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Reverse logistics system and recycling potential at a landfill: A case study from Kampala City

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ABSTRACT

The rapid growing population and high urbanisation rates in Sub-Saharan Africa has caused enormous pressure on collection services of the generated waste in the urban areas. This has put a burden on landfilling, which is the major waste disposal method. Waste reduction, re-use and recycling opportunities exist but are not fully utilized. The common items that are re-used and re-cycled are plastics, paper, aluminum, glass, steel, cardboard, and yard waste. This paper develops an overview of reverse logistics at Kiteezi landfill, the only officially recognised waste disposal facility for Kampala City. The paper analyses, in details the collection, re-processing, re-distribution and final markets of these products into a reversed supply chain network. Only 14% of the products at Kiteezi landfill are channeled into the reverse chain while 63% could be included in the distribution chain but are left out and disposed of while the remaining 23% is buried. This is because of the low processing power available, lack of market value, lack of knowledge and limited value addition activities to the products. This paper proposes possible strategies of efficient and effective reverse logistics development, applicable to Kampala City and other similar cities.

1. Introduction

The rapid increase in urban population especially in developing countries, means that the rate at which waste is generated is increasing at alarming rates (Rotich et al., 2006; Alam et al., 2008; Okot-Okumu and Nyenje, 2011). This high rate of waste generation has exhausted many landfill carrying capacities and underutilisation of resources whereas the waste could be converted into energy (Gupta et al., 1998; Sharholy et al., 2008), compost, animal feeds, construction materials and other resources. On the other hand, waste management authorities are exploring for recycling opportunities and venturing into alternative technologies to reduce waste that is being landfilled via incineration, composting and material recovery (Oteng-Ababio et al., 2013). However, these technologies have some setbacks. For instance incineration is a costly venture and thus not suited for developing countries.

Waste composition in many Sub-Saharan countries constitutes about 80% biodegradable materials. This high fraction of organic degradable material is good for composting. However, small scale manually operated and non-mechanised medium to large scale composting plants in developing countries have been unsuccessful and instead turned out to become public nuisances, posing health risks and emitting foul gases due to the limited attention of the biological processes involved (Vidanaarachchi et al., 2006; Hoornweg et al., 1999).

Furthermore, some products for instance electricals and electronics (cell phones, televisions, computers and accessories) can no longer be landfilled due to regulations and therefore need other treatment or disposal ways, other than landfilling (Rogers and Tibben-Lembke, 1999; Ferguson and Browne, 2001). Such developments aimed at economic motives and environmental concerns have encouraged many firms to explore more on take-back and recovery of products hence focusing on reverse logistics as a sustainable way of managing waste. The application of reverse logistics in the developed countries is already gaining momentum.

Previously, attention in the supply chain focused on forward logistics that deals with the movement of finished goods from the suppliers to the consumers (Cooper and Ellram, 1993; Bowersox et al., 2002). Manufacturers of goods were not responsible for what happens to their products after customer use as they were only following the traditional forward logistics (Thierry et al., 1995; Fleischmann et al., 1997). With the increase of pressure from government policies of deregulations and globalisation, it became the mandate of logistic managers to find solutions to problems of location, allocation and transportation and the technique of

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integrated logistics came into course (Min et al., 1998), and the outcome of this was the emergence of reverse logistics. Since the early nineties, reverse logistics has been the topic of discussion with regard to economic gains, legislation and environmental attributes (Dowlatshahi, 2000; De Brito et al., 2005).

Rogers and Tibben-Lembke (1999) defined reverse logistics as the process of planning, implementing and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal. The European Working Group on Reverse Logistics (2002) in De Brito and Dekker (2004) expanded the above authors' definition and defined reverse logistics as the process of planning, implementing and controlling the backwards flows of raw materials, in-process inventory, packaging and finished goods from a manufacturing, distribution or use point to a point of recovery or proper disposal. The issue was that in the first definition, packaging materials were left out. Reverse logistics being a new subject has been perceived to mean reversed logistics, returns logistics or reverse distribution. In all these terminologies, an element of resource recovery is contained within.

The concept of reverse logistics involves the movement of materials from the point of consumption back to the point of origin. Shih (2001) emphasized the importance of efficient reverse logistics planning and infrastructure design as the take-back rate of home appliances such as computers and electronics at their end-of-life. The relationship of reverse logistics and waste management involves activities in the reverse distribution channel such as reuse, recycle and proper disposal of waste. Reverse logistics can be a cost effective and environmentally friendly venture in that products life is extended. All these activities in the supply chain reduce on the environmental impact of the supply chain (Rogers and Tibben-Lembke, 2001). Generally reverse logistics involves activities of collection, transportation, reprocessing, value addition and final disposal of products. These products are moved backwards from the end user and processes include information flows associated with tracking and transaction processes.

Reverse logistics has three drivers and these are government legislation, economic value to be recovered in the returned product and environmental concerns (Srivastava, 2008). These driving factors are especially strong in the industrialised nations where government regulations are compelling firms to address recovering value and proper disposal of end of life products. Nagurney and Toyasaki (2005) noted that legislation has compelled a number of industries particularly in the electronics sector to set up a system of product recovery and safe disposal. However, the reverse logistics chain in most developing countries is informal comprising of a vast number of waste collectors, street children, waste loaders and small scale merchants. They are normally not organised and depend on recyclables collected from temporary garbage dumpsites and trucks, which deliver the wastes at the landfill (Matter et al., 2012). When the informal recyclers are present within the chain before delivery of solid wastes to the landfill, they reduce the inflow of waste to the landfill but these marginalised people are not accredited for the services they render towards waste management. For instance, waste pickers are perceived as unclean people and a public nuisance to many (Wilson et al., 2006). Waste pickers comprise of poor people who earn minimum wages for survival and hence they are at a great risk of toxic exposure to wastes, since the system they use does not address safety issues (Bleck and Wettberg, 2012).

Another setback of reverse logistics in the developing countries is information flow, making accurate recycling decisions problematic. Decision on what particular product to recycle depends heavily on tracking the costs. Additionally, reverse logistics of products in developing countries is substandard and value addition is limited to the fact that the gains accrued are little, yet the reprocessing of some products requires high investments within the reverse logistics network (Fleischmann et al., 2001). Nevertheless, reverse logistics can have environmental and economic benefits if it is done in a sustainable way, for instance, encouraging source segregation to ease sorting and grading. The expensive methods used in developed nations may not necessarily be needed in low- and middle-income countries at this stage because of the large numbers of informal workers still engaged in the separation and sorting of mixed waste at a low-cost, and yet they are much more effective than the mechanised methods used in developed countries.

Due to the economic crisis that is troubling most communities in developing countries, recycling is now seen as a sustainable approach to solid waste management. Communities have started coming up with activities that aim at material recovery in order to get some money for survival (Wilson et al., 2006). Such activities involve door to door collection of unwanted recyclable materials such as plastics, glass, metal and beverage containers.

In Uganda, data on reverse logistics is still lacking. The available data is normally on waste flows to disposal sites, normally landfills but the wastes that are recycled along the waste management chain are unknown. In the case of Kampala, currently the landfill in Kiteezi is receiving about 900 tons of waste per day (Komakech et al., 2014; Kinobe et al., 2015) but there is no documented data on the amount of waste that leaves the waste stream along the way to the landfill and at the landfill through reverse logistics distribution channel. The various functions executed under reverse logistics focus on material flow information management, relationship of value addition and proper disposal of products. With an effective reverse logistics system, operational costs would be reduced, employment of people would be availed, people's health would no longer be at risk and the environment would be kept in an ecologically sound manner (Sarkis et al., 2010).

The main objective of this paper was to examine the status of reverse logistics activities with emphasis on, collection and distribution channels and information flow of recyclable products from Kampala City to Kiteezi landfill and to various destinations for processing. The specific objectives were to:

- establish reverse logistics organisation and chain activities at Kiteezi landfill;
- classify solid waste streams delivered at the landfill and identify recyclable products;
- evaluate the reverse logistic potential products that leave the landfill and
- develop recommendations to take efficient measures to improve reverse logistics.

2. Materials and methods

2.1. Qualitative and quantitative data collection

The data was collected from primary and secondary sources. The research was carried out using both the qualitative and quantitative methods. The qualitative approach was used to study the problem comprehensively including methods such as interviews, questionnaires, observations, surveys and document analysis. The quantitative approach was used in a formal and structured way of collecting data. It was characterised by measurable data expressed in numbers and quantities. A key informant interview of one manager ($n = 1$) at the landfill was carried out. A questionnaire survey was administered to waste pickers ($n = 10$), small scale shop merchants of recyclables ($n = 5$) and small scale recycling plants ($n = 5$). This was meant to gain an in-depth understanding of the reverse logistics and how it is done. The