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AN ASSESSMENT OF SOLID WASTE GENERATION AND MANAGEMENT IN NIGERIA

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Introduction

Waste refers to anything that is no longer serving a purpose i.e. something without value. Additionally, wastes are items which people are required to be discarded and one person's waste can become another person's valuable material, for example, milk packages may be used as fuel, leftover food may be fed to animals, discarded cardboard may serve as walls and roofs of thatch house. Due to changing technologies, availability and cost of input materials, the demand and need to use recovered waste is changing, waste can therefore, be defined as something that nobody wants at a particular point in time and needs to be disposed of wastes are typically classified as solid, liquid and gaseous which could be bio-degradable, semi-biodegradable and non-biodegradable. Based on land-use and practices in the human environment,

Abstract

This paper assesses concepts, challenges and strategies of solid waste management in Nigeria. Also solid waste generation, the criteria for wastes classification, types of solid wastes, sources and typical waste generators and solid waste management process were looked at. Other issues discussed are best practices in solid waste management and the policies for solid waste management in Nigeria. Data was collected through a desk study. The study concludes that Disposal of solid waste has constituted a serious environmental threat to human existence in urban center in the developing countries of the world. But this is more pronounced in some of the urban centers in Nigeria due to the high rate of urbanization trends within

the last 25 years. The study finally recommends strategies which will be based on the enactment of legislations that will provide institutional framework that will allow for decentralisation of control of the entire waste management chain to local governments with provisions that will allow for private sector operation; sustainable financing mechanism; all-encompassing regulations; verifiable enforcement mechanism; independent monitoring and evaluation, dynamic information systems and mechanism for stakeholder participation.

Keywords: Solid Wastes Management, strategies, Best Practices, Challenges.

There are five major sources of waste, namely, domestic/residential, commercial, agricultural, industrial and institutional wastes. Domestic/residential and industrial wastes have the highest volume of wastes generated anywhere, anytime the world over (Ahmed, 2001).

Solid waste is defined to include refuse from households, non-hazardous solid waste from industrial, commercial and institutional establishments (including hospitals), market waste, yard waste and street sweepings. Semi-solid wastes such as sludge and night-soil are considered to be the responsibility of liquid waste management systems. While hazardous industrial and medical wastes are; by definition, not components of municipal solid waste, they are normally quite difficult to separate from municipal solid waste, particularly when their sources are small and scattered. Finally, debris from construction and demolition constitute “difficult” categories of waste, which also require separate management procedures (Peter et al. 1996).

Waste generation: Generation of solid waste is the stage at which materials become valueless to the owner and since they have no use for them and no longer require them and wish to get rid of them. Items which may be valueless to one individual may not necessarily be valueless to another. For example waste items such as tins and cans may be highly sought after by children. Solid wastes are generated from residential, industrial, institutional, commercial, public and semi-public as well as recreational areas.

Solid Waste Management is thus defined as the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with the best practices of public health, economics & financial, engineering, administrative, legal and environmental considerations (Shubeler, 1996). Solid waste management has three main components:

collection and transportation; reuse or recycling; and treatment or disposal. United State Environmental Protection Agency recommends using integrated, hierarchical approach to waste management with four components: source reduction, recycling, combustion, and land filling, to address the increasing volume of municipal solid waste. It ranks source reduction including reuse as the most preferred method, followed by recycling and composting, and lastly, disposal in combustion facilities and landfills.

CONCEPTUAL CLARIFICATION

Waste management is one of the important services provided by most urban authorities. Wastes need to be characterized by sources, generation rates, types of wastes produced, and composition in order to monitor and control prevailing wastes management systems while improving the existing system. The current solid waste management crisis being faced in Nigeria is an indication of the failure of the existing management systems. Government has attributed the situation to the inadequacy of funds to buy the necessary equipment needed for waste collection and disposal and the increasing uncooperative attitude of the public in keeping the environment clean among others (Yahaya,1999) In recent years, solid waste management has attracted increasing attention from bilateral and multilateral development agencies, due to the mounting urgency of urban environmental problems and increasing concern for capacity building at the level of solid waste management (Shubeler, 1996) **The criteria for wastes classification**

A number of criteria are employed to classify waste into types including their source, physical state, material composition and the level of risk associated with waste substance. Such classification of waste provides a basis for the development of appropriate waste management practice.

Classification of wastes

| Criteria for Waste Classification | Examples of Waste Classification |
|-----------------------------------|---|
| Sources or premises of generation | Residential, commercial, industrial, municipal services, building and Construction, agricultural. |
| Physical state of waste material | Liquid, gaseous, solid and radioactive. |

| | |
|--------------------------------------|---|
| Material composition of waste | Organic food waste, paper and card, Plastic, metal, glass, textile. |
| Level of risk. | Hazardous and non- hazardous. |

Source: World Bank (1992)

The source classification of waste is based on the fact that waste emanates from different sectors of the society such as residential, commercial and industrial sources. A good example of the source classification of waste was provided by the World Bank (1992)

TYPES OF SOLID WASTES IN NIGERIA

DOMESTIC WASTES: Domestic waste include paper, cardboard, metals, glass, food matters, old kitchen utensils ashes, plate, wood, and other discarded from homes, it also include old furniture house hold appliances, rubber products. One important characteristic of the waste is that it is highly putrescible and tends to decompose. Some of these wastes are highly combustible such as paper, textiles, wood, plastics and cellophane, the non-combustible one include glass, tin, cans ferrous and non-ferrous metals.

COMMERCIAL WASTES: It includes all solid waste which originates in business and profit making activities such as hospitals, educational, institutional, financial institutions such as banks, markets, stores supermarkets etc.

Commercial wastes also include food waste from restaurants, hotels, and barracks, most of this waste are collected with domestic waste.

AGRICULTURAL WASTES: The type of waste are made up of crop residues poultry and other animals manures particularly from intense breeding and fattening waste arising from the production and processing of the food and certain waste arising from the intense threshing of grains.

INDUSTRIAL WASTES: Industrial wastes are generated from industrial processes as a result of industrial activities. The waste generated from industries vary from one industry to another depending on the type of mechanical method used in its operation, the raw materials used and the end products of such industrial factory.

The generated wastes from chemical, plastic, metal processing depends on the end product. One major character characteristics of industrial wastes is that it constitutes a high Biological Oxygen Demand (BOD) and Chemical

Oxygen Demand (COD), which are harmful to the environment as well as man's well-being and requires a proper treatment.

DEMOLITION AND CONSTRUCTION WASTES: These are solid wastes generated from repairing or renovation of structures as well as construction or rehabilitation of roads and drainages. They are characterized by steal bricks concrete stones plumbing materials heating electrical parts from demolished structures. These types of wastes are heterogeneous in nature and are largely non-degradable.

| SOURCE | TYPICAL WASTE GENERATORS | SOLID WASTE CONTENTS |
|-------------------|--|--|
| Residential | Single and multi-family dwellings | Food wastes, paper, cardboard, plastics, textiles, leather, wood, glass, metals, ashes. |
| Industrial | Light and heavy manufacturing, fabrication construction sites, power and chemical plants | Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes |
| Commercial | Stores, hotels restaurants, markets, office buildings | Paper, cardboard plastics wood food wastes glass metals |
| Institutional | Schools hospitals prisons government centers | Paper cardboard plastics wood food wastes glass metals special wastes |
| Municipal service | Street cleaning, landscaping parks beaches | Street sweeping landscaping and tree planting /trimmings general wastes from parks |
| Agriculture | Crops, orchards, vineyards dairies, feedlots farms | Spoilt food wastes, agricultural wastes, hazardous wastes |

World Bank (1992)

SOLID WASTE MANAGEMENT PROCESS

Storage: This is the system for keeping materials after they have been discarded and prior to collection and final disposal. Here on-site disposal have been implemented, such as where people discard items directly in to family pits, storage may not be necessary. In emergency situations, especially in the early stages, it is likely that the affected population will discard domestic waste in poorly defined heaps close to dwelling areas. If this is the case, improved disposal and storage facilities should be provided fairly quickly and this should be located where people are able to use them easily. Improved storage facilities include:

Small containers: Household containers, plastic bins, etc. Large containers: commercial bins, oil drums etc. Commercial depots: walled or fenced in areas, incinerators etc.



Collection: simply refers to how wastes are collected for transportation to the final disposal site. Any collection system should be carefully planned to ensure that storage facilities do not become overloaded. Collection intervals and volumes of collected waste must be estimated carefully.



Transportation/ Transfer: This is the stage when solid waste is transported to the final disposal site. There are various modes of transport which may be adopted and the chosen method depends upon local availability and the volume of waste to be transported. Types of transportation can be divided into three categories, Human powered: open hand-cart, hand-cart with bins, wheelbarrow, Animal powered: donkey-drawn cart

Waste-to-energy: Solid waste can be collected in a similar way as the collection for landfilling or they can come from transfer stations and material recovery centers after sorting processes to remove recyclables. Burning the waste reduces the volume to one tenth of the original volume. The ash produced from burning is collected to recover metals and the rest are sent to monofills, which accepts only ashes, or to landfills to be used as alternative daily cover (ADC) or to be landfilled with the other wastes. The collected waste is first dumped into a storage pit or bin. From there

Solid waste disposal: This is the process of getting rid of solid waste from the collection point or dumpsite so that they do not constitute odor nuisances in the environments. The disposal operation of solid waste consists of the activities directed at the ultimate removal of the waste in a satisfactory manner



Waste Treatment: The techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste, thus making waste easier to dispose of. Treatment methods are selected based on the composition, quantity, and form of the waste material.

Waste management hierarchy:

Reduce > Reuse > Recycling > Resources recovery > Sanitary landfill > Incineration
Waste Reduction and Reuse: Waste reduction and reuse of product are both methods of waste prevention. They eliminate the production of waste at the source of usual generation and reduce the

demands for large scale treatment and disposal facilities. Methods of waste reduction include manufacturing products with less packaging, encouraging customers to bring their own reusable for packaging, encouraging the public to choose reusable products such as cloth napkins and reusable plastic and glass containers, backyard composting and sharing and donating any unwanted items rather than discarding them.

Recycling: Recycling refers to the removal of items from the waste stream to be used as a raw material in the manufacture of new products. Thus from definition recycling occurs in three phases: First the waste is sorted and recyclables collected, the recyclables are used to create raw materials such as, papers, plastic and tyres. These raw materials are then used in the production of new products. The sorting of recyclable may be done at the source (within the household) for selective collection by the municipality or to dropped off by the waste producer at a recycling centers.

Resources recovery: Resources recovery is the process of turning what has been considered as waste into useful product for use.

Sanitary landfill: Sanitary landfill is define as a controlled method of disposing of wastes by spreading them in layers, compacting them into smallest practical volume and covering them with solid anytime the operation is performed in order to reduce environmental health nuisances These are technically designed areas where waste is disposed scientifically. Disposing of waste in a landfill involves burying the waste, and this remains a common practice in most countries. Landfills were often established in abandoned or unused Quarries mining voids or borrow pits. A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials.

Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically. This gas can create odour problems, kill surface vegetation, and is a greenhouse gas. Plastic lining material. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity (Wilson,2015)



Incineration: Incineration is a disposal strategy in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products. This strategy is useful for disposal of residue of both solid waste management and solid residue from waste water management. This process reduces the volumes of solid waste from 30 to 20 percent of the original volume.

CHALLENGES OF SOLID WASTE MANAGEMENT IN NIGERIA

The challenges of solid waste management in Nigeria includes the following;

- ❖ The Lack of appropriate institutional and legal frame works for solid waste management. As a result the existing laws have failed to solve the problems for which they were enacted. Also the scraping of the erstwhile FEPA has created bottlenecks rather than improvement on the urban solid waste management in the Country
- ❖ Lack of a comprehensive policy on solid waste management which may have several implications but a notable one is that it reinforces the exclusion of the poor from services.
- ❖ Duplication of roles and responsibilities/ Conflicts of functions and Competition for supremacy among institutions with similar functions, as well as Lack of clear-cut jurisdictional boundaries

- ❖ Lack of formal recognition for some of the stake holders such as the informal private sector (scavengers, wheel barrow boys etc) community groups, households etc
- ❖ The issue of low level of development , technical incompetency, ignorance etc cannot be over emphasized,
- ❖ Another challenge is the present co-disposal practice of domestic, industrial, hospital and other wastes which make dumpsites hazardous to human health. Also the establishment of housing estates, markets and other uses on hazardous waste dump sites or landfills is not environmentally friendly.
- ❖ The use of private firms through public-private partnership (PPP) contracts (especially developing countries), is difficult due to the limited capacity of governments to manage PPP and the incapacity of governments to fulfil their financial obligations towards the private partners
- ❖ The haphazard disposal of wastes which is a common practice by urban households, leads to blockage of roads to impede free flow of traffic, blockage of drainages and producing offensive odour as the waste undergo decomposition. This practice also degrades the aesthetic value of the urban landscape due to its unkept condition.

BEST PRACTICES IN SOLID WASTE MANAGEMENT

This paper examines a number of country case studies of Solid Waste Management, in order to gain some insights into how they found innovative and sustainable solutions towards solving solid waste management challenges. Moshi in north east Tanzania and Ghorahi in south western Nepal etc are examples of best practices. Also Curitiba the capital city of Parana state, in southern Brazil are examples of cities where sustainable solid waste management are being practised. The case studies here show case two of the smaller cities.

Moshi: is a small municipality at the foot of Kilimanjaro in north east Tanzania. It has clear focus on the cleanliness of the city, driven by concerns over public health. The citizens are very supportive the local Chaga and Pare tribes both hold cleanliness in high esteem in their culture, regardless of income level, and are outspoken if someone litters the street. A stakeholder platform on solid waste has been active since 1999, making strategic and

action plans that are subsequently implemented. Pilot projects have been used to test new models of service delivery, involving both the local private sector and Community-Based Organisations (CBOs) that provide primary collection in unplanned settlements. As a result of these joint efforts by multiple stakeholders, Moshi has won the official title of the cleanest city in Tanzania for several years in a row. This is a result of a broader commitment of the council and citizens to Urban infrastructure and governance issues, as demonstrated by their active participation in various country-wide initiatives such as the Sustainable Cities Programme and the Urban Sector Rehabilitation Programme. In order to keep the city clean and provide waste collection services to as many people as possible, the service is free to 36% of residents, based on income.

Ghorahi: is a small and relatively remote municipality in south western Nepal. The municipality has very limited human and financial resources but, due to a clear vision, strong commitment by the authorities and active participation of key stakeholders, it managed to develop a wellmanaged state-of-the-art waste processing and disposal facility (one of only three in the country) without any form of foreign involvement. The facility includes waste sorting and recycling, sanitary landfilling, leachate collection and treatment, and a buffer zone with forests, gardens and a bee farm that shields the site from the surrounding area. A small initial investment from the municipality budget was used to commission geological studies from the National Department of Mines and Geology and identify a very suitable site that was accepted by the general public. In turn, this convinced the Ministry of Local Development to mobilise national financial support for the construction. The site was brought into operation within 5years, in 2005. A strong land fill management committee involving local people and key stakeholders ensures that the site is properly managed and monitored, and also giving a sense of ownership and even pride regarding the landfill. Activities are on-going to expand waste collection and strengthen recycling in the municipality

Privatisation of Waste Services in South East Asia, South America and Africa

More and more municipalities are convinced of the need for Privatisation and Community involvement. Various forms of Public-Private Partnership (PPP) are implemented in South East Asia, South America and to a much lesser

extent in Africa. (Peter et al. 1996) gives a good overview of formal private sector involvement and the variety of institutional arrangements, such as contracting concession, franchise, open competition, and the like, which can be deployed. It also discussed the many factors which need to be analysed; such as cost recovery, efficiency, public accountability, economics of scale in the decision to privatise. A number of case studies on privatisation of solid waste are presented below.

Jakarta: is one of several cities that began experimentation with the privatisation of waste collection in the second half of the 1980s. In 1988, Jakarta officials experimented with private contract for waste collection in 261 sub-districts (10 percent of the city's waste generating areas), which comprised middle to high income residents.

South Korea: A successful combination of public and private sector activity for hazardous waste disposal shifted the balance towards private sector operation. A public corporation built and operated two state-of-the-art hazardous waste treatment and disposal facilities. In a later stage the ministry was able to license and monitor the development of at least six privately owned and operated facilities.

Pakistan: city workers and managers were frustrated by the fact that the household waste containers were never placed on the street in the right place for the collection.

No amount of punitive enforcement or discussions seems to fix the problem, until a local NGO with a gender focus thought of asking the women about their opinions. It turned out that the women were in a double blind; the men in the family refuse to take the trash out themselves, cleaning it were a dirty job and therefore the job of the women. But the women were in purdah and were not permitted to leave their household compounds or have contact with men, so taking the trash to the designated corner was forbidden to them. The NGO worked with the household and together they came up with a solution: children would take the trash to the corner: either children from the household or street children who will receive nominal payment. Women were permitted to talk with children, so this was no problem. Until a deep cultural and social analysis was performed, no amount of money or equipment could solve the problem.

THE POLICIES FOR SOLID WASTE MANAGEMENT IN NIGERIA

According to the Federal Ministry of Environment (2006) the policy for solid waste management was derived from the national policies. These policies are the National Environmental Protection Management of solid and hazardous waste regulation, National policy on Environment and the National Urban Development Policy. In the national policies, the federal government will assume the supportive “enabling” role, whereas states and local government agencies will be assigned the full operational responsibilities, Public cleansing services and SWM will be gradually delegated to the private sector. The role of governmental agencies will then be focused on the planning, follow-up and control functions within a set of clearly cut licensing and contracting conditions in accordance to the prevailing legislative and regulatory framework, as well as a well-grounded “public -private partnership” approach, the “polluter pays principle” shall prevail. Procedures will be fully responsible for their products throughout their whole life cycle, particularly with regards to packaging materials

The National Environmental Policy on Solid and hazardous Waste

Regulation: It was enacted in 1991 and has objectives to identify solid, toxic and extremely hazardous waste dangerous to public health and environment, provide for surveillance and monitoring of dangerous and extremely hazardous waste and substances until they are safely disposed of, establish suitable and provide necessary requirements to facilitate the disposal of waste, research into possible reuse and recycling of hazardous waste and classified the collection and disposal of waste as a social service and vested the responsibilities for the collection and disposal to the local government authorities.

National Policy on the Environment: It was enacted in 1999 and the intent of this policy is setting up standards for sanitary facilities for the disposal of human and other solid waste in dwelling, housing estates and public facilities in both urban and rural areas, establishment of an early warning system for the identification of potential waste disposal hazards, provision of utilization of information on the appropriate methods and technologies for the treatment, reuse and disposal of wastes, encouraging of source reduction, reuse, recycling of wastes as well as the recovery of valuable products from wastes (4Rs) and to also secure a quality of environment adequate for good health and well-being.

National Urban Development Policy: It was enacted in 2006 the objectives of this policy is to promote efficient urban development and management, clearly define responsibilities and functions of each level of Government with a view to ensuring effective plan implementation and accountability, strengthen the capacity of the urban centers to manage economic growth, social development and poverty alleviation, encourage. Promote greater private sector participation in urban development, create enabling environment of regulations, laws, and institutions which will enhance urban market performance and social welfare, and give special attention to new state capitals and local Government Headquarters because of the challenges they face as new growth canterers

CONCLUSION

Disposal of solid waste has constituted a serious environmental threat to human existence in urban center in the developing countries of the world. But this is more pronounced in some of the urban centers in Nigeria due to the high rate of urbanization trends within the last 25years.

With growing urbanization and increasing per capital consumption, solid waste becoming an urgent social problem in many developing countries. Given the composition of disposal waste the solution to this issue will mainly be the choice between recycling and land filling.

However, the potential for solving the waste problem through enhancing recovery activities certainly deserves more attention. Government at federal state, local level can play an important role in this process by initiating appropriate recovery policies.

STRATEGIES/RECOMMENDATIONS FOR SOLID WASTE MANAGEMENT IN NIGERIAN CITIES

The strategy proffered is predicated on the enactment of legislations that will provide institutional framework that will allow for decentralisation of control of the entire waste management chain to local governments with provisions that will allow for private sector operation; sustainable financing mechanism; all-encompassing regulations; verifiable enforcement mechanism; independent monitoring and evaluation, dynamic information systems and mechanism for stakeholder participation. Other issues necessary for

consideration include professionalizing the service, creating awareness and training (Nabegu and Mustapha, 2015)

Decentralization of Solid Waste Management System

This is a situation where entire Solid Waste Management chain should be decentralized to the local authorities who should be responsible for collection, sweeping, storage, transfer, treatment, and final disposal of waste. This is predicated on the fact that local authorities are more accountable to the residents and business establishments they serve. Moving the decision making closer to the executing authority and beneficiaries allows functions to be handled more efficiently. A large and continuously expanding metropolis like Kano will obtain greater efficiency by dividing the municipality into zones for service provision. This mechanism will allow the zone to allocate available resources according to the particular needs. The powers delegated to the zones will ensure more effective supervision of the workforce as well as more effective handling of complaints from the public.

Private participation

Although the local government should ultimately be responsible for service delivery, some of the functions can be transferred to the private sector in the form of micro enterprises (MSEs) or Community based organizations (CBOs) for more efficient service. The private sector can participate in virtually all the areas of solid waste management chain such as providing door-to-door collection of domestic, commercial and hospital waste; transportation which covers all types of operation to transport solid waste from its generation point to the transfer station and to the treatment and disposal site; treatment which includes separation, recycling of different types of waste, composting incineration etc.

Sustainable Financing Mechanisms

Finance is the key to sustainable provision of waste management service and many countries employ different financing mechanism often involving a combination of many. For many emerging economies, legislation should cover all the broad sources such as the following:

- **User charges:** In many countries, user charges are being introduced. They are normally low for the majority of the citizens

but for commercial and industrial sector, the charges could be high to meet the costs in accordance with the polluter's pay principle. Charges should aim to motivate waste generators to reduce the waste, thus volume-based charges can be used as well.

- **Penalty, fine and levy:** This form of direct income is also becoming an important financing tool to finance solid waste management. The terminology and rate of the penalty/fine/levy may vary and should be based on stakeholder consensus.
- **Environmental Fund:** a revolving fund to assist the micro enterprises and the community based organisations registered to provide waste management services in meeting their financing needs for equipment and infrastructure at the initial stage. This fund could be sourced through various modes including annual budget, loans from local/international financing institutions and international cooperation.
- **Direct Loans:** Local governments may take direct loans either from domestic sources such as the Infrastructure bank or State government to help the SMEs.
- **International Cooperation:** International agencies are providing support to local governments to improve the local environment. Various bilateral initiatives, including sister cities, are also helping local governments to seek assistance for financing their development projects including solid waste management.
- **Annual budget:** Local governments should legally allocate substantial portion of their development budget to finance solid waste management. This can be transferred to the SMEs to fund their initial takeoff.

Regulations

Clear and all-encompassing regulations that cover all aspects of the waste management chain which should include standards covering every stage of existing solid waste management chain, responsibilities and guidelines for compliance and enforcement with the related penalty must be provided. Some examples of regulations or standards could be:

- Regulations on production and consumption – upstream measures

- Regulations on segregation of recyclable and nonrecyclable waste
- Regulations on electronics waste including storage and collection, transportation, treatment, disposal, and recycling and recovery.
- Regulations on handling of hazardous waste
- Regulations on collection and transportation of industrial waste
- Regulations on construction and operation of landfills
- Regulations on construction and operation of incinerators
- Regulations on construction and operation of composting plant
- Regulation on Extended Producer Responsibility (EPR)

Enforcement

Enforcement of all regulations and standards is crucial to achieving best practice and thus is the most important aspect of policies for solid waste management as they could only make a difference if these are properly enforced at all levels. Assessment of the level of enforcement is vital at all times but may become a challenging task if the criteria or benchmarks to ascertain the level of enforcement is not available or clearly defined or the opinion on the enforcement levels differ between the different stakeholders. Hence, a consensus as to what is the minimum requirement by the major stakeholders should be sought to get a comparatively appropriate assessment.

Monitoring and Evaluation

Once control of waste management is domiciled at the local governments, they automatically also assume the position of a regulator and therefore need to implement monitoring mechanisms to evaluate performance, demonstrate achievements, ensure accountability and contract compliance among others. The monitoring agency should be able to show that each component of the system is performing in compliance with the existing laws and regulations and is meeting targets established in the plans so that the implementing agencies can identify and implement corrective actions. Planning for monitoring and evaluation systems should include the following:

- Select indicators that will help measure the achievement of solid waste management objectives.

- Define the benchmarks or targets against which to judge service performance.
- Define a method for collecting data.

Monitoring and evaluation should be done over time, and the methodology should include frequent reporting to show progress or gaps in provision of service. The local governments should appoint an independent body for this important task.

Information Systems

Good management requires the collection of relevant information for taking corrective measures as well as planning for the future. Information must be collected to obtain an overall idea of the prevalent situation, deficiencies in the system, and likely requirements for the future. Advances in information technology and geographic information systems can be integrated with existing information systems. Data that need to be recorded and studied include relevant information about the department for planning processes as well as specific information to ascertain whether everyone involved in the various services is performing his or her duty well. The latter includes information about workers, vehicles, materials, repair and maintenance, processing plants, landfills, and so on.

Stakeholder involvement

Major stakeholders include waste generators, regulators, service providers such as organizations involved in waste collection, disposal, recycling and recovery as well as the general public. Active role for stakeholder participation must be enshrined legally. A strong stakeholder committee is required as it ensures maximum participation and ownership of solid waste management initiatives and cooperation among stakeholders. The participation of all stakeholders creates perception of equality and justice and thus government authority should be low and political vested interests should be minimal while representation across all strata of society should be ensured.

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