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An engineering approach to solid waste collection system: Ibadan North as case study

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Abstract

This research centered on finding and perfecting methods of collection and disposal of refuse in Ibadan North Local Government Areas. The methodology used included questionnaire administration, personal interviews, field reconnaissance, and biochemical tests of water samples, all aimed at providing useful data for the design of effective methods of collecting and disposing refuse. The local government area was divided into three classes based on resident income: a high-income area (Bodija Avenue, etc.), a medium-income area (Sanngo, Oluyole, etc.), and a low-income area (Beere, Adeoyo, etc.).

The research outcomes revealed that the waste generation rate for the local government ranged from 0.2 to 0.33 kg/cap/day and waste density ranged from 172.41 to 217.61 kg/m^3. Water analyses showed that the chloride, manganese, lead, and cadmium levels in water from low-income areas were above the WHO standard. The refuse generated in high and medium-income areas was collected and transported to the disposal site properly while only 54.5% of wastes were handled properly in low-income areas. Also, in order to make low-income areas free from wastes daily, an additional 15 metal skips and 9 refuse vehicles would be needed.

1. Introduction

Sustainable solid waste management is a strategy for achieving environmental quality in both the developed and the developing worlds, and environmental quality is a necessary condition for an increase in per capita welfare over time (Kgathi, 2001). Municipal solid waste management (MSWM) constitutes a serious problem in many Third World cities. Most cities do not collect all of the wastes generated, and of the wastes collected only a fraction receive proper disposal. Insufficient collection and inappropriate disposal of solid wastes represent a source of water, land, and air pollution, and pose risks to human health and the environment. Over the next several decades, globalization, rapid urbanization, and economic growth in the developing world will tend to further deteriorate this situation.

Furthermore, solid waste is a significant and growing problem in many urban areas of the developing world. Current systems of waste management in most developing country cities are very rudimentary at best and as such are grossly inefficient and ineffective (Bartone et al., 1991). Smith (1997) studied collection systems for urban and peri-urban areas of developing countries and found that collection systems must be designed to accommodate the particular conditions of the community. Studying solid waste management in Kuwait city, Alhumoud (2002) reported that there was a rapid increase in the total amount of municipal solid waste with significant changes in composition, an observation that was related to an increase in population and lavish spending. He opined that there is a need for the adoption of modern waste management practices to rid the environment of refuse.

Metin et al. (2003) concluded that a separate collection program for recyclable household waste in existence in Turkey should be adopted in order to promote a healthy environment. Al-Ghamdi and Abu-Rizaiza (2003) carried

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out an extensive study on how to best collect and transport about 192.8 tonnes/day of waste in the Holy City of Makkah in Saudi Arabia during the pilgrimage season. The proposal was based on a pneumatic transport technique by which wastes were to be collected and transported in underground pipelines. Municipal solid waste management in Accra Ghana was critically studied by Boadi and Kuitunen (2003). As a result of uncontrolled urbanization, large quantities of refuse are generated daily which exert much pressure on an overstrained solid waste management system. Home collection in the city was limited to high-income and some middle income areas, while poor areas were left to contend with the problem on their own. The existing solid waste collection and recycling practices in Nibong, Tebal town Phenang, Malaysia were studied using tools such as interviews, administration of questionnaires, and on-site observations (Isa et al., 2005). The results showed that a majority of the respondents expressed concern about recycling, illegal collection, aesthetically displeasing sites, inadequate funding, and lack of manpower.

At the core of the problem of solid waste management in Nigeria are the absence of adequate policies, enabling legislation, and an economically stimulated and enlightened public. Government policies on the environment are piecemeal where they exist and are poorly implemented (Agunwamba, 1998). In addition, planning for sustainable urban solid waste management has to address several interdependent issues such as public health, environment, present and future costs to society, and livelihood of the actors in the formal recycling sector (Sudhir et al., 1998). In order to start a new waste management study correctly, a recommended first step is to analyse the waste composition, characteristics, and generation rates (Nuwayhid et al., 1996).

A healthy environment is a wealthy environment. Solid waste is an international problem that transcends all nations. Changes in daily activities and operations throughout the various parts of Ibadan North Local Government over the years, particularly in demographic expansion, have brought about a phenomenal increase in the volume and diversity of solid waste generated. Heaps of refuse such as garbage, rubbish, ashes and dust, dead animals, and abandoned vehicles are a common sight in urban areas, particularly in the studied area. These heaps are composed of domestic, marketing, and industrial wastes, which continue to spoil several parts of the sprawling Oyo State Capital. Solid waste management today has become one of the most serious problems facing the local government, with its consequent effects on the pollution of water, air and land, not to mention its hazards to health and other natural resources of social and economic importance.

Recently, it has been observed that the efficiency of disposal techniques soon diminishes because of the negative impact on the environment as air, water and land resources are being polluted. Consequently, environmental damage in the form of ecological disturbances ultimately results in less bio-diversity and morbidity or mortality of populations. There is a need therefore to evolve an efficient solid waste management system based on the skill set of engineering management in consideration with environmental pollution.

The study areaIbadan (Èbá-Odàn) is the capital of Oyo State and Nigeria's largest city and the largest city in West Africa.

The city of Ibadan is the capital of Oyo State, and is the largest city in Nigeria and in West Africa. Ibadan had an estimated population of 1.8 million in 1995, lies between latitude 7°19′N and 7°29′N, longitude 3°47′E and 5°58′E, and is at an average altitude of about 200 m above sea level. Ibadan has eleven Local Government Authorities, with Ibadan North being the largest. Ibadan North is characterized by large and small industries (manufacturing and agro allied industries); households; and commercial, educational, religious and medical centers, as well as other various types of institutions. The Ibadan Solid Waste Management Authority (ISWMA), established in 1997, controls the management of solid wastes in all eleven local government areas. The authority has a Director General for Health in the state, and chairmen of all eleven local government areas in Ibadan act as a board of directors. Also, six managers are included in the line-up as Enforcement Manager, Enlightenment Manager, Operations Manager, Maintenance Manager, Director of Administration and Finance, and General Manager.

The core areas of Ibadan North, such as Beere, Adeoyo, Sabo, and Oke-Itunu, are classified as low-income areas. Areas like Agbowo, University of Ibadan, Sango, and Ashi are classified as medium-income areas. On the other hand, areas such as Bodija, Secretariat and Agodi GRA are classified as high-income areas (Fig. 1).

At present, different types of storage bins are used to store refuse in Ibadan North, ranging from metal drums to fabricated pyramidal sections in the form of a frustum in places classified as high-income and medium-income areas. Storage bins such as old baskets, paper boxes, polythene bags, and old plastic and metal buckets are used in low-income areas. The majority of the low-income area residents who are living close to streams do not have storage bins. They throw their refuse into nearby streams, over kerbs of roads and drains.

For easy large volume storage and easy collection, the ISWMA provides metal skips in some special areas and at various markets. There are over 90 such skips in Ibadan and less than 43 of them are in Ibadan North. The collection of refuse is done by ISWMA with the help of registered private sector waste managers. The private contractors use either open-top tippers covered with a tarpaulin or skip-eaters hired from ISWMA to collect waste from their clients once or twice in a month for a specific amount.

ISWMA has over 45 collection vehicles, but more than 95% of these are out of order due to inadequate maintenance. The labor and members of staff of ISWMA have been scheduled in two shifts (7:00 am–1:00 pm and 1:00