Waste Management in Developing Countries: Improving the Productivity and Efficiency of Ondo State (Nigeria) Integrated Waste Recycling and Treatment Plant in Akure (Nigeria)

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Executive Summary

The trend of solid waste generation in Nigerian cities has been rising for four decades due to oil boom in the country. As a result of improved economy and Gross National Domestic Product per Capital (GNDP/c), Nigerians apparently embraced increased use of renewable and non-renewable resources. However, as the country move into the future, how waste is reduced and fully utilized as resources will be a more relevant measure of the nation economic success.

In 2005, UNIDO estimated that about 180,000 tons [1] of garbage was generated in Akure municipality alone based on 0.32 CAP/Day/Kg [1]. This figure has since increased. The waste generated includes plastics, metals, bottles, biowaste, rags, etc, that were dumped in strategic places in Akure metropolis. This predisposition was a major source of concern and worry for Ondo State government. As a result, the State government commissioned waste recycling and treatment project in Akure. The aim of the project was to process Municipal Solid Wastes (MSW) generated in the city into useful resources. The project is known as Ondo State Integrated Waste Recycling and Treatment Project (OSIWRTP) and was commissioned in June 2006 by former President Olusegun Obasanjo.
The establishment of OSIWRTP was a pioneering and innovative approach in the Nigerian waste management sector.

OSIWRTP has operated continuously since 2006 till today and has recovered and recycled plastics, cast iron, aluminum and also processed organic wastes into compost. This study examines the performance of OSIWRTP in waste recycling since 2006 till now (June 2010). Unfortunately, the plant has operated less than 10% of its installed capacity due to operational constraints. This paper endeavours to proffer a system that could improve the productivity and performance of OSIWRTP in waste recycling and treatment. The study highlights economic and welfare opportunities that is inherent in improving the performance of the project for the entire Ondo State community.

Keywords: 
Productivity, Ondo State, Akure, Recycling, Municipal Solid Waste

1.0 INTRODUCTION

The objective of OSIWRTP is to “Turn City Waste into Wealth” because of the massive garbage illegally dumped in strategic places in Akure. The increasing rate at which wastes were illegally dumped on roads, market places, drains, rivers, and any available land was alarming and attracted the attention of government. On closer examination of the waste characterization, they include plastics, bottles, metal cans, food / putrescibles, cardboards, and some items that could be reused or recycled to create wealth.

Generally, waste generation in human societies is a natural act of life and could be linked to economic activities in markets, restaurants, motor parks, homes, schools, offices, etc leading to waste that nobody wanted.

In the last one-decade many State governments in Nigeria have come to recognize the embarrassing situation caused by generated waste but poorly disposed off within their cities. In order to address this problem, many state governments in Nigeria, due to inability of Local Government (Municipal Government) to tackle the waste problem, have established a waste management organ to deal with the waste problems. As a result, the Ondo State Waste Management Board was established in Ondo State. These public bodies are usually saddled with the responsibility of carting away these wastes as much as possible from sights (that is from within the occupied human communities) – with the belief that “out of sight is out of mind”. Unfortunately, this improper system of managing wastes that include municipal solid waste, hazardous waste, healthcare waste and sewage is lately beginning to impress on governments across the country that such an improper system may eventually have long last-
ing adverse penalty and implications on both the human and environ-
ment.

Furthermore, there is also growing awareness in Nigeria that tangible
economic resources can be derived from wastes through recycling and
treatment; and could also minimize or eliminate illegal dumping within
townships. Hence, Ondo state Government was one of few pioneering
state governments in Nigeria to take the initiative of implementing Inte-
grated Waste Management (IMW) policy. As a result, Ondo State Inte-
grated Waste Recycling and Treatment Project (OSIWRTP) was estab-
lished in 2006. The Project covers waste sourcing and procurement,
promotion of waste buy-back, processing of recovered waste materials,
marketing and development of markets for recovered, pre-processed and
recycled waste products. OSIWRTP operations have spanned a period of
over 3 years but it is regrettable that its operation cannot be said to be
optimal or could it be said that the project has fulfilled its start-off objec-
tive. The project has been marred by operational and institutional con-
straints.

The Ondo State government in its magnanimity initiated OSIWRTP as a
comprehensive Waste Management Plan (WMP) and also provided the
appropriate capital required for the implementation of the project as main
stakeholder. So far, money required to operate, maintain and manage the
plant is being provided and subsidized by government. The ownership
and operation of the facility is 100% for Ondo State government.

2.0 **EXISTING PRODUCTION STRUCTURE** OF
OSIWRTP

Ondo State Government acquired 7 hectares (17.3 acre) of land along
Igbatoro Road in Akure for the purpose of establishing an Integrated
Waste Management and Recycling project. The land was cleared for
dumping of refuse generated in Akure township in 2001. In 2006,
OSIWRTP was built on the acquired land. The construction work and in-
stallation of equipment commenced in early 2005. The plant started re-
cycling waste in December 2006. The project currently employs about 80
workers. Government have invested about USD 1.5 million in executing
the project and government still continue to subsidize worker’s salaries,
maintain and run the plant.

OSIWRTP is structured into three set of waste recycling units. The plant
consists of the followings:

- Plastic recycling,
• Metal recycling and
• Compost/organic fertilizer production plant.

2.1 Plastic Recycling Plant

The plastic recycling plant process 4 types of plastics. The plant recycles PET (plastic type 1), HDPE (plastic type 2), LDPE (plastic type 4) and PP (plastic type 5).

The plastic recycling process starts with workers manually sorting useful plastic scraps from waste streams that arrive at the dumpsite. The recovered plastics are further separated into HDPE, LDPE and PP types. PET plastics bottles are not processed in the plant but are simply baled for major consumer in Lagos. The plant has one bailing machine installed to bail recovered PET plastic bottles and then packaged for consumers.

The existing plastic process operation consists of washing, shredding, drying, wet grinding, extrusion and pelletizing. The final products (granules and pellets) are packaged for sale to consumers.

Nine (9) workers man the six units of plastic recycling plant. The units have been running effectively except for the Drying, Wet Grinding and Extrusion units that are not functioning completely due to equipment failure problem. This problem need to be solved before the 3 units can run smoothly.

Fig 1: Scrap of PET bottles ready for bailing in OSIWRTP

2.1.1 Rate of Plastic Recovery by OSIWRTP
The quantities of plastic wastes recovered by the OSIWTP are not encouraging compared to the quantities of plastic estimated to have been generated in Ondo State from sachet pure water popularly drank and disposed. The poor rate of recovery was due to lack of waste segregation in Akure and partly due to the reason that workers have to manually sort wastes at the dumpsite. This has mostly slowed down recovery rate of plastics. The quantity of plastics recovered in 2007 through June 2010 is shown in the Fig 2.

![Fig. 2: Rate of Plastic Recovery](image)

### 2.1.2 Finished/Recycled Plastic Products

The quantities of recycled plastics in 2007 through June 2010 by types are shown in Fig. 3. The high volume of PP recovered is a pointer to both the high rate of use of PP plastic products for domestic purpose in Akure, and high market demands for PP scraps for recycling necessitating its recovery.

![Fig. 3: Recycled Plastics Wastes (2007 – June 2010)](image)
2.2 **Metal Recycling Plant**

The metal recycling plant was designed to recycle metal wastes such as scrap of cast iron, aluminum scrap and cans, zinc, steel scraps and other metals. The original plant design was to melt the scraps with one unit of Rotary furnace rated 800 kg installed in the shop floor. The furnace consists of a cylindrical steel shell, blower, burner, fuel tank, drive system and exhaust box. The plant has aborted the plan of melting of scraps as a result of faulty furnace and hazards posed by the process to workers. The current effort is to recover aluminum cans and bail them for customers. Other metal scraps are left for scavengers that roamed the dumpsite and city neighborhoods for the considered precious metals.

![Image: Metals recovered by OSIWRTP](image)

*Fig. 4: Metals recovered by OSIWRTP*

2.3 **The Compost / Organic Fertilizer Plant**

The compost / organic fertilizer plant converts biowaste into organic fertilizer. The plant consists of 3 sub-units, i.e. Windrow, Curing Bay and Production. The unit produces 2 types of fertilizers, natural organic fertilizer with no additives and those with mineral additives.

The method of compost production is the aerobic process whereby micro organism decomposes biodegradable wastes to produce organic fertilizer in the present of ample oxygen.

2.3.1 **Rate of Organic Waste Recovery by OSIWRTP**

Organic waste (biodegradable) materials are more abundant and are essentially recovered from markets, poultry farms and dumpsites. The compost plant is the most successful in waste recovery effort in OSIWRTP. In 2007, about 241 tons of organic wastes were recovered...
and processed into compost fertilizer. This is about 52% of the total organic waste recovered from inception of plant in 2007 up till June 2010.

<table>
<thead>
<tr>
<th>Year</th>
<th>Organic Waste (Kg) Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>52%</td>
</tr>
<tr>
<td>2008</td>
<td>27%</td>
</tr>
<tr>
<td>2009</td>
<td>17%</td>
</tr>
<tr>
<td>2010 June</td>
<td>4%</td>
</tr>
</tbody>
</table>

Fig. 5: Pie showing Organic Waste Recovery per year

### 2.3.2 Finished Organic Compost Products

About 124 tons quantity of compost fertilizer was produced in 2007 but this volume fell sharply to 50 tons in 2009. For effective composting of MSW, it is important that the wastes received for composting should be in segregated form. However, this is very difficult to achieve due to lack of awareness among the general public.

Marketing of organic fertilizer by OSIWRTP has been a key challenge and concern. Among major drawbacks noticeable in the sales of organic fertilizer are:

- The absence of strong market promoter for organic fertilizer in Ondo state and generally in Nigeria.
- Due to bulky nature of compost fertilizer, this attracts transportation cost that makes the product less attractive.
- When price of compost fertilizer is compared to chemical fertilizer, it makes it less attractive to users and also the high cost of application of compost compared to chemical fertilizer per unit area.
3.0 **EXISTING MARKET STRATEGIES AND SALES PERFORMANCE**

i. The marketing section of the Project is headed by a marketing officer, and supported by a marketing assistant;

ii. Waste recycling market can be categorized as a specialized market; in essence it has to be developed or specially looked for;

iii. Through participation in conferences by the Project Manager on waste management and organic agriculture across the country potential markets have been discovered;

iv. Presently, the Project has marketing relationships with some waste plastics brokers and specialized waste recycling companies who regularly wait on
OSIWRTP finished products. One of these companies supplied a bailing machine to the Project to aid recovery operation and reduce transportation cost in transporting product to them;

v. However, for organic fertilizer (compost), this has a serious contender in the mineral fertilizer being subsidized by governments to farmers. Although, the market is gradually being developed both at local level (to oil-palm farmers in the southern part of the State who are engaged in commercial farming) and national level (to relevant institutions promoting organic agriculture)

![Bar chart showing total sales in Euros on recycled wastes](image)

*Fig.8: Total Sales (in Euros) made on recycled wastes*

### 4.0 PROPOSED SYSTEM FOR INTEGRATED WASTE MANAGEMENT IN OSIWTP

The existing waste recycling effort takes care of only 4 plastic types, makes compost fertilizers from biodegradable and recycles few other metals. However, other wastes such as glass, paper, sewage (faecal sludge), hazardous items, etc are dumped at the dumpsite and are not treated or recycled. From UNIDO report of 2005 [1], the composition of Akure MSW is shown in Fig. 9 below.
It has been observed that not all the metals and plastics wastes generated are currently been recycled. The existing system in OSIWRTP needs to be improved and expanded to include recycling of paper, all plastics, metals, wood, etc.

The efforts of the Ondo State government in initiating this project are commendable. Nevertheless, more efforts are needed to carry the project to the next stage where all wastes generated in Ondo State are treated or recycled. As it is now we remain a throw-away society for wastes whereas most of our wastes could be recycled or recovered for resource value. Viewing waste as a resource is the first step in waste management. Our waste management goal should be to protect the environment, public health and recover the value of the waste.

The wastes generated in Ondo State can be grouped into five broad categories:

- Municipal Solid Waste from household, markets, schools, hotels, etc
- Hazardous waste (including biomedical waste)
- Forestry residues
- Construction/Demolition waste
- Agricultural residues

### 4.1 Roles of Ondo State and Local Government

Government (state and Local) should, of necessity, strive to move waste management practices up in the waste hierarchy towards a more sustainable position. The challenge is to work towards reversing the current waste profile and ultimately works towards a zero waste society where all waste become resources.
4.1.1 Government Responsibilities

The government is responsible for ensuring that the state’s solid waste goals are implemented, thereby protecting public health, natural resources and the environment. This includes the development of solid waste policy that is consistent with state law. The local government has the primary role in planning SWM programs that ensure the proper management of solid waste generated within their jurisdiction. Local government activities should include all part of integrated waste programs, including waste recycling, waste reduction and proper disposal of MSW.

At the State government level, the Ministry of Environment should provide technical and financial assistance to local governments, business and the general public to improve solid waste management. The ministry should provide planning assistance, approve solid waste management plans, and presents policy analysis to the legislature. Although, local government have some health codes that were developed a number of years ago, these codes and regulations itself is not sufficient to protect the public health and the environment. The requirements of the regulations must be implemented and should be enforced, including banning of open burning of wastes. This is the largest contributors to emissions of Unintended Organic Pollutants (UOPPs) in Nigeria.

5.0 WASTE MANAGEMENT PROGRAMS THAT WILL IMPROVE RECYCLING ACTIVITY AT OSIWRTP

The following programs enumerated below will support and promote OSIWRTP recycling activities should state government promulgate and enforce some strict Environmental (Sanitation and Waste Control) regulation, 2009 [2] as promulgated by Federal Ministry of Environment.

- The State Government should initiate a program of waste Handling and collection that includes waste separation at source. The program should include provision of waste bins in the entire local governments’ areas. The bins should be with wheels and should be 3 in every location for biodegradable, recyclables and hazardous. Modern deep collection containers are recommended for cities like Akure, Ondo, Okitipupa, Ikare, etc.
There is immediate need for government to commence program for collection and recycling of used tyres, used crank engine oils, electronic equipment, batteries and items that are thrown away but are hazardous to humans and environment. The current situation where used tires are openly burnt or careless thrown away is not acceptable and not good for our environment.

Formation of Stakeholders Group: Government should initiate the formation of waste management stakeholders group that will provide direction and enlightenment regarding specific improvements for resource recovery and waste management in Ondo State. The stakeholder group should include among others local government representative, Ministry of Environment, NGOS, Private Sector and WAMASON.

6.0 Proposal for New OSIWRTP

The new OSIWTP plant envisaged should open its door to larger waste process capacity of over 250,000 tonnes (275,000 tons) per year of waste recovery of mixed recyclables that includes:

- Paper
- Plastics
- Glass
- Ferrous & non-ferrous metals
- Bio and agro wastes including waste Wood and sawdust from sawmills for production of briquettes for energy generation
- Waste crank oils

There is need to acquire an incinerator for the treatment of rejected and hazardous wastes that cannot be recycled.
Mixed wastes not found suitable for processing or incinerating should land filled in an engineered landfill.

Adopting screening technology for effective material separation that will achieve maximum recovery rates of high quality end product is also recommended. [3]

7.0 Concluding remarks

The capacity of 250,000 tonnes is achievable from coordinated collection of waste streams from local government areas of Ondo State. Each local government should have a collection centre or transfer stations where waste are deposited and later transferred to OSIWRTP for processing. However, the main challenge may remain as financing of the proposed system. Presently, the majority of the citizenry do not see the need for waste collection nor treatment fees but government should see waste management in a different perspective of the environment and human welfare.

The State Government strategic plan for improvement of MSW requires both institutional upgrading and considerable infrastructure investment. Resource conservation and waste minimization program and initiatives should be reviewed regularly to ensure they are consistent with best practices.

REFERENCES

[1] Pre-feasibility report for Solid Waste Management in Nigeria by UNIDO, June 2009 (not published)
