SOCIOECONOMIC IMPLICATIONS OF SOLID WASTE MANAGEMENT PRACTICES ON PARTICIPATING HOUSEHOLDS, KENYA

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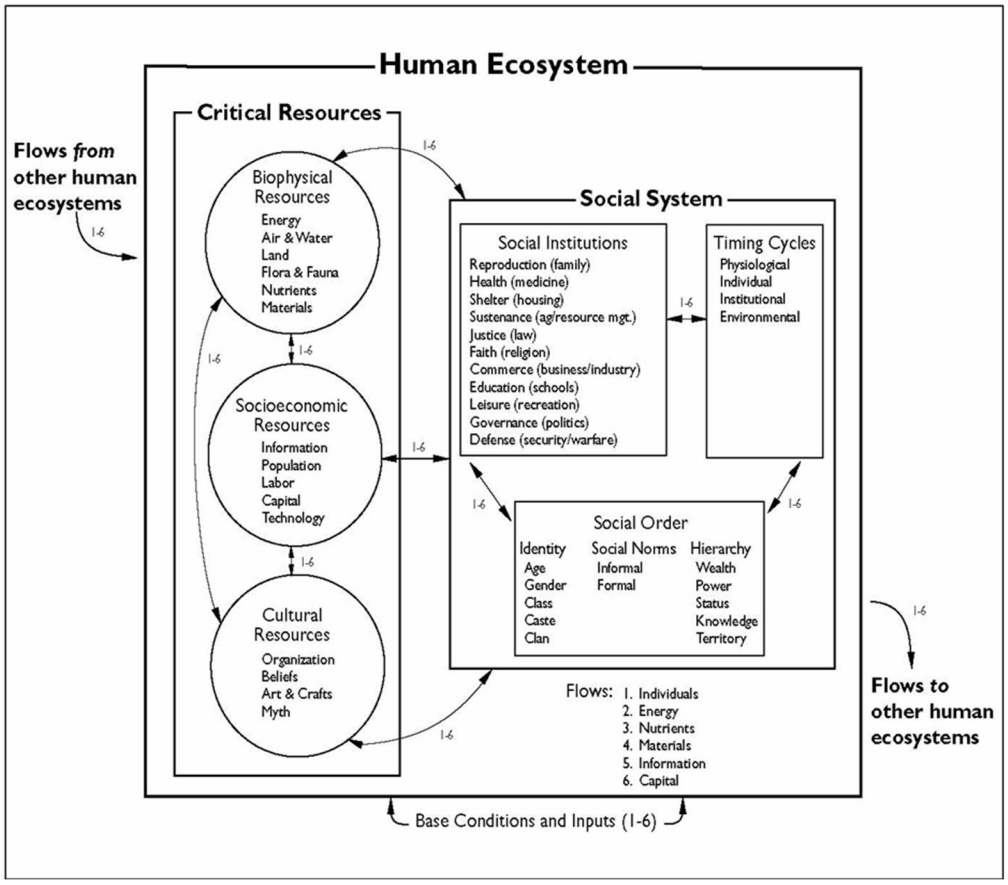
Abstract
This study sought to; determine levels of income generated from Solid Waste Management (SWM) practices, assess contribution of the income to participating households' (HHs) socio-economics and make policy recommendations to exploit existing potential in SWM practices. 121 HHs were surveyed from five phases of Dandora, Kenya. Respondents were selected through systematic sampling by phase. Relationships between SWM practices and household socioeconomic factors were established through descriptive analysis and correlations. Findings showed SWM practices had positive influence on socioeconomic lives of participants. Mean monthly income from SWM practices (Collection and Disposal, Recycling, and Minimization) were KShs 15941.28/=, KShs 16170.45/= and KShs 9467.50/= per household respectively. Total income of KShs 102,481,259/= per month from SWM Practices for the 6800HHs under study, contributed 82.47% of the total HH socioeconomic expenditure which included but not limited to education, food, health and housing expenses. These expenses constituted 55%, 21%, 18%, and 5% of total income respectively implying that HHs had other sources of income to supplement income from SWM practices. Correlation between total income and total expenses revealed a weak but positive correlation ($r=0.389$, at $p=0.01$) that was significant. The researcher recommends separation of waste at household level for easier collection, disposal and recycling; regular waste collection to avoid creation of mini-dumps in residential areas; and support for research and popularization of adoption of appropriate and low cost SWM technologies locally available to reduce handling cost of recyclable waste. Due to pollution of water supplied to HHs by leachate water from waste dumps, a separate cell should be provided at the sanitary landfill for the ashes of incinerated hazardous wastes and composting of solid waste at household level especially by those farming to generate organic manure for organic farming. The government should develop and implement policies that outline practical approaches to SWM practices.

Key words: Income/ revenue; participating household; solid waste management practices; socio-economic implications

1.0 Introduction

The term "waste" generally refers to "unwanted" for the person who discards it; a product or material that does not have a value anymore for the first user and is thus thrown away. But "unwanted" is subjective because the waste could have value to another person in a different circumstance or even in a different culture. Today, there are many large industries that operate primarily or exclusively using waste materials like paper and metals as their industrial feed stocks (Scheinberg, 2001). Waste can be classified as solid and liquid. Liquid waste is sometimes referred to as human waste or excreta but this paper primarily explores the socioeconomic value of solid waste to persons involved in Solid Waste Management (SWM) practices.

This study is based on the theory of human ecology which recognizes that natural systems have evolved over time and are being threatened by technological development initiated by industrial revolution and the resultant population explosion (Jarry and Jarry, 1995). In support of this theory, Ali (2009) argues that environmental problems result from the interaction between the human society and ecological systems. The human system destroys the ecological system through growing population requiring water, energy, food and developmental space. All these anthropogenic activities lead to waste generation for resources that are not properly utilized as in the Human Ecosystems Model (HEM), Figure 1.



Source: (Machlis, *et. al*., 2005; Luzadis, *et al*., 2002).

Figure 1: Human Ecosystems Model (HEM)

With regard to the foregoing, effective and sustainable SWM is a rapidly growing problem globally for national and local governments due to fast increasing quantity and type of solid and hazardous waste due to continuous economic growth, urbanization and industrialization. The United Nations Environmental Program (UNEP) Integrated Solid Waste Management (ISWM) plan (UNEP, 2009) estimated that the total amount of municipal solid waste (MSW) generated globally in 2006 reached 2.02 billion tonnes, representing a seven (7) percent annual increase since 2003. In addition, it projected that the global generation of MSW will rise by 37.3 percent, equivalent to approximately eight (8) percent increase per year between 2007 and 2011.

According to Scheinberg (2001), developing countries face challenges in proper management of waste with most effort made to reduce the final volumes and generate sufficient funds for waste management. He argues that if most waste could be diverted for material; and resources recovery, then a substantial reduction in final volumes of waste could be achieved while the recovered material and resources could be utilized to generate revenue to fund waste management. Based on the 3Rs (Reduce, Reuse, and Recycle), that form the foundation of an ISWM system in which a significant quantity of wastes can be diverted from landfills and converted into a useful resource with a suitable segregation and recycling structure.

Kenya's capital city Nairobi currently has a population of 3.3 million people (GoK Census, 2010). Located along the equator at 6000 feet above sea level, it covers an area of 696 km², thus practically is the smallest province in Kenya. There is a general disparity of incomes as well as population densities in Nairobi with the people living in the western suburbs being generally the more wealthy while the lower and middle-income elements of society dominate the eastern suburbs. The poor economic growth of 1.1 percent in 1993 and less than 2 percent in 2001 resulted in an increase in the level of poverty that stood at 56 percent in 2001 (Rotich, *et al*., 2005). Rural-

urban migrations resulted in unplanned settlements in the peri-urban areas accommodating about 60 percent of the urban population on only 5percent urban land area. Consequently, urban centers have experienced comparatively high growth rates with little infrastructure expansion to match it. This urbanization and accompanying industrialization in a state of overstretched infrastructure is one of the major challenges facing the Kenyan government. The benefits of urbanization in Kenya have therefore been accompanied by social, economic and environmental problems, some in overwhelming proportions. These include but not limited to lack of access to clean drinking water, illegal waste dumping and improper disposal of solid and hazardous wastes.

The current practice of collecting, processing and disposing municipal solid wastes is also considered to be least efficient in most developing countries. The typical problems are - low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control, the breading of flies and pests, and the handling and control of informal waste picking or scavenging activities (Bartone, 1995). Although some cities do spend significant portions of their municipal revenues on waste management (Bartone, 2000), they are often unable to keep pace with the scope of the problem. Senkoro (2003) indicated that for many African countries, only less than 30% of the urban population has access to proper and regular garbage collection.

One of the principal reasons for the inept SWM systems in developing countries is the financial constraint. SWM is given low priority, and very limited funds are provided to the SWM sector by the government. SWM services are a public-good in their nature thus there are imperative social and economic benefits that should be considered in deciding the level of services to be provided, though governments may have insufficient budgetary allocation. In Kenya, the SWM budgetary allocations for the Nairobi city Council in the 2003/2004 financial year were: 78.4% wages; 21% operations and maintenance and a meager 4% for service delivery. In 2011, with an annual budget of 121million U.S dollars, allocation for environment conservation was 7.1million dollars while SWM had 4.1million dollars for the 4million residents while the city requires at least 17 million dollars per year in order to handle the problem adequately (Mutai and Njoroge, 2012).

Nairobi is home to major slums in Kenya which include Kibera, Mathare and Dandora among others, accommodating about 2 million residents on only 5% of the municipal residential land (JICA, 1998; GoK, 1994a, 1994b). Kibera is currently the largest slum in Kenya and in sub-Saharan Africa, providing residence to more than 25% of the Nairobi population on only 250 hectares of land (GoK, 2003 and WSP, 2005). Dandora Slum is particularly complex, because of the Dandora dump site occupying 32 acres of residential land, creating congestion, insecurity for scores of unemployed households (HHs) who resort to SWM practices for lack of alternatives for a livelihood.

Most of the solid waste generated by Nairobi residents ends up in Dandora dumpsite; one of Africa's largest waste dumps located about eight (8) kilometers east of Nairobi. A visit to the site reveals the unhygienic conditions to which the poor living next to the dump are exposed. This is because the waste from Dandora Dumpsite has led to poor sanitation for the people residing in Dandora settlement (slum) which is a low-income residential area. According to Census, 2009 (GoK Census, 2010), Dandora has a population of 142,046 residents occupying an area of 3.9Km^2 thus a population density of 36,253.8/ Km^2 and serves as the only dumping site for the entire city of Nairobi.

A situation Analysis of SWM in Nairobi reveals that, until the mid-1970s the Nairobi City Council (NCC) singly collected over 90 per cent of the waste. In the late seventies, the Council owned 118 waste collection trucks which still had great difficulties collecting 800 tons of waste generated daily then. In the year 2002, Nairobi City Council admitted that it was unable to manage waste effectively in the city and of particular concern was the proliferation of informal medical facilities, some of which are located within residential areas. Even though collection of Solid Waste has been partly outsourced to the private sector, the council currently has less than 20 trucks which are expected to collect about 25 percent of the estimated 2,600 tonnes of solid waste generated daily and dumped at Dandora dumpsite whose capacity has been exceeded (UNEP, 2005). The problem has been compounded by the high population density settlements that have emerged in Dandora approximated at 36,253.8/km^2 occupants spread within HHs some of which live within less than the recommended one kilometre (1km) buffer between the waste and the settlements posing serious social, environmental and economic problems to the residents and indeed the entire City of Nairobi (NCC, 2010).

Nairobi city therefore faces enormous SWM challenges. Many of its residential estates are littered with garbage yet Solid Waste Collection (SWC) among Nairobi HHs is less than 25%, the bulk of which is done in upper income areas, and often managed by private enterprises. In comparison, the 25 percent solid waste collection and disposal is

worse than results reported by Hua et.al, (2011) for small towns in China that showed that 53% of the respondents reported no SWC&D activities in their neighborhood and another 21% reported only irregular collection and disposal activities. Muniafu, and Otiato, (2010) observed that in addition to the open dumping at the Dandora landfill being an inappropriate waste disposal method that saw the proposition of an alternative dumpsite in Ruai, Nairobi and that by 1998, it had been filled with about 1.3 million cubic meters of waste and lacks capacity to continue handling the 2600 tonnes of waste generated and disposed daily, the lack of political will has seen Ruai settled and any talk of relocating Dandora dumpsite is controversial. However, the residents of the low income and slum estates have the will to have an improved SWM system thus engage in SWM practices as a source of livelihood.

SWM practices in Kenya envisage the "polluter pay principle" where every polluter must meet the cost of disposing the waste in question. Similarly, every waste generator has a duty to ensure safe disposal of the waste. According to Afullo and Odhiambo, (2009), an individuals' the choice of involvement in a certain SWM practice, together with the technical and organizational nature of appropriate solutions, depends significantly on the country's economy and on the economic; situation and context in the particular environment where they live. This in effect translates into revenue for those who participate in the SWM practices. The Question is whether this income is adequate enough to sustain the needs of participating HHs with a focus on slum dwellers around Dandora dumping site. It is important to note that the levels of contribution of this livelihood sources have neither been quantified nor documented. Muniafu, and Otiato, (2010) noted that there have been efforts by non-governmental organizations working with communities to recycle waste such as paper, plastic and metals. The impact of this however, remains minimal; a claim that was not however supported by any evidence.

This study sought to investigate and provide existing evidence of impacts of SWM activities on participating HHs. This study was undertaken in consideration of the economic disparities and realities in various regions of Nairobi, aware of the preference of participation in various SWM practices by HHs based on perceived benefits. It sought to: - (i) Determine the levels of income generated from SWM practices (Collection and Disposal, Recycling and Minimization) among the slum dwellers, (ii) Assess the contribution of the income generated to household expenditures and (iii) Make policy recommendations to provide an enabling environment for participating HHs to exploit the potential there is in SWM practices based on (i) and (ii) above. This study was undertaken between January and September, 2011 and reveals the influence of SWM practices on the socioeconomic lives of participating HHs in Dandora, Kenya.

2.0 Materials and Methods

A survey design was modeled to enable assessment of the socioeconomic implications of SWM practices on HHs around Dandora dumpsite, Nairobi. The study targeted a population of thirty thousand (30,000) residents from 6800 HHs living around the dumpsite distributed as in Table 1.

Yamane (1967) formula (i) below was used to calculate sample size for this study based on a 91% confidence level and an assumed precision (P) = 0.09.

$n = N / 1 + N (e^2)$..... (i)

Where n is the sample size, N is the population size, and e is the level of precision.

Thus, with N = 6800 HHs, and e = 0.09

n= 6800/ {(1 + 6800(0.092)} = 121 HHs.

To get the sample HHs for each phase, proportional sampling was applied. Sample sizes for Phase 1 to 5 = n_1, n_2 to n_5 thus sample size for each phase was calculated as by: -

$n_i = N_i / N * n$..... (ii)

Sample size $n = n_1 + n_2 + n_3 + n_4 + n_5 = 121$ HHs

Table 1: Proportion of sample by phase

Household location	**Population** (No. of HHs)	**Percentage (%)**	**Sample Calculation**	**Sample size**
Dandora Phase I	N_1= 2000	29.4	n_1 = 121 * 2000/ 6800	36
Dandora Phase II	N_2= 1080	15.9	n_2= 121 * 1080/ 6800	19
Dandora Phase III	N_3 = 800	11.8	n_3 = 121 * 800/ 6800	14
Dandora Phase IV	N_4= 1220	17.9	n_4 = 121 * 1220/ 6800	22
Dandora Phase V	N_5= 1700	25.0	n_5= 121 * 1700/ 6800	30
Total HHs	**6800**	**100**	**n**	**121**

Where N_1 …… N_5 represents target population from Dandora Phase I – V respectively.

Data was collected using a questionnaire survey from household heads. Two specifically trained enumerators, participated in the survey pretests, conducted the household survey in July 2011. Care was taken to ensure that only the heads of selected HHs, who participated in specific SWM practices and were aware of overall situation of household income and expenditure thus, could determine the additional expenditures of the HHs were interviewed. In the household surveys, respondents completed the questionnaires independently under the guidance of enumerators to ensure objectivity and anonymity of in the survey. At the end of each field day the enumerators checked the returned questionnaires for completeness and accuracy according to a quality checklist.

The data was computed using the Statistical Package for Social Sciences (SPSS) where descriptive statistics and analytical tools such as Mean, frequencies, percentages were employed on data collected. Relationships between household socio-economic factors (Income, Health, Occupation, Education and Location) and the level of contribution from SWC&D, SWR and SW Minimization were established using Spearman's coefficient of correlation.
This research hypothesized that:
H_o: Ø=0: SWM Practices do not influence socioeconomic lives of participating HHs.

2.1 Conceptual Framework

The conceptual framework of this study shows the relationship Solid Waste Collection and Disposal (SWC&D), Solid Waste Recycling (SWR) and Solid Waste minimization (SWMin) as Independent variables and their socioeconomic implications on lives of participating HHs (considering Income, Health, education and housing) as the Dependent variable. Government policies are considered as moderating variable while Household participation was adopted as the extraneous variable in this study.

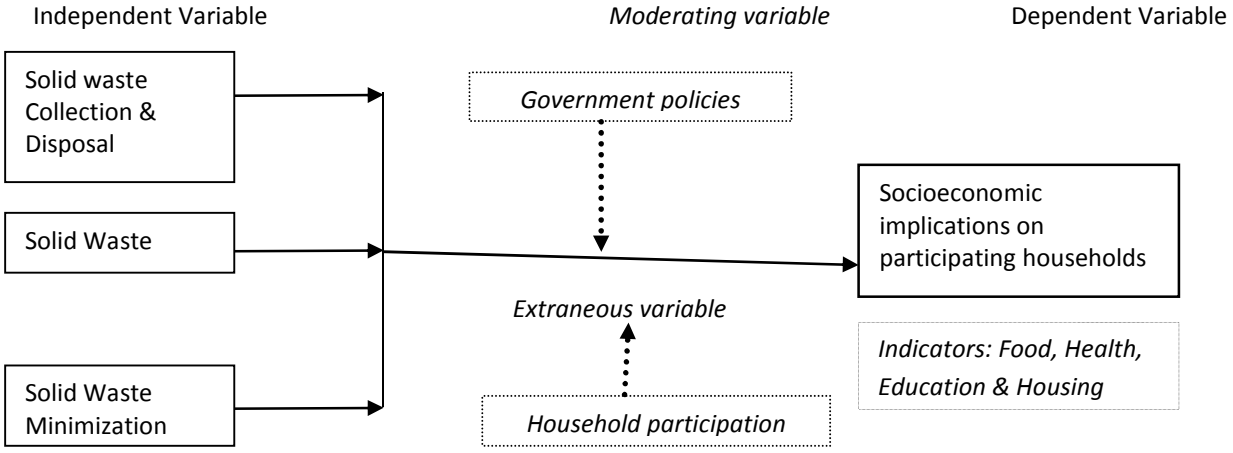


Figure 2: Conceptual framework of the study

3.0 Results and Discussion

3.1 Household Socioeconomic Characteristics

Eighty eight percent (%) of the 121 Questionnaires administered were fully filled and recovered from respondents as shown in Table 2 below. According to Mugenda & Mugenda (1999), this was satisfactory since a response rate of 70% is acceptable. The survey established that the number of individuals in 107 HHs was 468 with 65% males and 35% females gender distribution in HHs. The higher percentage of males implies that there are more men than women who participate in SWM practices as a source of income. It is also explained by the masculine nature of activities undertaken in SWM practices thus the job favors involvement of males than females. The distribution of HH members by location was such that 30% were from Phase 1, being highest, while Phase 2 and Phase 3 had the least at 12% each as in Table 2.

Table 2: Distribution of respondents by location

Location	Distribution		Respondents Gender			
	No. of household members	Percentage	Male	Female	Total	Percentage (%)
Phase 1	140	30	22	10	32	89
Phase 2	57	12	10	3	13	68
Phase 3	57	12	6	7	13	93
Phase 4	96	21	15	7	22	100
Phase 5	118	25	17	10	27	90
Totals	468	100	70	37	107	88

The survey established that the mean age of the population was 31 years implying that Dandora area had a higher concentration of the middle-aged (youthful) population compared to the elderly persons. This explains why the youth provided 72 percent of the labour-force for SWM practices in the area under study. Findings on occupation revealed that 44% of the population engaged in SWC&D, 41% took up SWR activities while 15% engaged in SWMin. These results suggest that more members of the population were motivated to participate in SWC&D because it gave higher economic returns compared to the other two SWM practices and agrees with Afullo and Odhiambo, (2009), who reported that individuals had preference for particular SWM practice based on perceived benefits.

3.2 Solid Waste Management Charges

This survey established that an average of three (3) kilograms (Kgs) in quantity was generated per household daily. The types of Solid Waste Collected from the household and disposed at Dandora dumpsite were found to be mostly domestic. Relative proportions of various domestic wastes were generated but included mainly i.e. Food Waste, Recyclable Paper, Textiles, Plastic containers, Leather, Rubber, Glass containers, Metal containers, and Ceramics.

Depending on location of household from the dumpsite waste collected from the HHs was picked and transported by use of both motorized and non-motorized means. This included use of 49% lorries and 44% handcarts, especially for HHs from Phases 1, 2 and 5 who stay farthest from the Dandora dumping site while 11% of the waste was illegally dumped by the waste generators themselves. The waste charge system of the HHs was not based on the quantity of waste collected but on the location i.e. the distance of the client's premises from the dumpsite and on income group payable monthly. Additionally, the survey found that for the most effective cases, waste collection and disposal was done once a week (Saturday only) but often took 2 – 3 weeks. This was not regular enough thus led to creation of mini-dumping sites in the residential areas. The survey established that the general Affordability to Pay (ATP) for SWM by residents' was 50%. Mean percentage willingness to pay (WTP) for SWM was 61%. The mean monthly fee charged was Kenya Shillings (KShs) 109/= with a minimum of KShs 40/= for very low income groups and a maximum of KShs 500/= for the high income groups. The study revealed that 11% residents do not pay for the SWM services at all and indicated that the dumpsite was so close to their residences that they chose to dump the waste by themselves.

These findings agree with JICA (2010) preparatory survey for integrated SWM in Nairobi city that revealed a monthly WTP of KShs 118.60/=. The survey reported that the level of waste charge in low income areas like Dandora had been set up on the basis of fixed pricing system referred to as the willingness to pay (WTP) and the average affordability to pay (ATP). The public awareness survey conducted by JICA revealed an average WTP and an average ATP of the low income areas as KShs 32/= per month and KShs 153/= per month respectively. The actual waste charge was therefore set up between the WTP and the ATP.

The fact that those not willing to pay chose to dump the waste by themselves agrees with earlier studies by Ali (2009) examining Characterization management and improvement strategies for household waste in Nairobi. He found that it had become a common practice to dump waste on streets, roadside and between plots especially in the middle and low income areas. The prevailing high HH solid waste generation was due to ever increasing population, improved income, poor attitudes and behaviour, low environmental awareness, absence of source reduction and recycling practices, geographical and physical conditions, low frequency of collection and characteristics of service area.

3.3 Dumpsite Dynamics around SWM Income and HH Location

The survey established that the mean distance from HHs to the dumpsite was 1060 metres with variations in the five locations as in Table 3. Phase 2 had the longest mean distance of 1958 metres (approximately 2 Kms) while Phase 4 had the least mean of 361 only with some HHs as close as 50 metres away from the dumpsite. These findings agree with NCC, (2010) which showed that there were high population density settlements that had emerged in Dandora some of which were less than the recommended 1000metres buffer between the dumpsite and the settlements posing serious health problems to the residents. Participating HHs from Phase 5 raised the highest mean income at 25% thus experienced the highest influence of income from SWM practices while Phase 2 raised the least at 15%.

Table 3: SWM income versus HH distance to dumpsite

Location	Mean Monthly Income (KShs)	Percentage contribution	Mean Distance (Metres)	Distance (Metres)	
				Minimum	Maximum
Phase 1	12766.88	17	1420	300	4000
Phase 2	11011.54	15	1958	50	5500
Phase 3	14126.92	19	738	300	1200
Phase 4	17645.45	24	361	50	800
Phase 5	18099.26	25	926	200	2000
Total	**73650.05**	**100**	**1060**		

The correlation between income and Distance revealed a strong negative relationship (r= - 0.829 at p=0.1) that was not significant. This implies that income from SWM practices tends to decline with increase in the distance from the disposal point. This was attributed to the operational costs incurred in ensuring the safe disposal of the SW at the dumpsite from source HHs. It suggests that those bringing the waste from HHs' located farthest spent a larger percentage of their income on operational costs compared to those near the dumpsite. The expenses included: - payments for the hired labour to facilitate the SW Collection and Disposal, Recycling and Minimization; transportation costs, provision of waste collection containers mainly large polythene bags, hiring of transportation equipment such as lorries and handcarts, acquisition of operational licenses from the City Council of Nairobi, repairs of transportation equipment due to wear and tear, payment of disposal fees at the dumping site as well as money lost to cartels controlling the dumping activities at the dump site. This findings show that the HHs found nearest to the dumpsite benefit more socio-economically compared to their counterparts living farthest. As a result they had more disposable income thus more comfortable to take care of their HH expenses leading to better lifestyles.

3.4 Household Revenue Levels Generated from SWM Practices

This section discusses the contribution of earnings from Solid Waste Collection and Disposal (SWC&D), Solid Waste Recycling (SWR) and Solid Waste Minimization (SWMin) activities to the social and economic lives of participating HHs.

3.4.1 Influence of Solid Waste Collection and Disposal (SWC&D) Earnings

The survey established that of the population that deals with SWC&D, a combined 56% were from Phase 5 and 1 shared equally, 23% from Phase 4 while Phases 2 and 3 had 11% each. The higher percentage of population dealing with SWC&D from Phases 5 and 4 was attributed to the shorter distance between the HHs as sources of Solid Waste generated and the disposal point thus lower operational costs among participants with a mean income of KShs 15941.28/=. When the mean SWC&D income for participants was compared to their socioeconomic expenditure patterns, the contribution varied in percentage as in Table 4.

Table 4: A comparison of Means of SWC&D Income to Expenses

SWM Practice	Mean	% Contribution to Total Income
SWM Income	**15941**	**79**
Food expenses	4046	20
Education expenses	11560	57
Housing expenses	3740	19
Health expenses	832	4
Total expenses	**20178**	**100**
Income Deficit	(4237)	-21

The pattern showed highest allocation to education (57%), followed by food, housing while health took the least (4%). Income from SWC&D contributed a significant 79% of the total monthly socioeconomic expenses while the deficit of 21% was covered by other sources of income. 57% of this income was spent on education indicating that the HHs gave priority to education in relation to the other social and economic needs. Health expenses took up 4% though it would have been expected to be higher based on the nature of activities undertaken in SWC&D which pose health risks to participants. This was explained by the fact that there was availability of cheap labour provided by the youth who had dropped out of school opting for the menial jobs to raise income to help their HHs' meet their social and economic expenses. Most HHs therefore took advantage of the cheap labour as a way of transferring the health risks to members outside their HHs thus minimizing health related expenses at household level.

The survey found that SWC&D was done once a week (Saturday only) but often took 2 – 3 weeks which was not regular enough thus led to creation of mini-dumping sites in the residential areas. This led to offensive odour, smoke and existence of disease vectors such as cockroaches, rats, flies and mosquitoes that had negative impacts on public health. It resulted in environmental pollution that increased chances of disease infections thus had a negative effect on the socioeconomic lives of residents. Respondents in this study mentioned cases of throat and respiratory infections, Skin diseases, Tetanus due pricks from sharp objects from the dumping sites among children and adults alike.

These results agree with JICA (2010) that wastes are not collected regularly at many collection points. They reported that delays in waste collection for a long time resulted in smell of leachate which is a polluter of watercourses due to its high concentration in chemicals. Leachate generated in these collection points and in the illegal disposal sites polluted the household water systems and rivers of Nairobi causing high level water and soil pollution which in turn affected the health of residents consuming the water.

Those who directly participated in SWC&D pursued it as a form of employment or for environmental conservation. Those who did not argued that the waste were smelly and the collectors did not have safety gear for handling it thus a risk to health. Some indicated that they left the work to street children who collected the waste for cheaper costs thus low returns from direct participation or that they had alternative source of income thus had choice not to be involved in the practice. Others felt that it led to social stigma because those involved were despised by community. Cases of children dropping out of schools while opting to make quick money from the landfill and engage in drug abuse were reported leading to child employment- an exploitation - which was a bridge of the labour laws of Kenya.

The correlation analysis on SWC&D income and socioeconomic variables revealed a positive but weak linear relationship between income and food expenses($r= 0.229$, at $p= 0.1$). This implies that the higher the amount of income generated from SWC&D the more the percentage contribution towards settling socioeconomic expenses of HHs. The correlation was however not significant. Income against education expenses revealed a positive near moderate correlation which was significant ($r=0.439$, at $p=0.01$ implying that education takes up a fair percentage of this income. The statistic also revealed a weak but positive linear relationship between Income and housing expenses ($r=0.203$ at $p=0.1$) which was not significant. Income and health analyses showed a weak positive

correlation (r=0.168, at p=0.1) which was not significant. The SWC&D income against total socioeconomic expenses revealed a positive near moderate correlation (r=0.474) which was significant at p=0.01. This shows that the income raised from SWC&D had a significant positive influence on socioeconomics of participating households.

3.4.2 Influence of Solid Waste Recycling (SWR) Earnings

The survey established that 34% of the population dealing with SWR came from phase 1, 25% from Phase 5 while 9% was from Phase 3. The mean income from SWR was KShs 16170.45 and contributed a significant 93% to the total monthly household socioeconomic expenditure, Table 5. The expenditure pattern revealed a 53% allocation to education, 23% to food, 18% to housing while 7% went to health indicating a positive influence on socioeconomic lives of participating HHs. As a source of income, SWR maximized material utilization thus HHs saved money that was used to meet alternative needs and it also added value to the waste recycled. The total expenditure (KShs.17402.73) was higher than the income generated implying that the respondents had other sources of income used to supplement the income from the SWR practice in settling monthly socioeconomic expenses.

Table 5: A comparison of Means of SWR Income to Expenses

SWM Practice	Mean	% Contribution to Total Income
SWR Income	**16170**	**93**
Food expenses	3954	23
Education expenses	9223	53
Housing expenses	3064	18
Health expenses	1162	7
Total expenses	**17403**	**100**
Income Deficit	(1232)	-7

The correlation between Solid Waste Recycling income and the food expenses revealed a weak but positive linear relationship (r=0.134 at p=0.1) which was not significant. Income against education expenses showed a weak positive correlation (r=0.305) significant at p=0.05. Income against housing expenditure revealed a weak positive correlation (r=0.114, at p=0.1) that was not significant. SWR was associated with health effects that included tetanus infection resulting from metal and glass pricks increasing household health expenditure. The relationship between income and health showed a weak positive correlation (r=0.067 at p=0.1) which was not significant.

The SWR income against pooled expenses revealed a positive but weak correlation (r=0.348) significant at p=0.05. This survey results shows that the income raised from SWR activities had a positive influence on the social and economic lives of participating HHs. It implies that higher returns motivate participants to engage more in the practice. These results agree with Scheinberg (2001), who argued that developing countries face challenges in proper management of waste with most effort made to reduce the final volumes and generate sufficient funds for waste management. He suggests that if most waste could be diverted for material; and resources recovery, then a substantial reduction in final volumes of waste could be achieved while the recovered material and resources could be utilized to generate revenue to fund waste management. Based on the 3Rs (Reduce, Reuse, and Recycle) this should form the premise of Integrated Solid Waste Management (ISWM) system principle. With an appropriate segregation and recycling system, a significant quantity of wastes can be diverted from landfills and converted into a useful resource.

The study findings also agree with JICA (1998), that Recycling of products such as papers, tyres, plastics, used clothes, and metals, has become increasingly popular. This was especially true for the example given on community-based organizations (CBOs) managed by women recycling market waste from Korogocho market to produce organic manure for sale thus raising income for household use. The report revealed that in 1996, self-help activities of the Mukuru project earned KShs 1.55 million from the recovery of 1,018 tons of materials annually. This income was however not sufficient for the project's 60 members and for financing investments required to improve efficiency agreeing with the results of this study where the mean monthly SWR income KShs 15,941/= was

found to be lower than the mean expenditure of KShs 18,220/= thus not enough to take care of all the household socioeconomic needs.

3.4.3 Influence of Solid Waste Minimization (SWMin) Earnings

The survey established that Phases 1, 3 and 4 had equal percentage of residents participating in SWMin at 25% each. Phase 5 had 19% while Phase 2 had a mere 6%. The Mean income from SWMin was KShs 9467.50 per participating household. The expenditure pattern showed a 54% allocation to education, 21% to both food and housing while health took up 4% as in Table 6.

Table 6: A comparison of Means of SWMin income to expenses

SWM Practice	Mean	% Contribution to Total Income
SW Minimization Income	**9468**	**63**
Food expenses	3189	21
Education expenses	8075	54
Housing expenses	3119	21
Health expenses	589	4
Total expenses	**14971**	**100**
Income Deficit	(5504)	-37

Income from SWMin contributed 63% to the total HH expenditure leaving a deficit of 37% to be covered by other sources of income. Though health expenses made up just 4% it would have been expected to be higher based on the nature of activities undertaken in SWMin which pose health risks to participants. The low percentage was explained by the fact that there was availability of cheap labour provided by the youth. The HHs therefore took advantage of the cheap labour as a way of transferring the health risks to members outside their HHs thus minimizing health related expenses at household level.

Those who directly participate in SWMin by burning indicated that they do so because it reduces bad smell and the waste volumes. It was noted that the street children light fires at the dumpsite every night to keep themselves warm minimizing the wastes although this also affected the residents as the wind blew the smoke into the densely populated residential areas surrounding it. 91% of respondents avoided burning solid waste at household level for fear of fire break ups in the congested residential area. It was also socially linked to skin infections, environmental effects like air pollution due to smoke and floating waste particles, bad smell and water pollution. Little economic value was attached to this practice thus the level of income generated from it was relatively low in comparison to the other SWM practices.

The total monthly HH expenditure (KShs 14971.44) was higher than the income raised (KShs 9467.50) implying that the respondents had other sources of income used to supplement this income in meeting their household expenditures. The correlation between SWMin income against food expenses revealed a weak negative relationship ($r=-0.076$ at $p=0.1$). SWMin income and education expenses also revealed a weak negative correlation ($r= -0.146$ at $p=0.1$) with an $r= -0.073$ at $p=0.1$ against housing expenses. The correlation between Solid Waste Minimization income and health expenses revealed a weak negative relationship ($r= -0.013$ at $p=0.1$). The relationships above were not significant. The correlation between income and total expenses revealed a weak negative correlation ($r= -0.153$ at $p=0.1$) showing that the Income raised from SWMin contributes to a lesser extent to the overall household expenditure compared to other SWM Practices as sources of income to HHs in Dandora.

These results agree with Scheinberg (2001), who found out that self-help activities of the Mukuru project earned KShs 1.55 million from the recovery of 1,018 tons of materials annually though the income was not sufficient for the projects' members and for financing investments required to improve efficiency.

3.4.4 Patterns of Household Pooled Income and Expenditure Statistics

To evaluate the influence of combined SWM practices on socioeconomic lives of the HHs, the total income for the sample was compared to their pooled household expenses. The results were as in Table 7 below.

Table 7: Pooled monthly household income and expenditure pattern per month

Socioeconomic aspect	Income	Expenditure				
		Food	Education	Housing	Health	Total
Totals(KShs)	**1,705,687**	**426,352**	**1,107,188**	**370,423**	**102,222**	**2,006,185**
N	107	107	107	107	107	107
Mean per month	15,941	3,874	10,052	3,364	930	18,220
Percentage (%) Contribution	**82**	**21**	**55**	**18**	**5**	**100**

The spending pattern by the respondents showed a 55% expenditure on education, 21% on food, 18% on housing and 5% on health (Table 7). The mean income was found to be KShs 15,941/= and was lower than the mean total expense of KShs 18,220/= implying that the HHs have other sources of income they rely on to supplement income from SWM practices.

When the results were generalized for the population under study, the combined income from different SWM practices was found to have contributed a significant 82.47% to the total household expenditure. This implies that SWM Practices had a positive influence on socioeconomic lives of participating HHs but left a deficit of 17.5% which participants had to find other sources of income to bridge the gap (Table 8).

Table 8: Influence of Income from the different SWM practices to participating HHs

SWM Practice	% HH participants	No. of HHs	Total Income (KShs)	Total Expenses	% socioeconomic influence	Income Deficit
SW C&D	41	2,788	44,444,279	47,470,108	93.63	(3,025,829)
SWR	44	2,992	48,380,640	60,372,831	78.41	(11,992,191)
SWMin	15	1,020	9,656,340	14,428,151	63.24	(4,771,811)
Mean Socioeconomic Influence	**100**	**6,800**	**102,481,259**	**122,271,090**	**82.47**	**(19,789,831)**

In general, the percentage influence of revenue from SWC&D on Socioeconomic lives of participating HHs was found to be 93.63%. The influence of SWR was 78.41% while SWMin had a 63.24% influence. These combined translate to a Mean Socioeconomic Influence of 82.47% on participating HHs. A comparison of percentage contribution of revenue by SWM practices for total population revealed that SWC&D contributed 43% of income generated by the total population under study (Table 9). Similarly SWR contributed 47% while SW minimization contributed 10% to the HHs socioeconomic needs.

Table 9: Comparison of percentage revenue contribution by SWM practice

SWM Practice	Contribution to Total Income (KSh.)	% Contribution to Total Income
SWM Income	44,444,279	43
SWR Income	48,380,640	47
SW Minimization Income	9,656,340	9
Total Income	102,481,259	100

When SWM income was correlated with monthly expenditure, the analysis revealed a weak positive correlation (r=0.389, at p=0.01). The relationship was significant; it suggests that the higher the amount of income is raised from the SWM practices, the higher the level of its contribution towards offsetting participating HHs' monthly expenditure.

4.0 Conclusions

The mean monthly income generated from SWM practices (Collection and Disposal, Recycling and Minimization) were KShs 15941.28/=, KShs 16170.45/=, and KShs 9467.50/= contributing 79%, 93% and 63% income levels to participating HHs socioeconomic expenditure respectively. Majority of the population participating in SWM practices were motivated by the income generated from the practice. The household socioeconomic expenditure items of the total SWM Practices monthly income for the 6800 HHs under study, KShs 102,481,259/=, included but not limited to Education, food, health, and housing expenses with major share of the income spent on education indicating that the HHs gave high priority to education in relation to the other household social and economic needs. The percentage influence of revenue from SWC&D on Socioeconomic lives of participating HHs was 93.63%, 78.41% for SWR and 63.24% for SWMin. These combined translate to a Mean socioeconomic influence of 82.47% on participating HHs leaving a deficit of 17.5% only to be covered by other sources of income thus *reject the Statistical hypothesis; H_o: Ø=0: SWM Practices do not influence socioeconomic lives of participating HHs.*

Based on the findings, SWM is a viable venture option that investors can target for revenue generation in improving livelihoods and poverty eradication. However, support for mechanization, financial inputs, training on entrepreneurial skills and financial management are necessary to enhance accountability and sound financial management for participating groups as evidenced by limitations of organizations revealing that the self-help activities of income were not sufficient for the project members and for financing investments required to improve efficiency.

5.0 Policy Recommendations

The researcher recommends separation of waste at household level for easier collection; disposal and recycling ensuring participants accrue maximum benefits from the practices, regular waste collection to avoid creation of mini-dumps in residential areas and support for research and popularization of adoption of appropriate and low cost SWM technologies that are locally available to reduce handling cost of; especially recyclable waste. The City Council of Nairobi should establish waste transfer stations amongst high density settlements to avoid mini-dumpsites. These will offer flexibility in waste handling and disposal options, lower fuel expenses and road wear, reduce air pollution, allow for screening of waste, and reduce traffic at the disposal facility.

Due to pollution of water supplied to HHs by leachate water from waste dumps, the researcher recommends provision of a separate cell at the sanitary landfill for the ashes of incinerated hazardous wastes and composting of solid waste at household level especially by those farming to generate organic manure for organic farming. The government should develop and implement a SWM policy that outlines practical approach SWM practices including creation and enforcement of waste management policy framework, incentives, public participation, awareness creation and education extension, proper waste collection and disposal procedures and relocation of the existing Dandora dumpsite and support mechanisms to waste handlers by providing protective gear. It should develop appropriate monitoring and evaluation mechanisms, empower National Environmental Management Authority (NEMA) to implement relevant penalties and incentives and provide access to relevant information and training in SWM and exploitation for employment. The government should invite public private partnerships for SWM and should take into account the investment costs, user charges/tariffs, period required to recoup the investment, carbon credits, energy sales, etc. These should be structured to accommodate issues related to existing local authority staff, youth, women groups, and garbage collection companies. Corporate institutions should be encouraged to implement corporate social responsibility (CSR) plans on welfare of SW handlers for long-term sustainability of their enterprises, by nurturing markets and creating socially and environmentally sound values so as to grow cost-effective investment.

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