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RESEARCH ARTICLE

OBSERVATIONS REGARDING WASTE GENERATION AND DISPOSAL IN RURAL HOUSEHOLDS IN CENTRAL KENYA

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ABSTRACT

With increasing technology, better infrastructure, improved standards of living and education, increased consumerism, rural human societies live better and their numbers gradually increase. This increases the stress on the environment as more solid and hazardous waste materials are generated and disposed. The study focused on 266 households located in central Kenya. Interviews and a questionnaire were used to understand the types of solid and hazardous waste generated by households and how the material was disposed. Organic waste, once the main component of solid waste material generated in rural households was found to only comprise one-third of the total (34%); while industry contributed a lion's share (57%) of the total waste generated for this community. Some strategies including focused education opportunities on better rural solid and hazardous waste handling techniques, and promotion of informal entrepreneurship are suggested.

INTRODUCTION

The generation of solid waste is an integral consequence of human existence as we utilize natural and manufactured (processed) materials from our environment. Solid waste is material produced from human activity (both domestically and in industrial settings) that has no economic value or demand, and therefore must be disposed of in ways that do not risk the health of communities (Ana *et al*, 2011; Bernardes and Guther, 2014). Most waste production and management studies have focused on urban areas for good reason: humans, in most developed nations, live in urban centers. However, in the developing world, even with the increased rural-urban migration of young people in search of political, social and economic opportunities; the majority of people still have a rural-based existence. As a result, and with the relatively low human density in rural areas and subsequent low waste generation, studies on solid waste have not attracted much scientific attention (Amouei *et al*, 2010).

In times past, the generation of waste and its disposal in rural environments was not as concerning because: as human populations were small, there was a lower standard of living, rural areas were not as integrated with urban areas, infrastructural and communication technology was low, and waste generated was mainly organic and easily composted. Today, with the increasing connectivity of rural and urban social, political and economic environments due to improved communication technology, infrastructural development, and improved standards of living, waste generation has increased in complexity, amounts and types (Ahmed and Ali 2002). This has been accelerated by rural people's access to better education opportunities, improved health care and better nutrition.

It was therefore interesting to see how those dynamic local, national and international forces had shaped waste generation and disposal in rural neighborhoods. The primary objective of this study therefore, was to find out the types and sources of solid waste generated in rural households, and how it was disposed.

MATERIALS AND METHODS

A rural residential area in central Kenya was selected for this study based on the author's previous knowledge of the region. An area enclosed by four main roads (Sagana-Nyeri, Nyeri-Othaya, Othaya-Muranga, and Muranga-Sagana roads) was demarcated on a map. Since residential characteristics (land

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acreage, economic activity, demographic characteristics, etc.) are generally very similar among the various households in the region, grids were used to choose sampling areas. Within each of the eight designated grids on the map, a sample of 33 households was selected in a systematically random manner covering as much of each grid as possible. Together, a total of 266 households were sampled for this study. A prepared questionnaire was used to conduct interviews and surveys in each household visited.

RESULTS AND DISCUSSION

While the amount of organic waste generated was only about a third of the total, industrial waste was a dominant category comprising 57% of the total for this community (Table 1). Organic waste comprised of raw food waste, fruit peels, cooked/rotten food remains, and ashes from burned wood - most of which was composted and added onto home gardens as fertilizer. This compares with what He (2012) found in rural China where about 50% of the waste generated was easily biodegradable. This contrasts with what Bernades and Gunther (2014) found in rural communities in Brazil, where over 90% of solid waste generated was organic and composted locally. Shehata *et al* (2004) reported similar results in rural Egypt. I suspect that these latter studies were located in areas far from all-weather roads which greatly facilitates transport; far from the electric grid which stimulates rural development; and low technology areas with little urban influence. This study, while still very rural based, was conducted in areas with significant influence from urbanization particularly access to a paved road network and better communication technology.

Table 1 Source of Solid and Hazardous Waste.

Category	% in Households
Industry (hazardous and non-hazardous)	57
Food remains (organic waste)	34
Other household	9

Most industrial waste was made up of plastics (shopping bags, water/medicine bottles, cooking oil containers, and water buckets); cartons (detergent, medicines, bathroom products, and other packaging materials like wrapping paper); cans (food, oil, beverage and paint products); electronic waste (phone chargers, old phones, radios, old wires, etc.); old/torn shoes and rubber; old paper/newspapers; and construction waste (timber pieces, cement bags, iron sheet pieces, old nails, scrap metal, plastic sheets, and broken glass). Hazardous products included old paint/thinners, petroleum products mainly used oil/jelly/tar/grease, expired pesticides and human/veterinary medication. Other household items made up only about 9% of the total waste generated and comprised of old/torn/worn-out clothes, old beddings, mattresses, old cookware/pots/utensils, and other miscellaneous items like old toys.

As would be expected, the amount of organic waste generated varied with distance from local markets/trading centers and all weather road networks. For instance, communities near major roads and big trading centers had less organic waste per household than those located farther away; and most likely nearness to market centers increased per household consumption of manufactured products requiring plastic packaging in shopping bags like cooking oil, sugar, flour, meat products, eggs, beverages, veterinary products like livestock feed, and bathroom products. Households living far from major roads and/or trading centers would often do without most products sold in local markets like sugar, meat products, cooking oil, and livestock feed especially in rainy seasons when local dry-weather roads became unusable by vehicles.

Households in the study area used a mixture of disposal mechanisms for waste generated. Small pit dumping (95% of the households, Table 2) was the prime choice in many households where wastes were dumped into a pit excavated about 25-50 meters from the main house. Most household pits were wide irregular holes about 1 meter across to 1.5 meters deep, where accumulated waste was periodically burned. The pits would then be refilled with waste and again burned. Over time, ash and slag accumulation would force the pit be buried by covering it with top soil, then abandoned, and a new one excavated nearby. In China, He (2012) reports that instead of burying the ash in rural neighborhoods, it would be transported to on-site landfill areas lowering the costs of extending existing municipal solid waste networks by up to one-third of the total cost. Bernades and Gunther (2014) found that of total waste generated in Brazilian rural areas, only about 10% was inorganic and was either reused, burned or dumped into open sites (2014). In rural Guatemala, Temple (2011) found that due to environmental and human health risks caused by pollution from inappropriate disposal of solid waste, local communities had devised creative pathways that emphasized re-purposing waste materials to other uses, cleaning the environment and creating vocational and educational opportunities for local people.

Table 2 Disposal Mechanisms for Solid and Hazardous Waste.

Mechanism	% of Households
Dumping (open pits)	95
Hoarding (for later recycling/disposal)	52
Burying	11
Recycling	5

Hoarding, where currently unwanted materials are kept for prolonged periods of time was found to be a significant way of disposal. Such materials in this category include scrap metal, old mattresses/pillows, old beddings, textiles (old/unwanted clothes), old shoes, plastic/glass bottles, cardboard, metal containers, and sisal bags. Hoarding areas were scattered throughout the main house in varying quantities from a few bottles to stacks of materials. Sometimes a back room, separate storage unit outside the main house, and unused rooms were used for hoarding. Although published literature reports that hoarding behavior affects a significant portion of the adult population in many developed nations (for example studies by Medard and Kellett, 2014; Buscher *et al*, 2014; Mataix-Cols, 2014), this study found hoarding to be a common way for household members to hang on currently unwanted materials. Only about 11% of the surveyed households were found to bury their wastes after disposal. This involved digging shallow round holes about 0.5 meters wide to 0.5 meters deep in home gardens where wastes were dumped and covered with top soil within a few days. Such areas were later used for growing

crops. Recycling of scrap metal, bottles, aluminum cans, and household waste (old clothes, shoes, old and worn-out utensils, linen, etc.) was found in only about 5% of the households. Recyclers were usually middlemen comprised of small-scale entrepreneurs and artisans who frequented neighborhoods on an irregular basis. Crafty strategies were used where such recyclers paid small children to collect such materials for token amounts of cash on a graded basis depending on material scavenged. The role played by such informal recycling cannot be underestimated in ridding the environment of contaminants and pollutants in rural settings. Sembiring and Nitivattananon (2010) report that informal recycling in Bandung, Indonesia handled about 13% of total waste generated in the city and call for these poor and marginal waste scavengers and pickers to be integrated as part of an inclusive society. Nzeadibe (2008) also found that such recyclers formed a significant subsystem of informal solid waste recycling in Nigeria and needed to be acknowledged as major players in this sector.

CONCLUSION

Solid waste generation has gradually been changing in rural communities with less material being classified as organic, and therefore non-biodegradable. A combination of factors including increasing human populations, better technology, better standards of living, increased rural-urban connectivity, and improved education in rural communities have caused this transformation. The study's findings suggest that rural waste generation needs greater attention to reduce environmental degradation, soil toxicity from leachates, ground and surface water contamination, air pollution all of which increase human health risks. Such attention might include strategies like community education outreach about effects of poor solid waste disposal to human health; promotion of informal recycling entrepreneurs; and better rural solid waste handling techniques.

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