* who were aware of recycling and the deposit refund scheme three questions (questions 10, 11 and 14 in the questionnaire):

- Do you usually set aside materials from your waste for reuse and recycling?
- What materials do you usually set aside?
- Do you usually return your beverage bottles?

Of the 97.1 percent respondents from *'general households'* who were aware of recycling, 47 percent set aside some materials for recycling while 53 percent did not. Within those who set aside materials for recycling, the majority of them (51 percent) set aside glass bottles because of the deposit paid for returning the bottles. A cross-tabulation of heard or read about recycling by setting aside materials for recycling in Table 4 showed that the relationship between awareness and practising of recycling was weak with a continuity correlation of 0.806 (computed for 2x2 table to compensate for overestimation of the Pearson Chi-square). The weak relationship between the two variables means that few people who have heard or read about recycling set aside materials for recycling. This could indicate that there are other factors in addition to awareness that contribute practising recycling such as 'visible' recycling centres and incentives. Furthermore, failure to translate awareness of recycling into participation in recycling initiatives could undermine the role of public awareness programmes.

Table 4: Cross-tabulation of heard/read about recycling by setting materials for recycling

Heard or read about recycling	Setting aside materials for recycling		
	Yes (row%, column%)	No (row%, column%)	Row Total (%)
Yes	94 (47.0, 97.9)	106 (53.0, 96.4)	200 (97.1)
No	2 (33.3, 2.1)	4 (66.7, 3.6)	6 (2.9)
Column Total (%)	*96 (46.6)*	*110 (53.4)*	*206 (100)*
χ^2	**Value**	**Df**	**Significance**
Continuity Correlation	0.060	1	0.806

The sample for *'specific households'* was too small to be of any statistical significance. However, of the 100 percent households who were aware of recycling, 58.3 percent set aside some materials for recycling. Within those who set aside materials for recycling, the majority of them (60 percent) set aside beverage glass bottles.

The relatively low level of setting aside some materials for recycling compared to awareness could be explained by the general lack of 'visible' recycling centres. For example, 51 percent of *'general households'* set aside glass bottles because they had 'visible' collection system provided by the deposit refund scheme through a network of beverage distributors such as stores. In addition, within the *'specific households'* who set aside materials for recycling, 60 percent set aside glass bottles because of the available collection system provided by the deposit refund scheme for beverage bottles. Apart from the deposit refund scheme, the other recycling systems include:

- Buy back scheme for beverage steel cans, which operates from a single depot not centrally located in the city.
- The 'bring' site operated by Somarelang Tikologo, which has four material banks for glass, paper, metal cans and plastics. The site is located within the NGOs small fenced office premises, which are not centrally located. In addition, the 'bring' site was only accessible for use from 8 a.m. until and 5 p.m.

In addition to lack of 'visible' recycling centres the low level of setting some materials aside compared to awareness could be explained by lack of financial incentives. For example, 51 percent of *'general households'* set aside glass bottles primarily because of the deposit paid back on returning them; similarly 60 percent of *'specific households'* set aside glass bottles. Furthermore, from that, of the 98.1 percent *'general household'* respondents who were aware of the deposit refund scheme, 76.3 percent returned their bottles to obtain the deposit. This high level of participation could be a result of the monetary gain attached to returning the beverage bottles. In the absence of the monetary gain, the level of participation could be reduced. A cross-tabulation of the awareness of the deposit refund scheme and the returning of beverage bottles, as shown in Table 5, shows that there is a significant relationship between the two variables with a Continuity Correlation of 0.001 (computed for 2x2 table to compensate for overestimation of the Pearson Chi-square). The strong relationship means that most people who are aware of the deposit-refund schemes do return the bottles to get back their deposit.

Table 5: Cross-tabulation of awareness of deposit refund scheme by returning beverage bottles

Awareness of deposit refund scheme	Returning beverage bottles		
	Yes (row%, column%)	No (row%, column%)	Row Total (%)
Yes	193 (76.3,100.0)	60 (23.7, 92.3)	253 (98.1)
No	0 (0.0, 0.0)	5 (100.0, 7.7)	5(1.9)
Column Total (%)	*193 (74.8)*	*65 (25.2)*	*258 (100)*
χ^2	**Value**	**Df**	**Significance**
Continuity Correlation	11.362	1	0.001

Even though the sample for '*specific households*' was too small to be of any statistical significance, it indicated that 29.4 percent and 35.3 percent of households 'agreed' and 'strongly agreed' respectively that of they would be more motivated to participate in source separation if it brought them money. This further indicated the importance of direct financial incentives in encouraging the practising recycling.

4.2 Willingness to participate in source separation

The questions in section D of the questionnaire for the '*general households*' and section E of the questionnaire for '*specific households*' were designed to establish the willingness of households to participate in future source separation schemes. In particular three questions were asked to establish their willingness to participate and their preferred system of source separation respectively, being:

- If Gaborone City Council started collecting separated glass, metal and other recyclables for recycling, would you be willing to separate your household waste for recycling?
- Which of the following components would you be willing to separate? You can choose more than one category. (paper, film plastic, rigid plastic, glass bottles, metal cans, other scrap metals, cloth and other)
- Under which system would you be more likely to participate? (commingled kerbside, separate kerbside, drop-off systems)

It was found that an overwhelming majority of households were willing to participate in source separation schemes. Of the sampled '*general household*' respondents, 97.9 percent were willing to source separate their household waste. Even though the sample for '*specific households*' was small for any statistical significance, 88 percent of those interviewed were willing to participate in source separation. The explanation for such a high willingness to participate among the '*general households*' could be attributed to a lack of first hand experience of the source separation schemes. The respondents might not have been aware of the practical implications that go with source separation. Overall, the high willingness to participate could have been enhanced by the fact that in recent years the local media had been carrying articles on recycling through source separation [23]. The high willingness to participate in source separation supports the findings of research by Chung and Poon [8], who found that even though Guangzhou citizens did not have waste sorting schemes, there was wider support for such schemes with 84 percent of the respondents willing to separate their household waste.

It was also found that of the households who are willing to participate in source separation schemes, 30 percent and 25 percent are willing to separate glass bottles and metal cans respectively, the materials that are currently known to have some value and are easy to separate. This supports the findings by Chung and Poon [8] that the majority of households are willing to source separate the materials that are easy to separate.

The majority of households in Gaborone (65.3 percent) preferred to participate in kerbside collection schemes. This is probably because the existing waste collection system was mainly kerbside, hence households support the status quo even in the collection of recyclables. The results are in agreement with the findings of other studies in other areas [7,8,27] that generally people prefer to separate and transport waste to shorter distances.

It is however difficult to establish how the willingness to participate would compare with actual participation. Of 97.9 percent of households in Gaborone willing to participate in source separation schemes and 47 percent are presently setting aside some material for reuse or recycling, it would be reasonable to assume that at least 47 percent would participate provided that there are incentives for doing so. However, possibly the best way to test if

people's willingness to participate in source separation schemes represents actual behaviour would be to introduce a pilot source separation schemes. Further research is required to establish the relationship between willingness to participate and actual participation.

4.4 Households attitudes to source separation

The results of the *'specific household'* attitude surveys are shown in a tabular matrix in Table 6. Even though the sample was too small for any statistical significance, it shows a trend of opinions of households who participated in the pilot source separation scheme based on their practical experience. Of the 17 respondents who were interviewed, an overwhelming majority of them (93.8 percent) supported the pilot scheme. This could be because the representatives of the piloting authorities explained the perceived benefits of the scheme to them in detail at the time when they were recruited to participate. It also emerged that 100 percent of the respondents who supported source separation schemes were willing to participate in future schemes. Among those who were willing to participate, the majority of them (68.8 percent) were willing to participate in a scheme with separate kerbside collection of recyclables. This could be because the pilot scheme in which they participated had separate kerbside collection of recyclables.

The responses pertaining to respondents' attitudes on source separation, as shown in Table 6, suggest that there was a stronger feeling on the environmental value of recycling. Most respondents either 'agreed' or 'strongly agreed' with issues that are deemed to enhance environmental acceptability of recycling. For example 50 percent, 33.3 percent and 28.6 percent of the respondents respectively 'agreed' that source separation is good for the environment, creates environmental awareness and reduces the quantity of waste destined for disposal. Furthermore, 50 percent, 53.3 percent and 71.4 percent of the respondents respectively 'strongly agreed' that source separation is good for the environment; creates environmental awareness and reduces the quantity of waste destined for disposal. In addition to the environmental value attached to source separation, 29.4 percent and 35.3 percent 'agreed' and 'strongly agreed' respectively that they would be more motivated to participate in source separation if it brought them money. However, householders generally disagreed with some potential negative aspects of source separation. Among the respondents, 52.9 percent, 52.9 percent and 41.2 percent respectively 'disagreed' that source separation is time consuming, it is a health risk and takes a lot of space.

Table 6: Matrix of attitudes of households on source separation

Opinion issues	Percentage (frequency) of responses					
	SDA	DA	DK	A	SA	Total
Reduces the quantity of waste disposed of	-	-	-	28.6 (4)	71.4 (10)	100 (14)
Good for the environment	-	-	-	43.8 (7)	56.3 (9)	100 (16)
Creates environmental awareness	-	-	17.6 (3)	29.4 (5)	52.9 (9)	100 (17)
Motivated to participate if it brings money	17.6 (3)	17.6 (3)	-	29.4 (5)	35.3 (6)	100 (17)
It is time consuming	17.6 (3)	52.9 (9)	11.8 (2)	17.6 (3)	-	100 (17)
It is a health risk	23.5 (4)	52.9 (9)	17.6 (3)	5.9 (1)	-	100 (17)
Takes a lot of space	29.4 (5)	41.2 (7)	11.8 (2)	17.6 (3)	-	100 (17)

Notes: **SDA**-strongly disagree; **DA**-disagree; **DK**-don't know; **A**-agree; **SA**-strongly agree

The household attitude survey showed a stronger support for the environmental values associated with source separation. The larger majority of households (71.4 percent) strongly agreed that support source separation reduced the quantity of waste to be disposed of. This indicated that households are willing to participate in source separation for the benefit of the environment, but they would be even more motivated to participate if they could visualise the benefit. Apart from that, support for source separation schemes would even be enhanced if households could derive direct financial gain from their participation. The willingness of households to participate in source separation because they generally believe it is good for the environment is supported by other studies [25,26,27].

4.5 Other significant findings

This section includes other significant findings from households' perceptions and attitudes surveys. The findings are included here for informational purposes and could be pertinent to the formulation of recycling plans or for future research in Gaborone and other areas.

4.5.1 Type of collection service and household income

It was found that the nature of households' collection service was significantly related to income, with a Pearson Chi-square of 0.003, as shown by a cross-tabulation of income by collection service in Table 7. Even though kerbside collection is the most prevalent method of waste collection, covering 86.3 percent of the sampled households, 97.7 percent of households with high-income have a kerbside collection service compared to 76.6 percent of their counterparts with low-income. The results mean that there is a possibility for a source separation scheme to succeed if is built onto the existing kerbside waste collection system particularly in high-income areas. Any recyclables collection system that is significantly different from the current waste collection method, may limit participation in source separation if it is judged to be inconvenient.

4.5.2 Gender and knowledge of final disposal

There is a significant relationship between gender and knowledge of final destination of collected waste, with a Continuity Correlation of 0.015, as shown in Table 8. It was found that the majority of women (60 percent), even though responsible for handling most of the waste at household level, do not know its final destination once collected. The results show that there is some variation of knowledge of waste management issues across gender groups. This variation can have an impact on the design of public awareness programmes on waste management issues. For example, the saving of landfill space will probably not be an appealing motive for women to recycle, because the majority of them are not aware of the final destination of their waste. However, the environmental benefits of recycling are expressed across all gender groups and may be an appealing motive for all to participate in source separation.

4.5.3 Education and household income

A cross-tabulation of education by income shows a significant relationship with a Pearson Chi-square of 0.000 as shown in Table 9. This means that, for future household surveys that intend to stratify households by income in Gaborone, education can be used as a proxy to reflect household income.

Table 7: Cross-tabulation of income by type of collection service

Income	Type of collection service				
	Carry waste to nearby skip (r%, c%)	Carry waste to shared bin on street (r%, c%)	Put it in bin at gate (r%, c%)	Other (r%, c%)	Row Total (%)
Less than P1350	17 (13.7, 77.3)	7 (5.6, 77.8)	95 (76.6, 42.0)	5 (4.0,100.0)	124 (47.3)
Between P1350 and P7000	4 (4.3, 18.2)	2 (2.1, 22.2)	88 (93.6, 38.9)	0 (0.0, 0.0)	94 (35.9)
More than P7000	1 (2.3, 4.5)	0 (0.0, 0.0)	43 (97.7, 19.0)	0 (0.0, 0.0)	44 (16.8)
Column Total (%)	*22 (8.4)*	*9 (3.4)*	*226 (86.3)*	*5 (1.9)*	*262 (100)*
χ^2	**Value**	**Df**		**Significance**	
Continuity Correlation	19.959	6		0.003	

Table 8: Cross-tabulation of sex by knowledge of final disposal

Sex	Knowledge of final disposal		
	Yes (row%, column%)	No (row%, column%)	Row Total (%)
Male	44 (57.1, 36.1)	33 (42.9, 22.0)	77 (28.3)
Female	78 (40.0, 63.9)	117 (60.0, 78.0)	195(71.7)
Column Total (%)	*122 (44.9)*	*150 (55.1)*	*272 (100)*
χ^2	**Value**	**Df**	**Significance**
Continuity Correlation	5.884	1	0.015

Table 9: Cross-tabulation of education by income

Education	income			
	<P1350 (r%, c%)	Between P1350 and P7000 (r%, c%)	>P7000 (r%, c%)	Row Total (%)
None	19 (100.0, 15.6)	0 (0.0, 0.0)	0 (0.0, 0.0)	19 (7.4)
Primary	29 (60.4, 23.8)	16 (33.3, 17.6)	3 (6.3, 7.0)	48 (18.8)
Secondary	62 (45.3, 50.8)	49 (35.8, 53.8)	26 (19.0, 60.5)	137 (53.5)
Tertiary	12 (23.1, 9.8)	26 (50.0, 28.6)	14 (26.9, 32.6)	52 (20.3)
Column Total (%)	*122 (47.7)*	*91 (35.5)*	*43 (16.8)*	*256 (100)*
χ^2	**Value**	**Df**		**Significance**
Pearson	39.132	6		0.000

5 CONCLUSIONS

The main conclusions from the household survey are there is a high awareness of recycling and recycling initiatives in Gaborone. However, this awareness does not necessarily translate into practising source separation in the absence of 'visible' recycling systems and incentives. In addition, there is a high willingness by households to participate in source separation schemes that target materials that are easy to separate and have known market demand such as metal cans and glass bottles. This means that the immediate policy challenge is to translate the awareness of recycling and willingness to participate into actual participation in recycling activities such as source separation. There are indications that other things being equal, there is sufficient ground for piloting source separation schemes. But such source separation schemes should adopt an incremental approach by first starting with materials that households are willing to separate to raise sufficient environmental awareness. Furthermore, there has to be general rethink on the extent at which public education programmes would contribute to participation in recycling in developing countries without offering appropriate incentives.

Even though the sample for 'specific households' was small to warrant generalisations, most them supported source separation because they thought it was good for the environment by virtue of reducing the quantity of waste disposed of. This provides an opportunity for environmental education to articulate reduction of waste destined for disposal as the main objective for organising source separation schemes. This could be more appealing to households because it is easy to visualise.

At strategic level, there are some important and practical considerations affecting the planning and implementation of a source separation for recycling programme. These considerations include among others, forms of collection, collection frequency, availability of economic incentives for waste separation and identifying and sustaining of markets for recyclables. It is however clear from the survey that the successful scheme should be based on kerbside collection of separate recyclables. Any significant deviation from the current collection system could limit participation. However, there are two successful forms of bring systems currently in operation in Gaborone, being the deposit refund scheme for refillable beverage bottles and the buy back system for steel metal cans. But the success of these schemes hinges on incentives that directly accrue to those who return the materials.

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