Federal Republic of Nigeria

Avian Influenza Control and Human Pandemic Preparedness and Response Project

= Medical Waste Management Plan =

Final Report
January 2007
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<td>Agricultural Development Programmes</td>
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<td>NAPA</td>
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<td>National Emergency Contingency Plan</td>
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<td>NMWMP</td>
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Executive Summary

The Avian Influenza (AI) outbreaks in Nigeria pose serious threats to West Africa through the trading in poultry and the migration of wild birds. The virus has been reported to spread rapidly among domesticated, wild, and migratory birds, and can be transmitted to humans through physical contact with infected animals or contaminated products.

Carcass disposal and treatment sites are environmentally vulnerable due to the liquids and organic material associated with dead animals’ bodies that are disposed off. Carcass disposal needs to be handled correctly and quickly to minimize environmental impacts on surface water, groundwater, soil, and air.

In fulfilling the requirements of the World Bank’s requirements, the Nigeria AI project is expected to prepare a National Medical Waste Management Plan (NMWMP) for the implementation of the Human Health component of the project.

The objective of the plan is to provide processes that the implementing agencies (Federal and States Ministries of Health and Agriculture) will follow to maximize project compliance with international and national environmental regulation and ensure that the disposal of AI infected bird carcasses is conducted in an environmentally safe and sustainable manner.

Medical wastes are a reservoir of potentially harmful micro-organisms which can infect patients, healthcare workers and the general public. Other risks include the spread of micro-organisms into the environment. These wastes can also cause injuries, e.g. radiation burns or sharps-inflicted injuries; poisoning and pollution, through the release of pharmaceutical products e.g. antibiotics or toxic elements such as mercury.

There are over 20,000 health care facilities with an estimated 243,000 beds in Nigeria and activities from these institutions generate about 5,000 kg of medical wastes daily, most of which are not handled or disposed off properly. These existing practices constitute a major risk to human health due to the hazardous, toxic and infectious characteristics of this waste stream. Careless and indiscriminate disposal of medical waste and AI infected carcasses would contribute to the spread of communicable diseases such as hepatitis HIV/AIDS and the highly pathogenic avian influenza (HPAI).

This plan describes the existing practice and proposes actions for a standardized approach to management of infectious and dangerous wastes. The study examined the current medical wastes handling practices within healthcare facilities and municipal dumpsites. The study shows that infectious and non-infectious wastes are dumped together in most hospitals, resulting in a mixing of the two, which are then disposed of with municipal waste at the dumping sites. It also assessed the level of knowledge among healthcare staffs about the practices to be adopted, and the availability of treatment equipment such as incinerators. Similarly, current carcass disposal practices were examined with respect to transportation, disposal, bio-safety arrangements, as well as any other relevant measures that require attention and potential capacity building needs.

The results of the study demonstrate the need for enhancement of new regulations, strict enforcement of existing provisions, capacity building and a better environmental management system for the disposal of medical waste in Nigeria.

This plan will contribute to diminishing the burden of AI and loss of productivity in Nigeria, limiting the regional spread of AI, and enhancing economic and social prospects at the national, regional, and global levels.

The existing legal framework for environmental assessment in Nigeria is considered adequate. Detailed laws, regulations and guidelines have been developed and serve as the framework for Environmental Protection. Their implementation has been poor due to poor enforcement.
Environmental health regulations are practically non-existent and there is an urgent need for the government to promulgate a Public Health Act to regulate and implement the promotion, prevention and maintenance of public and environmental health. The Act should provide guidelines on safe handling and disposal of medical and infectious waste with a view to minimise the spread of infections diseases e.g. zoonotics, HIV/AIDS, Hepatitis etc and reduce occupational health hazards.

The Nigerian AI project has been assigned World Bank category B status and triggered the Environmental Assessment Safeguard Policy (BP/OP 4.01). This implies that the potential impacts are site-specific and can be effectively reversed with appropriate mitigation measures. Medical waste treatment and disposal facilities vary by the categories of healthcare institutions (tertiary, secondary and primary) and range from incinerators; open ditches; pit latrines to off-site facilities.

There are currently no sanitary landfills in Nigeria; but only open dumpsites. These are unsuitable for the disposal of AI infected and medical waste and pose a serious public health hazard.

The goal of carcass disposal is to eliminate the pathogen, in a timely, bio secure, socially acceptable and environmentally responsible manner. The current disposal practices employed in Nigeria in attempting to control AI infections include open-air burning and burial.

The audit of medical waste management undertaken in this study has shown that although the portfolio for solid waste management does not directly fall under the Federal Ministry of Health (FMoH), there is a need for FMoH to be fully involved because of the nature and quantities of waste generated at healthcare facilities. It is therefore necessary that when legislating on medical waste management, FMoH should work in consultation and collaboration with the Federal Ministry of Environment (FMEnv) and other stakeholders.

The findings on medical waste generation and management practices highlight the following main concern:

- The existing legislations (National Environmental Protection Pollution Abatement in Industries and Facilities Generating Wastes and Guidelines and Standards for Environmental Pollution Control in Nigeria Regulations, 1991) do not adequately address issues of medical waste management.
- Medical waste is not classified at its source according to its type for easy treatment and final disposal.
- Most healthcare facilities do not take due responsibilities for the waste they generate to the environment and the public to ensure safe, efficient, sustainable and culturally acceptable methods for the collection, storage, transportation, treatment and final disposal both within and outside their premises.
- Local authorities do not have sound managerial approaches for dumpsites and the use of appropriate technologies, which would minimize health risks that result from inadequate management of hazardous medical waste.
- Scavenging is allowed to take place at all dumpsites without taking necessary measures to abate it.
- The level of knowledge among those involved in handling hazardous medical waste is low especially among those outside the health care facility who are exposed to such waste due to poor management practices.
The following recommendations require necessary immediate attention from the Federal Ministries of Health, Environment and Information as well as the state ministries, LGAs, farmers and other stakeholders in order to:

- Develop a National Environmental Health policy and strategies with necessary statutory instruments governing and regulating the management of medical waste in Nigeria, especially hazardous medical waste
- Ensure that all healthcare facilities have appropriate, reliable and sustainable measures in place for hazardous waste collection, storage, transport, treatment and final disposal
- Collaborate with local agencies to develop byelaws that will deal more strictly with medical waste including infectious waste produced during home based care
- Ensure that all basic environmental permits and licenses be obtained for large health care facilities that will help to deal with environmental impacts of medical waste including health impacts, air, soil and water pollution
- Develop a healthcare waste management code of conduct and technical guidelines
- Develop a national inventory and reporting system for medical and hazardous waste generation at all levels of the healthcare system
- Integrate medical waste management plans into all national and state healthcare facility plans
- Training and capacity building to ensure successful implementation of the plan and enhance capacity to deal with risks associated with medical waste
- Ensure that medical waste is segregated at ward level using different colour containers
- Develop monitoring indicator for waste generation

To implement this plan it is estimated a total budget of about US$5,120,000 would be required over a five-ten year implementation period. The major cost components are

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<tr>
<th>Component</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Action Plan</td>
<td>3,350,000</td>
</tr>
<tr>
<td>Training and Capacity Building</td>
<td>1,200,000</td>
</tr>
<tr>
<td>Public Awareness</td>
<td>170,000</td>
</tr>
<tr>
<td>Monitoring &amp; Evaluation</td>
<td>400,000</td>
</tr>
</tbody>
</table>

Healthcare facilities should prepare for an increase in the amount of medical waste generated due to the influx of patients during a pandemic outbreak. The World Health Organization (WHO) has directed healthcare providers to follow standard precautions (i.e., gloves, gowns) for contact with blood and body fluids and infectious waste.

Healthcare facilities should follow the guidance provided in this NMWMP as well as any federal, state, and local requirements. In the case of conflicting requirements, the provision of this plan must be followed. During a pandemic outbreak, Healthcare facilities should coordinate with local emergency response personnel and be actively involved in the local contingency plan. In the event that a local contingency plan is unavailable and the disposal contractor is inadequate or unavailable, the following emergency disposal/treatment options should be considered.

- Deploy treatment units that can be built locally e.g. De Monfort, Brick or Drum Incinerators.
- Prepare shallow burial pits for disposal
- Pack sharps into specially made UNICEF/WHO cartoons or treat with disinfectants e.g. common bleach solutions to render them non-infections before disposal as a regular solid waste.
- Consult State Ministries of Health and Environment regarding regulatory issues before proceeding with any treatment and/or disposal of medical waste during a pandemic.

It is quite possible that an hospital run out of sharps containers during a pandemic outbreak. In this case, plastic storage containers with snap-on lids should be used; however these containers must be labeled with the universal biohazard symbol.

Medical waste bags could also be in short supply as well. General trash bags may be used as a substitute provided that the medical waste receptacles are doubled or tripled bagged, as necessary to maintain adequate barrier between the medical waste and the waste handlers. These bags, as well as the receptacles, must display the universal biohazard symbol.
Chapter 1.0: Introduction

1.1 Background

Following the outbreak of Highly Pathogenic Avian Influenza (HPAI 5N1) in three Nigerian States (Kaduna, Kano and Plateau), the Federal Government of Nigeria (FGN) initiated steps to prevent and control the outbreak but the Veterinary Service have been severely challenged due to the current limited capacity for the early detection and rapid response to outbreaks of highly contagious diseases of animal origin.

The Nigeria Avian Influenza Control and Human Pandemic Preparedness and Response Project (AICP) is funded by the World Bank’s Global Program for Avian Influenza Control and Human Pandemic Preparedness and Response Project (GPAI). The GPAI is designed to support the efforts of national governments to minimize the threat posed by AI to humans and the poultry industry and prepare control measures to respond to a possible influenza pandemic to prevent further spread. GPAI will provide support to the FGN in three major areas: (i) response and containment, (ii) control and prevention and (iii) preparedness and planning.

In addition to the above, the Project will support the development of a National Medical Waste Management Plan (NMWMP) to ensure the (i) safe disposal of infected carcasses as well as (ii) safe medical waste management at the health care facilities and waste dump sites. The plan will enable the country to address current medical waste management problems at its healthcare facilities and waste dump sites as well as deal with the additional medical waste generated by the AICP.

The project, although designed to strengthen institutional capacity to deal with the AI will generate medical wastes as well as negative environmental and social impacts related to carcass disposal.

Carcass disposal and treatment sites are environmentally vulnerable due to the dead animals’ bodies and their associated liquids and organic material that would be disposed. Carcass disposal needs to be handled correctly and quickly to minimize environmental impacts on surface water, groundwater, soil, and air.

In fulfilling the requirements of the World Bank and existing national regulations, the Nigeria AI project is expected to prepare a National MWMP in furtherance to the implementation of the Human Health component of the project.

The plan will provide a framework for measures to mitigate adverse impacts during project implementation. It will focus on the human health impact of clean-up and disposal of AI infected and culled poultry. It will also provide a framework to ensure (i) environmentally and socially sound disposal of infected carcasses in order to prevent the further spread of HPAI; and (ii) safe medical waste management at the health care facilities and waste dump sites to prevent the further spread of HPAI and HIV/AIDS due to unsafe medical waste management.

The plan will support both medical waste management at healthcare facilities and safe disposal of AI infected carcasses. The examination of the existing medical waste handling practices will:

- verify waste management practice in health care institutions and management by municipal authorities after collection;
- appraise the level of knowledge among health care staff (doctors, nurses etc.) about the practices to be adopted;
- assess the availability of equipment such as incinerators to deal with medical waste and carcasses; and
- verify current carcass handling, transportation, disposal, health, safety and environment practice, as well as other measures that require attention and capacity building needs.
The MWMP will be prepared according to national policies, regulations and guidelines as well as to regulations of the financing institutions.

The objective of the plan is to provide processes that the implementing agencies will follow to maximize project compliance with international and national environmental regulation and ensure that the disposal of AI infected poultry is conducted in an environmentally sound and sustainable manner.

1.2 Health Care System

Nigeria’s health care system is a three-tier system, which comprises the following:

- **Primary Health Care**

  The Provision of health care at this level is largely the responsibility of Local Governments with the support of state ministries of health and within the overall national health policy. Private medical practitioners also provide health care at this level.

  Examples include Health Centres, Veterinary Clinics, Smaller private hospitals and clinics, Health Stations and Traditional Health Clinics

- **Secondary Health Care**

  This level of health care provides specialized services to patients referred from the primary health care level through out-patient and in-patient services of hospitals for general medical, surgical and paediatric patients and community health services. Secondary health care is available at the state level. Adequate supportive services such as laboratory, diagnostic, blood bank, rehabilitation and physiotherapy are also provided.

  Examples include General Hospitals, Missionary Hospitals and Large Private Hospitals

- **Tertiary Health Care**

  This level consists of highly specialized services provided by teaching hospitals and other specialist hospitals which provide care for specific diseases such as orthopaedic, eye, psychiatric, maternity and paediatric cases.

  Examples include University Teaching Hospitals, Federal Medical Centres, State Specialist Hospitals, National Referral Hospitals, Medical Research Institutes, Veterinary Research Institutes, Pharmaceutical Research Institutes and National Blood Banks.

1.2.1 Public Health Administration

- **Federal Level**

  In Nigeria, the Federal Ministry of Health (FMOH) is responsible for the national health policy development. The basic functions of the FMOH include: policy formulation, regulation, human resources development, evaluation and monitoring of the services provided, funding of tertiary health institutions and oversight function on the National Health Insurance Scheme (NHIS).

- **State Level**

  The State Health Management Boards (SHMB) is responsible for the supervision of the State Ministry of Health (SMOH). The SMOHs are responsible for health system planning, implementation of health projects, provision of infrastructural facilities, management of the health system (HS), prevention and control of epidemics at state level and training of personnel to meet the medical needs of the state and health education.
1.3 Health Care Wastes

Health-care activities e.g. immunizations, diagnostic tests, medical treatments, and laboratory examinations, protect and restore health and save lives. Nevertheless, these activities also generate wastes and by-products that are hazardous to both human health and the environment.

The medical waste stream from a healthcare facility (HCF) contains about 75-80% domestic waste e.g. paper, plastic packaging, glass, etc that has not been in contact with patients. A smaller proportion (15-20%) is infectious waste that requires special treatment. This smaller fraction is focus of this plan due to the risks that it poses both to human health and the environment.

Medical or healthcare wastes are by-products of healthcare that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. Poor management of MW exposes healthcare workers, waste handlers and the community to disease and injuries.

1.3.1 Sources of Health Care Waste

The major sources of medical waste are hospitals, clinics, laboratories, blood banks and mortuaries; while the minor sources are dental clinics, pharmacies, etc. The main actors involved in medical waste management are:

- health care facilities that generates the waste;
- service providers who collect the waste from the healthcare facilities and transport it to the treatment facilities; and
- treatment facilities that process the waste to make it safe for final disposal.

Based on WHO guidelines and the Basel Convention Annexes I, II, VIII and IX classification, medical waste can be broken down into the major categories presented in Table 1.1.
<table>
<thead>
<tr>
<th>Waste type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Infectious waste</td>
<td>Infectious wastes are susceptible to contain pathogens (or their toxins) in sufficient concentration to cause diseases to a potential host. Examples include discarded materials or equipment, used for the diagnosis, treatment and prevention of disease that has been in contact with body fluids (dressings, swabs, nappies, blood bags etc). It also includes liquid waste such as faeces, urine, blood or other body secretions.</td>
</tr>
<tr>
<td>2. Pathological and anatomical waste</td>
<td>Pathological waste consists of organs, tissues, body parts or fluids such as blood. Anatomical waste consists in recognizable human body parts, whether they may be infected or not.</td>
</tr>
<tr>
<td>3. Hazardous pharmaceutical waste</td>
<td>Pharmaceutical waste includes expired, unused and contaminated pharmaceutical products, drugs and vaccines. This category also includes discarded items used in the handling of pharmaceuticals like bottles, vials and connecting tubing.</td>
</tr>
<tr>
<td>4. Hazardous chemical waste</td>
<td>Chemical waste consists of discarded chemicals (solid, liquid or gaseous) that are generated during disinfecting procedures. They may be hazardous (toxic, corrosive, flammable or reactive) and must be used and disposed of according to the specification formulated on each container.</td>
</tr>
<tr>
<td>5. Waste with a high content of heavy metals</td>
<td>Waste with high contents of heavy metals and derivatives are highly toxic (e.g. cadmium or mercury from thermometers or manometers).</td>
</tr>
<tr>
<td>6. Pressurised containers</td>
<td>Pressurised containers consist of full or emptied containers or aerosol cans with pressurized liquids, gas or powdered materials.</td>
</tr>
<tr>
<td>7. Sharps</td>
<td>Sharps are items that can cause cuts or puncture wounds (e.g. needle stick injuries). They are highly dangerous and potentially infectious waste. They must be segregated, packed and handled specifically within the healthcare facilities to ensure the safety of the medical and ancillary staff.</td>
</tr>
<tr>
<td>8. Highly infectious waste</td>
<td>This includes microbial cultures and stocks of highly infectious agents from medical laboratories. They also include body fluids of patients with highly infectious diseases.</td>
</tr>
<tr>
<td>9. Genotoxic/cytotoxic waste</td>
<td>Genotoxic waste includes all the drugs and equipment used for mixing and administration of cytotoxic drugs. Cytotoxic drugs or genotoxic drugs are drugs that have the ability to reduce the growth of certain living cells and are used in chemotherapy for cancer.</td>
</tr>
<tr>
<td>10. Radioactive waste</td>
<td>Radioactive waste includes liquids, gas and solids contaminated with radio nuclides whose ionizing radiations have genotoxic effects. These include x- and g-rays as well as a- and b- particles.</td>
</tr>
</tbody>
</table>

Source: Safe Management of Health Care Waste WHO 1999
1.3.2 Health Impacts

Medical waste is a reservoir of potentially harmful micro-organisms which can infect hospital patients, health-care workers and the general public. Other potential infectious risks include the spread of micro-organisms from health-care establishments into the environment. Wastes and by-products can also cause injuries, e.g. radiation burns or sharps-inflicted injuries; poisoning and pollution, whether through the release of pharmaceutical products, in particular, antibiotics and cytotoxic drugs, through the waste water or through toxic elements or compounds such as mercury or dioxins.

Although treatment and disposal of health-care waste aims at reducing risks, indirect health risks may occur through the release of toxic pollutants into the environment during treatment or disposal.

1.3.4 Health Care Waste Management

Improper handling of medical waste can create harmful effects and reduce the overall benefits of health-care. Generally, lack of awareness about the health hazards, poor management practice, insufficient financial and human resources and poor control of waste disposal are the most common problems connected with medical waste management in developing countries. Most developing countries do not have appropriate regulations to cover medical waste and where these regulations exist they are not effectively enforced. A major issue is the lack of clarity on whose responsibility is it to handle and dispose medical waste. According to the 'polluter pays' principle, this responsibility lies with the waste producer i.e. the health-care provider (hospitals, maternity homes etc).

Urgent improvements are required in the following key areas:

- build-up of a comprehensive system addressing responsibilities, resource allocation, handling and disposal;

- awareness raising and training about risks related to health-care waste, and safe and sound practices; and

- selection of safe and environmentally-friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating or disposing of waste.
Chapter 2.0: Project Description

2.1 Aims and Objectives

The Nigeria AICP will minimize the threat posed by AI to humans and the poultry industry, and prepare appropriate control measures to respond to a possible influenza pandemic. The Project will also assist in preventing further spread of AI to other parts of Nigeria not yet infected by the virus.

The objective of this study is to develop a National Medical Waste Management Plan (NMWMP) to ensure the (i) environmental and social sound disposal of infected carcasses and thus preventing the further spread if HPAI; and (ii) safe medical waste management at the health care facilities and waste dump sites to prevent the further spread of diseases e.g. hepatitis B and HIV/AIDS due to unsafe medical waste management. The plan will support medical waste management at Nigeria’s health care facilities where the demand for health care services will increase under the Project, and safe disposal of AI infected carcasses with support from the Project.

The study examined the current medical wastes handling practices within hospitals and other healthcare facilities (HCF) and also the management by municipal waste management authorities once the waste has left the source. It also assessed the level of knowledge among hospital staffs about the practices to be adopted, and the availability of equipment such as incinerators. Similarly, current carcass disposal practices were examined with respect to transportation, disposal, bio-safety arrangements, as well as any other relevant measures that require attention and potential capacity building needs.

2.2 Project Components

The Project consists of the following four components:

- Animal Health
- Human Health
- Social Mobilisation and Strategic Communication
- Project Implementation Support, Monitoring and Evaluation

2.2.1 Component 1: Animal Health

This component will support national prevention and control strategies proposed to cover the country’s needs over the short, medium and long-term, based on detailed assessments of the AI epidemiological status, the capacity of national Veterinary Services (VS) to cope with the HPAI epidemic, and the vulnerability of the poultry industry to new emerging infectious diseases.

HPAI outbreaks must be addressed on the animal side, as the threat to human health will persist as long as the problem persists in livestock and poultry flocks. The different elements of the Animal Health components are:

(a) Strengthening HPAI Control Programs and Outbreak Containment Plans

This sub-component will provide support for the implementation of HPAI control and eradication measures. These measures included in HPAI Control Programs or Emergency Outbreaks Containment Plans are intended as a rapid mobilization to respond quickly and effectively to HPAI outbreaks during the project lifespan. The following activities are planned:

(i) Targeting virus elimination at the source: HPAI control strategies and programs will include the principle of targeting the disease at source of infection: (a) stamping out of infected and at-risk poultry; (b) compensation to farmers and producing companies at a reasonable market-oriented price; (c) disposal of carcasses and potentially infective materials in a bio-secure and environmentally acceptable manner; (d) enhanced bio-security at poultry

UnenonQuest 6
farms and associated premises, through bio-containment and bio-exclusion; and (e) control of movement of birds and products that may be infected, including controls at the interface of infected/non-infected areas and border controls.

(ii) Vaccination campaigns: This activity will support the vaccination of poultry. Ring vaccination will be employed around newly infected, depopulated hotspot areas, in parallel with stamping out and targeted strategic field surveillance and epidemiological studies to identify virus sources, selection of priority hot spots, imposition of transport bans, and post-vaccination monitoring. A DIVA vaccine, using a strain different from H5N1, will be used to allow laboratory differentiation between vaccinated and infected poultry, especially during post-vaccination serological monitoring. The use of non-vaccinated sentinel domestic ducks and chickens is essential to monitor vaccinated domestic poultry flocks. The activity will also provide capacity building in vaccine quality control at the national level to ensure that the vaccines used conform with those of the World Organization for Animal Health (Office International des Epizooties – OIE). The adoption of a poultry vaccination policy for HPAI is still being considered by the Federal Government of Nigeria (FGN), in the context of local poultry production systems.

(iii) Bio-safety for at-risk stakeholders: Due to the highly pathogenic nature of the AI virus to humans, particularly the Asian H5N1 strain, training of people in contact with the live virus will be supported. Adequate resources will be allocated for training and equipment (bio-safety hoods and appropriate personal protective clothing) for laboratory workers, poultry farm workers, and poultry vaccinators.

(b) Strengthening Disease Surveillance, Diagnostic Capacity and Applied Research

As part of the control strategy for an HPAI infected country like Nigeria, the proposed sub-component will support activities to strengthen national VS, including the private and related sectors operating under its authority, enhance animal disease surveillance, diagnostic and PAI-dedicated research capabilities. The sub-component will consist of the following activities:

(i) Strengthening of veterinary services: Based on the evaluation of VS and related services, support will be provided to strengthen national VS to bring them in line with OIE standards. This would be a gradual process, and, under the aegis of project objectives, would prioritize HPAI control-dedicated strengthening.

(ii) Strengthening animal disease surveillance and epidemiological analysis: This activity will support: (a) shifting from passive to active, targeted surveillance, supported by sound epidemiological principles; (b) improving animal health information flow among relevant agencies; (c) early detection and timely reporting and follow-up of suspected or positive cases; (d) public and community-based surveillance networks by establishing a community-based early warning system, utilizing existing human infrastructures at the village level; and (e) routine serological surveys and epidemic-surveillance.

(iii) Upgrading diagnostic capacity: The activity will support the upgrading of the laboratories earmarked to carry out diagnostics for HPAI. The NVRI will be upgraded to contain a BSL-3 facility and will be expected to carry out virus isolation and identification and any other isolate characterization, while the VTHs at Ibadan, Maiduguri, Nsukka, Sokoto, and Zaria will be upgraded to conduct PCR and serological testing. An acceptable bio-safe environment will be created in these laboratories.

(c) Strengthening of Veterinary Quarantine Services

This sub-component aims to upgrade the technical capacity of quarantine inspectors in enforcing quarantine regulations, and improve inspection procedures. It includes the following activities:

(i) Strengthening information transfer: This is to ensure that disease information generated from quarantine inspections feeds rapidly to decision makers to allow for the timely banning of infected poultry and poultry products from infected countries.
(ii) Provide training in quarantine protocols, pre-entry inspections, reporting and in-transit clearance of livestock and poultry shipments at all land, sea, and air-based ports of entry.

(d) Strengthening Applied Veterinary Research

While a range of methodologies and tools are available to control HPAI, there are aspects of the disease that are not clearly understood. While some of these researchable issues are beyond the scope of this program, it is proposed that funding be provided for applied research into and field studies dedicated to HPAI disease dynamics.

(e) Enhancing Legal and Regulatory Frameworks for Trans-boundary Disease Prevention and Preparedness Capability

This sub-component supports strengthening of the regulatory framework to address key policy issues to ensure that the recommended disease control, prevention and eradication measures are implemented in a uniform and effective way and in accordance with OIE standards and guidelines. In addition, support will be provided to review existing regulations and policies, will fund related policy studies and dissemination workshops and will include workshops and will include a focus on trans-boundary animal diseases. Specifically, this sub-component will support key institutional issues, including the following activities:

(i) Rapid assessment of national veterinary services: The ability of Nigeria to prevent, detect and control an HPAI epidemic depends on the quality of its national VS. To be effective, national VS should operate on scientific principles and, be technically independent from political pressures. In terms of the emergency response, this will be medium-term activity.

(ii) Updating the National Emergency Contingency Plan (NECP) for HPAI: Building on existing preparedness and action plans to prevent and control HPAI epidemics in domestic poultry, water fowl, and wild birds, a team of national and international consultants will assist the Federal Ministry of Agriculture and Rural Development (FMARD) in updating the existing Emergency Contingency Plan. The Plan will be accompanied by operations manuals, outlining in detail the steps to be taken at all levels of VS.

(iii) Human capacity building: The activity will support participation of Veterinary and Livestock Services officials and project staff in regional and international information exchanges and dissemination of AI. Laboratory technicians will be trained in HPAI-dedicated diagnostic techniques, and epidemiology staff will receive refresher training in the epidemiological principles of active field surveillance and data analysis.

(f) Improving Bio-security in Poultry Production and Trade

Improved bio-security in poultry production and trade is not only an important longer-term strategy to guard against the damaging effects of HPAI, but also a complicated intervention that requires understanding of the entire market value chain. This component will support improved public hygiene in poultry shops and live-bird markets, bio-security regulations for commercial farms, and devising rural poultry sector restructuring strategies to stop rural households from living in close proximity with poultry.

(g) Compensation and Economic Recovery

The following three areas highlight the compensation issue:

(i) Establishment of a national compensation policy and national compensation fund: Early detection and reporting as well as rapid response depend critically on the incentives for poultry owners to report sick and/or dead poultry to their veterinarians, and adequate compensation arrangements are absolutely essential. The existing Animal Diseases Control Act (1988) provides for compensation wherever mandatory stamping-out/ depopulation of diseased animals/birds takes place. However, appropriate guidelines for implementation have to be worked out, including financing, fiduciary aspects, eligibility criteria, payment arrangements, flow of funds, and transparency.
(ii) **Support to economically vulnerable groups:** Smallholder poultry stakeholders have little or no access to animal health services and are therefore highly exposed to the consequences of an HPAI epidemic. This activity will provide support to low-income groups that are particularly vulnerable through activities specifically designed to increase small farmers’ awareness, improve animal health services at the community level, and provide grants for additional compensation. This includes the development of pro-poor exist strategies, including livelihood diversification, to benefit economically vulnerable poultry stakeholders who have been severely affected by HPAI.

(iii) **Alternative livelihoods for affected stakeholders:** This activity will support smallholder poultry farmers in a bottom-up, demand driven and equitable manner to resume poultry farming or undertake a different livelihood, based on demand-driven proposals made by stakeholders. The Project will provide:

- advisory services that will support new investment or restocking activities in project areas on request by thematic associations; and
- seed money, through a credit mechanism yet to be decided, to eligible stakeholders, based on their own proposals to undertake an alternative livelihood, to be approved by the Compensation Fund.

Beneficiaries of the Compensation Fund will receive technical and management assistance from reputable service providers, to be engaged by the State Project Office in order to equip them with the necessary skills to properly utilize the fund. The Project will: (i) support training and learning, knowledge sharing on good and bad practices; (ii) create and maintain a database of service providers which will be made accessible to all participating stakeholders; (iii) encourage the participation of service providers in the learning and experience sharing events that will be arranged by the State Project Desk Office (SPDO); and (iv) receive training on environmentally friendly practices for selected service providers.

Under the umbrella of the Community Thematic Association (CTA), the eligible stakeholders will present their proposals for alternative micro-enterprises to the service providers for evaluation and approval before receiving credit from the Fund, utilizing a credit mechanism similar to that of the FADAMA II Project. Suitably qualified service providers will include, in addition to the public Agricultural Development Programs (ADPs), private enterprises, NGOs, research and educational institutions, other public sector departments, and international agencies. The component coordinator (CC) at the state fadama development office (SFDO), which coordinates the Project at the state level, will provide technical assistance to user groups for the evaluation of proposals from service providers.

### 2.2.2 **Component 2: Human Health**

The human health component will support the implementation of HPAI prevention, preparedness, response, and containment activities in the human health sector as contained in the Avian Influenza Response Plan (AIRP). The project, designed by the Rapid Response Team of the Federal Ministry of Health (FMoH), in collaboration with WHO, Centre for Disease Control (CDC) and other bilateral partners, took into consideration the government’s health policy agenda. This is geared towards integration of the avian influenza prevention and control strategies into a wider framework of strengthening the capacity of the health sector to effectively address infectious diseases control.

To prevent human-to-human outbreak, short-term emergency strategies will be supported while planning for long-term interventions. Initial support will focus on prevention and reporting of human cases through the protection of farm workers and others who are in direct contact with sick birds, social mobilization, and raising public awareness and strengthening of the surveillance and laboratory in the affected areas. The long-term strategy will mitigate the chances of a circulating pandemic influenza virus strain through (i) year-round surveillance; (ii) effective and accurate methods of diagnosis; and (iii) social distance interventions; (iv) vaccines; (v) anti-viral drugs; and (vi) strengthened medical services. The different elements of the Human Health components include:
(a) Enhancing Public Health Program, Planning, Delivery and Coordination

Funding will be made available for: (i) coordination and management of response at the federal, state, and local government authority (LGA) levels; (ii) adaptation and establishment of appropriate Public Health legislation; (iii) identifying and addressing gaps in effective communication structures among the levels; and (iv) strengthening the capacity for effective planning and supervision of implementation of the response plans.

(b) Strengthening of National Public Health Surveillance Systems

To assess risks to public health and establish early warning systems to guide protective measures, information is needed on the extent of AI infection in animals and humans and on circulating viruses. National as well as regional surveillance systems must be improved urgently in potentially affected countries. When outbreaks in animals occur, active human case detection should be done by a coordinated animal-public health team.

National surveillance will be strengthened through the following activities: (i) review and assessment of the current Integrated Disease Surveillance and Response (IDSR) system; (ii) strengthening and harmonizing existing IDSR to include HPAI; (iii) supporting field serological and epidemiological surveys to increase case detection and sensitivity of the surveillance system; (iv) strengthening existing and establishing specific laboratories on Influenza Like Illness (ILI) in a phased approach; (v) providing technical assistance to states and LGAs; (vi) supporting capacity building and participation in scientific meetings; (vii) supporting hospital mortality studies; and (viii) enhancing community-based surveillance.

Current surveillance systems should be enhanced prior to the possible start of a pandemic to assure that the high demand for timely information that can be anticipated in a pandemic can be met. It is also recommended to carry out active sero-surveillance of the population at risk to complement the animal health surveillance strategy. To this end, the Project will support the following activities:

- Improvement of health information and telecommunication systems;
- Improvement of public health laboratory networks;
- Training;
- Studies and research in epidemiological surveillance; and
- Technical assistance.

(c) Strengthening Health System Response Capacity

Social distancing measures: The most effective measure to prevent contracting HPAI will be to limit contact of the virus with the public. Therefore, the Project will support the implementation of immediate term responses, i.e. the classic “social distancing measures”, such as school closings, backed up by a well-designed communication strategy. For the longer term, options with industry to improve anti-viral and vaccine capacity will need to be explored and supported. The social distancing measures will probably be enforced on advice from health institutions, but these will not be the enforcing agency. Financing will therefore be made available to develop guidelines on social distancing measures (in phases) to operationalize existing or new laws and regulations, support coordination among the Federal Ministries of Agriculture, Health and Information and other agencies and personnel involved in pandemic control activities.

Vaccination: Under this activity, support will be provided for seasonal influenza vaccination among high risk workers as a vital step to prevent an outbreak among humans. In case of an avian influenza pandemic, when a vaccine becomes available, funding will be made available for implementing an influenza program that rapidly administers vaccine to priority groups and monitors vaccine effectiveness and safety. To this end, support will be provided for the rehabilitation, expansion, and equipment of cold chain facilities for vaccines and other perishable medical products. In addition, National Advance Purchase Agreements (NAPAs) of vaccines will be considered. This measure will help operationalize a public-private
partnership on influenza pandemic vaccines and achieve equitable distribution by matching capacity with total pandemic demand.

**Procurement and distribution of drugs and other supplies:** The use of anti-viral drugs, while not a panacea, will be part of the strategy to contain an avian influenza pandemic and to reduce morbidity and mortality. Project support will be provided for the purchase, stockpiling and distribution of anti-viral drugs and antibiotics; to determine the susceptibility of the pandemic strain to existing influenza anti-viral drugs, and target use of available supplies; and the adoption of measures to limit the development of anti-viral resistance and ensure that this limited resource is used effectively.

**Medical services:** Assistance will be provided to the health care system for preparedness planning to provide optimal medical care and maintain essential community services. Strengthened clinical care capacity could be achieved through financing plans for establishing specialized units in selected hospitals, treatment guidelines, and hospital infection control guidelines. Also, strategies will be developed to increase hospital bed availability. A substantial burden will fall on inpatient and outpatient health care services, and Project support will be provided to rehabilitate and equip selected health facilities for the delivery of critical medical services to cope with increased demand for services, develop intra-hospital infection control measures, mobilize additional health personnel, including local and international medical NGOs; training of health personnel, provision of drugs, vaccines, and other medical inputs, diagnostic reagents, including kits, other operational expenses such as those related to mobilization of health teams and salaries, and technical assistance.

### 2.2.3 Component 3: Social Mobilization and Strategic Communication

This component will promote public awareness, participation and improved coordination in the execution of emergency contingency plans as outlined under the National Avian Influenza Plan (NAIP). The main challenges in fighting AI relate to low risk perception, lack of motivation and trust, and livelihood issues. These are compounded by the lack of knowledge of AI among the general public and a wide range of stakeholders, especially the small-scale family poultry farmers.

To address these constraints, the Project will support the following activities:

**Communication preparedness:** Activities will include developing and testing messages and materials to be used in the event of a pandemic or emerging infectious disease outbreak by enhancing the dissemination of information from the national to state and local levels as well as between the public and private sectors. Cost effective, sustainable communication activities will be developed through multi-media channels, counselling, schools, etc. These messages will be incorporated into avian flu-specific interventions, as well as outreach activities of involved ministries, especially the Ministries of Health, Education, Agriculture, and Transport. Community mobilization will take place by outreach to the general public, especially in rural areas, the church, and local community leaders. Radio messaging will plan an important role in outreach. Specifically, support will be provided for: (i) the development and distribution of basic communication materials on influenza, influenza vaccine, anti-viral agents, and other relevant topics; (ii) general preventive measures such as “dos” and “don’ts” for the general public; (iii) information and guidelines for health care providers; (iv) training modules (web-based, printed, and video); (v) presentations, slide sets, videos, and documentaries; and (vi) symposia on surveillance, treatment, and prophylaxis.

**Collaboration with stakeholders:** The multi-dimensional problems associated with HPAI infection necessitate collaboration by a wide range of stakeholders, to be supported by broad-based communication and information campaigns to improve public awareness. The major stakeholders include various ministries (notably the members of the Inter-Ministerial Committee), traditional and religious leaders, NGOs, civil society, private sector companies and associations (e.g. large poultry production companies, farmers’ and market women’s associations, veterinarians and farmers at the grass roots level). The activity will support
activities designed to improve the effective coordination and collaboration among these stakeholders.

*Developing capacity building modules and rapid social and communication assessment:* This activity will support the development and implementation of training courses in communications methodology for several cadres of information and national orientation officers, extension and veterinary staff as well as health workers at the federal, state and local levels. It will include preparation of local programs, preparation and dissemination of information materials, and the provision of communications and information equipment for use at the local and central levels as well as representatives of non-governmental and community-based organizations involved in social mobilization activities at the grass roots level. A rapid social and communication assessment will be conducted to investigate household and individual health-related behaviours within their complex matrix of personal, organizational, and social realities. The assessment will explore opinions, attitudes, behaviours, and motivations of affected communities, leading to an understanding of health, livelihood and other social development issues relevant in designing an effective communication strategy.

### 2.2.4 Component 4: Implementation Support and Monitoring & Evaluation

This component will support implementation costs associated with project management, coordination and Monitoring and Evaluation (M&E). This includes the provision of technical assistance for procurement, financial management, and technical assistance/training and coordination. It will also support training in participatory monitoring and evaluation at all administrative levels, monitoring and impact evaluation assessments.

The different elements of this component are:

**(a) Project Management Subcomponent**

This subcomponent will support strengthening the effectiveness and quality of project operations. The Project Management subcomponent will support new or existing institutional entities and mechanisms at the federal, state and local levels of government for overall project coordination and supervision and would help to strengthen the effectiveness and quality of project operations. It will support, at the federal level, the Project Desk Office at the NFDO of FMARD and the Project Desk Office at the HSDP II – which will be responsible for overall project coordination. At the local government level, the Project will support a Local Government Desk (LGD) and a multi-stakeholder committee which would be responsible for, respectively, screening and approving project activities and compensation proposals submitted by the Community Thematic Associations (CTAs). The LGD will comprise of three officers including an Animal Health Officer, Human Heals Officer, and a Community/Monitoring and Evaluation Officer.

Specific items and activities to be funded include equipment, vehicles, operations and maintenance costs, and minor civil works for office rehabilitation at the national, state and local government desks. It will finance specialized technical assistance and training at the federal, state, and local government levels aimed at developing capacity for coordination of implementation. Because this Project will be implemented at the grassroots level, the National Project Desk Office will maintain regular liaison with the state level offices and through that office with the LGD, to ensure effective reporting and backstopping.

The AICP organizational structure and the command chain should be seen as transitory, pending the emergence of a more relevant, tested and sustainable institutional arrangement. In the local context, the risk of rivalry between various specialists/professionals in government institutions must be avoided. As soon as is feasible, while the management structure of FADAMA II is being used to jumpstart the animal health component of the Project, the FDL&PCS of the Federal Ministry of Agriculture responsible for delivery of VS nationwide should strengthen existing VS delivery structures so that it can take full charge of implementing the animal health component.
In line with OIE’s “Performance, Vision and Strategy (PVS) for National Veterinary Services”, the development of an appropriate framework and technical capacity strengthening accompanied by human and financial capacity strengthening should lead to privatization of VS and greater interaction of veterinary service providers with the private sector.

(b) Support to National Technical Committee on Avian Influenza (NTCAI)

Under this subcomponent, the Project will support the enhancement of the current database and policy formulation capacity of the NTCAI. The Project will finance two main activities: (a) the establishment and operation of Avian Flu Control and Prevention data bank, building on past experience of the relevant research institutions and governmental agencies; and (b) capacity building for policy and strategy formulation and implementation. The Project will finance the investment costs (mainly equipment) for establishing the data bank, training and international and national consultant services.

(c) Monitoring and Evaluation

This subcomponent will support the development of simple, but effective M&E systems in both implementing ministries and for the Project as a whole. It will also support the development of an action plan for M&E, training in participatory monitoring & evaluation at national, regional and local levels, and a mid-term evaluation workshop.

The Project will support training in participatory monitoring and evaluation at all administrative levels, and measurement of performance at various project milestones, including four main elements:

- Management Information Systems (MIS) integrating existing project M&E structures of Project Desk Office at NFDO and HSDP II;
- Impact evaluation and beneficiary assessments to enhance project implementation performance;
- Monitoring the performance of project activities and
- Environmental Management Plan (EMP).

2.3 Scope of work

The project scope covers the whole Nigerian federation, as it is fully possible that AI will appear in wild birds and domestic poultry in all areas of the country. Initial areas of concern are the 16 states in which the presence of H5N1 has been already confirmed (Katsina, Kano, Kaduna, Yobe, Bauchi, Plateau, Nassarawa, Lagos, Ogun, Benue, Anambra, Rivers, Delta, Kwara, Borno, Taraba) and also the federal capital Abuja, but areas that host large populations of migratory waterfowl will also be closely monitored.

As contained in the Terms of Reference (TOR), the specific tasks to be performed are:

- Assess the Policy, Legal, Regulatory and Administrative Framework on (i) carcass disposal, and (ii) health care waste management and treatment/destruction facility in the country including statutory air emission standards (current and in the next ten years).
- Identify all required and statutory permit and procedures for medical waste treatment, and disposal facilities.
- Outline any public participation or public hearing requirements and procedures.
- Assess the time frame for proposed facilities (e.g. carcass disposal facilities) to obtain permits and address both environmental and social impact and public participation requirements.
- Inventory health care facilities nationwide (including basic information such as the number of beds, bed occupancy rates, and specialists) under the following categories: University Hospitals, General Hospitals, Municipal Hospitals, and other health care establishments.
- Identify all carcass disposal facilities in the country and provide relevant information for each facility, particularly with regard to bio-safety arrangements.
- Assess the health care waste generation at (i) one major hospital; (ii) one general hospital; and (iii) one private clinic. Detailing total waste generated per week, waste composition etc, and extrapolated the result to cover the entire country.
- Assess the level of scavenging or recycling taking place inside the health care facilities; along the transportation routes, and at disposal sites. Analyses social issues in relation to scavenging.
- Assess the level of scavenging that might take place at the AI infected carcass disposal sites.
- Review and analyze existing medical waste storage, collection and disposal systems with regard to separation, the frequency of collection, and environmental and health impacts of existing treatment practices.
- Review and analyze existing carcass disposal systems with regard to handling of carcasses at source, the frequency of transport of carcasses and environmental and social impacts of existing disposal practices.
- Determination of treatment and disposal technology, Sitting of the Facility and Analysis of existing sites
- Assess private sector participation as service provider
- Review existing training and public awareness programs on medical waste management at hospitals and other health care establishments
- Identify training needs and Prepare capacity building program
- Prepare project management program

2.4 Study Approach/Methodology

The methodology for conducting the study is as detailed below. This approach ensures that all pertinent issues raised in the ToR were adequately addressed.

- **Description of Proposed Project**

EnvironQuest conducted a comprehensive review of existing literature and information on the scope of the project. The objective was to gather concise information that addresses all phases of the project. Specifically, the team: compiled and reviewed existing documents and national regulations relating to health and waste management institutions; reviewed and assessed the project guiding principles, policies and reforms; and assessed existing operational framework and the institutional arrangement.

- **Policy and Regulatory Framework**

The team conducted a comprehensive review of national health, safety and environmental legislations pertinent to carcass disposal and medical waste management.

- **Institutional Framework**

EnvironQuest developed a framework to address institutional tasks from project initiation to monitoring. This task identified responsible implementing agencies and their roles and assessed the capacity of the agencies to manage the execution and supervision of the project activities.

- **Baseline Data Gathering**

A detailed survey was conducted to obtain data on all existing healthcare facilities (tertiary, secondary, primary and private) in the country. These descriptions include information such as number of beds, number of specialists, occupancy rates, types of disposal facilities and AI infection status. Tertiary institutions assessed include the university teaching hospitals and
federal medical centres, while secondary and primary institutions covered include state
general hospitals, and primary health care centres.

- **Permitting Requirements**

EnvironQuest identified permit requirements for medical waste treatment and disposal
facilities and also carcass disposal facilities. The typical timeline and procedures for these
permits to be in place were detailed as well as requirements for environmental and social
impact assessment and public consultation.

- **Waste (Medical and Carcasses) Assessment and Auditing**

This task established the detailed descriptive, qualitative and quantitative data on waste
generated in (i) a tertiary health care institution; (ii) a major regional institution; (iii) a general
hospital and, (iv) a private clinic. The data include quantity of waste generated per week,
composition and disposal methods. The data was extrapolated to cover other institutions in the
country.

- **Determination of Technology for Medical Waste and Carcass Disposal**

An assessment of existing disposal methods was conducted with a view of recommending
cost-effective technologies for medical waste and carcass disposal.

- **Determination and Analysis of Disposal Sites**

Existing carcass disposal facilities were assessed with respect to (a) site accessibility, (b)
distance from health care facilities; (c) distance from the source of infected carcasses; (d)
distance to sensitive areas; (e) future development plans of the area; (f) possibility to acquire
the area (g) cultural and historical sites; (h) public opinion; (i) noise and dust impact to nearby
communities.

- **Monitoring and Evaluation**

A monitoring and evaluation plan was developed to ensure that project operational controls
and mitigation measures conform to planned arrangements and are properly implemented.
The monitoring plan followed FMEnv’s and World Bank’s *Environmental Performance
Monitoring and Supervision* guidelines (World Bank, Environmental Assessment Sourcebook
Update No. 14, June 1996).

- **Training and Capacity Building**

An intensive training and capacity building program was developed for the implementing
agencies based on gaps identified. This will enable stakeholders to integrate environmental
and social issues into project implementation.

- **Public Awareness and Consultation**

Existing public awareness/sensitization programmes regarding proper management and
disposal of medical wastes at the different health care institutions visited were reviewed. A
public awareness plan was developed to enhance interaction with the general public. This
will help reduce the negative health and social impacts of medical waste management.
Chapter 3.0: Policy, Legal and Institutional Framework

A number of national and international environmental guidelines are applicable to the development of the NMWMP. In Nigeria, the power to enforce activities that might impact the environment is vested in the Federal Ministry of Environment (FMEnv). Internationally, agencies such as the World Bank and other development partners usually set environmental criteria for projects they intend to finance.

3.1 National Policies

*The National Health Policy (NHP) (1988)*

The policy is aimed at providing comprehensive health care to every Nigerian through:

- adequate health education concerning prevailing health problems and the methods of preventing and controlling them;
- promotion of proper nutrition, family planning etc;
- immunization against the major infectious diseases e.g. measles, meningitis etc;
- prevention and control of locally endemic (lesser) and epidemic (widespread) diseases; and
- provision of essential drugs and supplies.

The policy gives appropriate direction to the health care providers in both public and private sectors with a view to achieving the goal of ‘health for all’ using the ‘primary health care’ approach as its main strategy.


The National Policy on the Environment aims to achieve sustainable development in Nigeria, and in particular to:

- secure a quality of environment adequate for good health and well being;
- conserve and use the environment and natural resources for the benefit of present and future generations;
- restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- raise public awareness and promote understanding of the essential linkages between the environment, resources and development, and encourage individuals and communities participation in environmental improvement efforts; and
- co-operate with other countries, international organizations and agencies to achieve optimal use of trans-boundary natural resources and effective prevention or abatement of trans-boundary environmental degradation.

3.2 Legislations

*Environmental Protection Agency Decree No 58 (1988)*

The Federal Environmental Protection Agency (FEPA) was established by Decree No. 58 of 1988 and charged with the responsibility for environmental protection. Following the upgrading of the agency to a Federal Ministry of Environment (FMEnv) in 1999, the Ministry was mandated to coordinate environmental protection and natural resources conservation for sustainable development. The present structure of the ministry is presented in Figure 3.1.
FMEnv has developed statutory documents to aid in the monitoring, control and abatement of industrial waste. These guidelines stipulate standards for industrial effluent, gaseous emissions and hazardous wastes. Table 3.1 summarizes the existing regulations applicable to environmental protection while Table 3.2 presents a list of proposed legislations.

**Table 3.1: Existing National Environmental Protection Regulations**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Regulations</th>
<th>Year</th>
<th>Provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>National Environmental Protection (Effluent Limitation) Regulations</td>
<td>1991</td>
<td>The regulation makes it mandatory for industrial facilities to install anti-pollution equipment, makes provision for effluent treatment and prescribes a maximum limit of effluent parameters allowed.</td>
</tr>
<tr>
<td>2</td>
<td>National Environmental Protection (Pollution and Abatement in Industries in Facilities Producing Waste) Regulations</td>
<td>1991</td>
<td>Imposes restrictions on the release of toxic substances and stipulates requirements for monitoring of pollution. It also makes it mandatory for existing industries and facilities to conduct periodic environmental audits.</td>
</tr>
<tr>
<td>3</td>
<td>National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations</td>
<td>1991</td>
<td>Regulates the collections, treatment and disposal of solid and hazardous wastes from municipal and industrial sources.</td>
</tr>
<tr>
<td>4</td>
<td>Harmful Wastes (Special Criminal Provisions etc) Decree No. 42</td>
<td>1988</td>
<td>Provides the legal framework for the effective control of the disposal of toxic and hazardous waste into any environment within the confines of Nigeria</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Impact Assessment Act (Decree No. 86).</td>
<td>1992</td>
<td>The decree makes it mandatory for an EIA to be carried out prior to any industrial project development</td>
</tr>
<tr>
<td>6</td>
<td>National Guideline and Standard for Environmental Pollution Control</td>
<td>1991</td>
<td>The regulations provide guidelines for management of pollution control measures.</td>
</tr>
<tr>
<td>7</td>
<td>Workmen Compensation Act</td>
<td>1987</td>
<td>Occupational health and safety</td>
</tr>
<tr>
<td>8</td>
<td>Urban and Regional Planning Decree No 88</td>
<td>1992</td>
<td>Planned development of urban areas (to include and manage waste sites)</td>
</tr>
<tr>
<td>9</td>
<td>Environmental Sanitation edicts, laws and enforcement agencies</td>
<td></td>
<td>General environmental health and sanitation. Enforcing necessary laws</td>
</tr>
<tr>
<td>10</td>
<td>State waste management laws</td>
<td></td>
<td>Ensure proper disposal and clearing of wastes</td>
</tr>
<tr>
<td>11</td>
<td>Public Health Law</td>
<td></td>
<td>Covering public health matters</td>
</tr>
</tbody>
</table>

**Table 3.2: List of Proposed Environmental Legislation**
Presently, there are no specific legislation to regulate the management of medical waste in Nigeria, although there are laws and regulations pertaining to the environmental and health protection. Hence, control and handling has remained a major challenge to the healthcare and waste management authorities. This is principally due to:

- lack of a national environmental health policy and regulations;
- inadequate legal instruments;
- inadequate or non-existent technical capacities

**National Air Quality Standard**

The World Health Organization (WHO) air quality standards were adopted by the FMEnv in 1991 as the national standards. These standards define the levels of air pollutants that should not be exceeded in order to protect public health.

<table>
<thead>
<tr>
<th>Air Pollutants</th>
<th>Emission Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulates</td>
<td>250 (ug/m3)</td>
</tr>
<tr>
<td>SO₂</td>
<td>0.1 (ppm)</td>
</tr>
<tr>
<td>Non-methane Hydrocarbon</td>
<td>160 (ug/m3)</td>
</tr>
<tr>
<td>CO</td>
<td>11 (ug/m3) or 10 (ppm)</td>
</tr>
<tr>
<td>NO₅</td>
<td>0.04-0.06 (ppm)</td>
</tr>
<tr>
<td>Photochemical Oxidant</td>
<td>0.06 (ppm)</td>
</tr>
</tbody>
</table>

**Animal Disease Control Act (1988)**

The act provides for the control and prevention of animal diseases, with the purpose of preventing the introduction and spread of infectious and contagious diseases among animals, hatcheries and poultries in Nigeria.

**Anatomy Act (1990)**

This act gives the minister of health the authority to grant license to medical practitioners to practice anatomy. It also makes a provision that all remains from an anatomical examination be decently interred in a public burial ground.

**Land Use Act (1978)**

This act provides a legal basis for land acquisition in Nigeria. The major provisions include:

- Section 1: all land comprised in the territory of each state in the Federation is hereby vested in the Governor of the state and such land shall be held in trust and administered for the use and common benefit of all.

- Section 2: (a) all land in urban areas shall be under the control and management of the Governor of each State; and (d) all other land shall be under the control and management of the local government within the area of jurisdiction in which the land is situated.
State Governments have the right to grant statutory rights of occupancy to any person for any purpose; and the Local Government has the right to grant customary rights of occupancy to any person or organization for agricultural, residential and other purposes.

**Workmen Compensation Act (1987)**

The law provides for the payment of compensation to employees for injuries suffered in the course of their employment.

**Factories Act (1987)**

This act makes general and special provision for the health, safety and welfare of persons employed in a factory. It makes provisions for the protection of employees from hazardous and harmful wastes. It also stipulates the minimum measures to be adopted by employers to safeguard occupational health and safety.

### 3.3 Assessment of the Legal Framework

The existing legal framework for environmental assessment in Nigeria is considered adequate. Detailed laws, regulations and guidelines have been developed and serve as the framework for Environmental protection. The implementation has been poor due to poor enforcement.

**EIA Act**

The Act does not encourage the participation of people whose lives are likely to be affected by a project; rather, it encourages the collection and documentation of technical information which is confusing to most people.

**Environmental Policy**

The policy and its laudable institutional arrangements have not yielded the desired results. This is principally due to weak enforcement; inadequate manpower in the area of integrated environment management; insufficient political will; inadequate and mismanaged funding; low degree of public awareness of environmental issues; and a top–down approach to the planning and implementation of environmental programmes.

**Environmental Health Regulations**

There is a need for the government to promulgate a Public Health Act to regulate and implement the promotion, prevention and maintenance of public and environmental health. The Act should provide guidelines on safe handling and disposal of medical waste with a view to minimise the spread of infections diseases e.g. HIV/AIDS, Hepatitis etc and reduce the risk of accidental injury to staff, patients, visitors and the local community.

### 3.4 World Bank Policy

The World Bank requires that a full EA be conducted for all projects that fall within certain categories (A,B,C) to ensure that operational activities during project execution are socially and environmentally sustainable, that all potentially negative impacts are adequately mitigated, and that affected people have been duly consulted.

The Nigerian AI project is assigned Bank category B status and it triggered the Environmental Assessment Safeguard Policy (BP/OP 4.01). The EA policy is described below.

**Environmental Assessment BP/OP 4.01**

This policy is triggered by any project that is likely to have potential adverse environmental impacts in its area of influence. The policy covers the natural environment; physical, cultural resources and human health and safety. A project that triggers this policy is classified as category A, B, C according to the nature and magnitude of potential environmental impacts.
Category B projects imply that environmental impacts are largely site-specific, that few if any of the impacts are irreversible, and that mitigation measures can be designed relatively readily. The environmental assessment for this category needs to:
- examine the project’s potential negative and positive environmental impacts,
- recommend measures to prevent, minimize, mitigate, or compensate for adverse impacts, and
- recommend environmental enhancement measures.

### 3.5 International Environmental Agreements

#### Basel Convention on the control of hazardous wastes and their disposal

This agreement aims to address the problems and challenges posed by hazardous waste. The key objectives of the convention are to:
- minimize the generation of hazardous wastes; and
- reduce the movement of hazardous wastes by disposing of them as close as possible to the source.

The convention aims to protect human health and the environment by minimizing hazardous waste production whenever possible through ESM (Environmentally Sound Management), which controls the generation, storage, transport, treatment, reuse, recycling, recovery and disposal of a hazardous waste. Medical wastes are one of the categories of hazardous wastes covered by the Convention (Annexes I, II, III).

#### Stockholm Convention on Persistent Organic Pollutants

This treaty aims to protect human health and the environment from persistent organic pollutants (POPs). POPs are chemicals that remain in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife.

#### Bonn Convention on conservation of Migratory Species

The Convention aims to conserve terrestrial, marine and avian migratory species throughout their range.

Nigeria is also a signatory to the following relevant international conventions:
- The Convention Concerning the Protection of the World Cultural and Natural Heritage, The World Heritage Convention, 1972;
- The Framework Convention on Climate Change, Kyoto Protocol, 1995;
- The Convention on Biological Diversity, 1992;

### 3.6 Safeguard Principles

Safeguard principles seek to avoid, minimize or mitigate adverse environmental impacts, social costs to third parties, or marginalization. Some principles of international environmental law developed to guide damage to the environment include:
- Precautionary Principle: there is need to take precautions when the risk involved in waste cannot be ascertained.
- Polluter Pays Principle: a polluter is liable to bear the cost of damage imposed on the environment by waste he generated
- Duty of Care Principle: a producer of waste is responsible for waste handling, transportation and disposal.
- Proximity Principle: Hazardous waste should be disposed off as close as possible to the source of generation to reduce risks involved in transportation.

3.7 Institutional Framework

There is an urgent need to strengthen institutional capacities for environmental health management in Nigeria. This would enlighten, educate and raise awareness on medical waste management. The following institutions and agencies are responsible for regulating and monitoring human and animal health, information and waste management standards in Nigeria:

i. Federal Ministry of Health
ii. Federal Ministry of Environment
iii. State Environmental Protection Agency
iv. Federal Ministry of Information
v. Federal Ministry of Agriculture and Rural Development

Federal Ministry of Health (FMOH)

The FMOH has responsibility to manage health services for the prevention and control of communicable and non-communicable diseases. Under the implementation of this plan, the FMOH will:

- Coordinate the efforts of state, local government and private health care providers and development partners to ensure effective implementation
- Ensure the provision of adequate equipment in tertiary and specialized hospital services
- Provide technical assistance to state ministries of health in the development of plans, technical materials, policies and standards to properly perform their functions
- Issue and promote adherence to norms and standards, and provide guidelines on health matters, and any other matter that affects public health, promoting adherence to norms and standards for the training of human resources for health.
- Supervise the provision of health services for the management, prevention and control of communicable and non-communicable diseases e.g. AI, HIV/AIDS.

Federal Ministry of Environment (FMEnv)

The Federal Ministry of Environment (FMEnv) has responsibility to administrate and enforce environmental laws in Nigeria. The specific responsibilities of the ministry include:

- Monitoring and enforcing environmental protection measures;
- Enforcing international laws, conventions, protocols and treaties on the environment
- Prescribing standards for and making regulations on air quality, water quality, pollution and effluent limitations, atmosphere and ozone protection, control of toxic and hazardous substances; and
- Promoting cooperation with similar bodies in other countries and international agencies connected with environmental protection.

State Environmental Protection Agency (SEPA)

Each state within Nigeria is empowered to make laws for the protection of its own environment, within its jurisdiction. SEPAAs are responsible for the assessment of all public or private projects activities within the states. The roles of SEPAAs in this project include:

- Conducting public enlightenment on environmental sanitation and management;
- Co-operating with the Federal and Local Governments, Statutory bodies and Research Agencies on matters relating to the project;
- Pollution control and environmental health in the states;
- Collaborating with FMEnv and other agencies to achieve effective prevention of abatement of trans-boundary movement of waste;

**Federal Ministry of Information (FMOI)**

Generally the FMOI is responsible for disseminating information to promote national unity and attainment of the socio-economics and political objectives of the FGN. The ministry chairs the AICP Publicity committee, whose major role is to sensitize and disseminate essential and vital information to the public on AI status and safe medical waste management.

**Federal Ministry of Agriculture and Rural Development (FMARD)**

The FMARD is responsible for promoting agriculture and rural development and managing agriculture related natural resources. The ministry is responsible for the implementation of the animal health component of the AICP.

**National Fadama II Development Office (NFDO)**

Currently the AICP Animal Health component is housed at the Fadama II project office. This transitional arrangement will cease as soon as the substantive project office under the FMARD is established. NFDO is the implementing agency of the International Development Association (IDA) funded FADAMA II and FADAMA II GEF Projects.

**National Health Systems Development Project (NHSDP) Office**

The AICP Human Health component including the implementation of this plan is presently operating under the National Health System Development Project (NHSDP) Office. This arrangement will cease when the substantive project office is created. NHSDPO is the implementing agency of the IDA-funded NHSDP II.

### 3.8 Implementation Arrangement

The implementation of the NMWMP requires effective non-competing collaboration between the Federal Ministries of Health, Agriculture, and Environment. Other stakeholders whose active involvements are required include the private sector, NGOs, funding agencies, regulatory bodies, industry associations (e.g. Nigerian Medical Association) and training institutions. To avoid competition and duplication of effort, it is necessary to establish a partnership framework to determine the roles and responsibilities of each stakeholder. The proposed roles and responsibilities of stakeholders are presented in Figure 3.2.

However, in the case of a full AI outbreak in Nigeria, the following command structure should be adhered to for the implementation the medical and carcass waste management within the AICP framework. The minister of health has overall responsibility through NISCAI.
Figure 3.2: Proposed MWMP Implementation Arrangement

Figures 3.3 present the command structure for the health sector response in areas with outbreak of AI epidemics.

Figure 3.3: The AICP Implementation Arrangement

The roles and responsibilities of the different stakeholders in the implementation of the plan are detailed below.

**Federal Ministry of Health**
- Co-ordinating medical waste management at states and LGAs
- Establishing medical waste management unit (MWMU) to coordinate medical waste management
- Coordinating budgetary allocation for MWMP in all programme where MWMP is implemented
- Coordinating implementation of the policy and future evaluation of the policy with respect to the national health policy
- Enforcing law and regulation in MWMP
**National Inter-Ministerial Committee on Medical Waste (NICMW)**

It shall be composed of representatives from federal ministries of health and environment involved in HCW activities. Its duties shall include:

- Evaluating Medical Waste Management
- Locating and mobilising financial resources for MWM
- Reviewing the policy in collaboration with the FMOH
- Guiding collaboration of MWM unit in FMOH with other stakeholders
- Receiving reports from FMOH and other agencies on medical waste generation
- Review indicators for monitoring impact
- Approving technologies for MWM

**State Medical Waste Management Committee (SMWMC)**

The SMWMC shall coordinate MWM at the states level in conjunction with the NICMW and FMOH management committee. Its duties shall include:

- Allocation of financial and human resources to MWM
- Budget for MWM annually
- Supervising of injection safety practices in the state public and private hospitals.
- Establishing an MWM information and reporting system
- Collecting all information on MWM including medical waste related injuries and contamination reported from health facilities to create a state database.
- Establishing measures to penalize HCF that fail to implement MWM guidelines

**Healthcare Facilities Medical Waste Management Committee**

Individual hospitals shall establish a MWM committee, whose duties shall include:

- Mobilising financial resources through income generating activities like user fee.
- Mobilising the local communities to support MWM.
- Developing information system for feedback from the community.
- Promoting the role of the community in MWM.
- Establishing auditing system for MWM.
- Integrating health care waste management with injection safety.
- Recording all injuries and contamination due to medical waste exposure/ contact.
- Establishing a MWM information and reporting system
- Establishing a disciplining system for misconduct in MWM.
- Establishing a data base for MWM
- Training all auxiliary staff in MWM before starting their work

**Communities**

- Recording the presence of infectious waste and sharps in the community.
- Identifying the source of the waste containing infectious waste and sharps
- Reporting the presence of infectious wastes and sharps to SMOH/SEPAs.
- Encouraging public awareness in MWM in the State.

**Local Governments**

- Collaborating with the SMOH/SEPAs to ensure implementation of NMWMP
- Providing financial support for MWM

**Federal Ministry of Environment**

- Monitoring environmental impact of medical waste pollution
- Recording all medical waste pollution
- Participating in public sensitisation of MWM
- Establishing standards for medical waste pollution to environmental degradation
**Industry Associations (e.g. Nigeria Medical Association)**

- Collaborating with the FMOH, FMEnv, SMOHs and SEPAs
- Incorporating MWM in their routine inspections of health facilities
- Facilitating curriculum development in MWM for health institutions
- Enforcing law and regulation in MWM practices

**Health Training Institutions (Teaching Hospitals and Nursing Schools)**

- Developing MWM curriculum in collaboration with FMOH and FMEnv
- Incorporating MWM curriculum in their curricula
- Assisting in development of curriculum for in-service and public awareness
- Training their student in MWM
- Assisting in in-service training and community awareness.
- Carrying out research in MWM

**Non-Governmental Organisations**

- Mobilising financial resources for MWM
- Carrying out in-service training and public awareness training
- Harmonising and validating MWM procedure

### 3.8 Permitting

Environmental permits are granted by the FMEnv and are applicable to specific tasks and/or operations. For sustainable operations of a waste disposal facility, the required permits are provided for in the National Environmental Protection (Pollution Abatement in Industries Generating Wastes) Regulation S.1.9. Permits are required for the following activities:

- Storage, treatment and transportation of harmful toxic waste;
- Discharge of effluents with constituents beyond permissible limits into public drains, rivers, lakes, sea, or soil;
- Discharge of oil in any form into public drains, rivers, lakes, sea, or soil; and
- Construction of a facility with a new point source of pollution or a new process line with a new point source. Such facility shall apply to the agency for a discharge permit.

The lists of Environmental Permits required with regard for the construction and operation of medical waste and carcass disposal facilities are listed in Table 3.4.

**Table 3.4: Environmental Permits required for Operating Waste Management Facilities**

<table>
<thead>
<tr>
<th>Permit</th>
<th>Lead Agency</th>
<th>Duration to obtain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact Statement (EIS) Certificate</td>
<td>FMEnv/SEPAs</td>
<td>6 months</td>
</tr>
<tr>
<td>Environmental Impact Assessment</td>
<td>Town Planning</td>
<td>6 months</td>
</tr>
<tr>
<td>Building Approval</td>
<td>State Governments</td>
<td>3 months</td>
</tr>
<tr>
<td>Building Plans Permit</td>
<td>Local Planning Authority</td>
<td>3 months</td>
</tr>
<tr>
<td>Disposal Site License</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Effluent Waste Discharge</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Industrial Waste Disposal</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Hazardous/Toxic Wastes Disposal</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Waste Storage/Treatment</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Land fill Site Operation</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Air Emission</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Wastewater Treatment</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Solid waste generation/disposal</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Land fill site operation</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
<tr>
<td>Waste Incinerator Permit</td>
<td>FMEnv</td>
<td>6 months</td>
</tr>
</tbody>
</table>
3.8.1 Permitting Procedure

Complying with environmental permits is an essential for operating waste management facilities. The permits must be in place prior to commencement of operations.

The following procedure is required for the process of permit issuance:

- Pre-application activities: understanding the general contents of the application.
- Preparation and submission of application - following standard guidance and form.
- Initial check of application by the regulatory authority - to ensure that the application conforms to the legal requirements.
- Consultation of the permitting authority with other stakeholders to gather facts and opinions that would contribute to the assessment of the application.
- Assessment of the application and determination of permit conditions, using technical guidance and requirements of relevant legislation.

Issuance or refusals of a permit is subject to relevant administrative and legislative considerations. The required timeframe for the issuance of permits should be within 12-24 months including environmental assessments. Figure 3.4 provides a typical schedule of processes and the required duration.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Permitting Steps</th>
<th>Responsibility</th>
<th>Duration</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contact FMEnv for consultation and assistance.</td>
<td>Proponent</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Identify required permits/Guidance</td>
<td>SEPAx/FMEnv</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Obtain the required forms from FMEnv</td>
<td>Proponent</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Fill out the required forms</td>
<td>Proponent</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Provide required documentations</td>
<td>Proponent</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Return all the completed forms</td>
<td>Proponent</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Document Review &amp; Processes Evaluation</td>
<td>SEPAx/FMEnv</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Site Visit</td>
<td>SEPAx/FMEnv</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Issue Permits</td>
<td>SEPAx/FMEnv</td>
<td>1 week</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Environmental Impact Assessment</td>
<td>Proponent</td>
<td>20 weeks</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Public Consultation</td>
<td>Proponent/FMEnv</td>
<td>3 Weeks</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 3.4: Proposed Permitting Steps and Schedule

3.8.2 Public Participation:

- **Environmental Assessments Process**

FMEnv has a standard procedure in place for public participation as part of environmental assessment on any developmental project. The proponent will present a proposal to the FMEnv which will be subsequently subjected to a review process.

The general public is usually invited by FMEnv to participate in the review process through invitations placed, at Local Government Council notice boards, the FMEnv secretariat and notices placed in newspapers. The details of the project are displayed for a period of 21 days, within which any objection is expected to be raised. Upon completion of the review process, a final report shall be submitted to the FMEnv within 6 months of receiving the ministries comments. FMEnv shall issue an EIS certificate for the EIA Report.

- **Others**

No other permit requires public consultation.

3.8.3 Costs required for obtaining and maintaining permits

These permits are usually valid for one year. A waste treatment and disposal facility operator must comply with the permits limitations for renewals to be granted. The cost of the renewals for all permits is within the range N300,000 – N450,000 per year.
Chapter 4.0: Baseline Data

4.1 General Description and Location

Nigeria is situated in the western portion of Africa, and lies between latitudes 4°00’ N and 14°00’ N, and longitudes 2°50’ E and 14°45’ E. Nigeria is bordered by Chad to the northeast, Cameroon to the east, Benin Republic to the west, Niger to the northwest and the Atlantic Ocean to the south. The country’s total area is 923,768 sq km, of which 910,768 sq km is land and 13,000 sq km is water.

Nigeria was created by the merging of the northern and southern protectorate by the British Colonial Government in 1914. The country gained independence on October 1st, 1960 and was declared a republic in 1963. The country is divided into 36 states and a federal territory.

4.2 Description of the Environment

The main characteristics of the biological, physical and socio-economic environment of the project area are summarized below.

4.2.1 Physical Environment

Climate

Nigeria’s climate varies from arid in the north, to tropical in the centre and equatorial in the south. The climate is largely controlled by prevailing winds and nearness to the Atlantic Ocean. The two dominant air masses are the dry wind from the Sahara and the wet wind from the Atlantic Ocean. Marginal alterations have been recorded due to landform characteristics, configuration of surrounding shoreline and the generally flat topography of the country.
Rainfall

Rainfall is the single most important element for defining the climatic seasons in the tropics. Hence, Nigeria has two dominant seasons; the wet and the dry seasons. Rainfall throughout Nigeria depends on the interaction of the tropical maritime air mass and the tropical continental mass which meet along the inter-tropical convergence zone (ITCZ). The annual average rainfall around the country is between 750mm and 3000mm.

Temperature

Nigeria’s climate is characterized by relatively high temperatures throughout the year. The average annual maximum varies from 35°C in the north to 31°C in the south; the average annual minimum from 23°C in the south to 18°C in the north. On the Jos plateau and the eastern highlands altitude makes for relatively lower temperatures, with the maximum no more than 28°C and the minimum sometimes as low as 4°C.

Wind

Two principal wind currents affect Nigeria. The south-westerlies dominate the rainy season of the year while north-easterlies dominate the dry season. Depending on the shifts in the pressure belts in the Gulf of Guinea, these winds are interspersed respectively by south-easterlies and north-westerlies in different parts of the year. The wetter winds prevail for more than 70% due to the strong influence of the breeze from the Atlantic Ocean.

Mean annual wind speed varies between 2 to 6 m/s. Speeds in dry season (November - March) are lower. In the wet season (April–October), daily average speed could rise to 15 m/s. Values of up to 25 m/s are sometimes experienced due to inducement by convective rainfall activities and relative diffusion.

Ambient Air Quality

The quality of air in some parts of the country is within the National Ambient Air Quality Standards (NAAQS). However, air quality in major industrialized cities (Lagos, Port Harcourt, Aba, Kaduna, Kano, and Ibadan) are relatively high. Nigeria adopted the WHO standards as the national standards for air emissions against which air quality parameters monitored are compared in order to ascertain its “cleanliness”.

Geology

Nigeria lies on the southern portion of the West African Craton. The geological setting comprises broadly crystalline basement complex rocks and sedimentary formations. They occur in equal proportions around the country. The former are highly mineralized and give rise to soils of high nutrient status, although variable from place to place. The latter are found in the south-east, north-east and north-west of the country, and give rise to sandy and less variable soils that are deficient in plant nutrient.

Topography

Nigeria has varying landforms and much of the country is dominated by plains, generally less than 610m above sea level. The eastern border with the Republic of Cameroun is lined by an almost continuous range of mountains which rise to about 2,419m at Chappal Waddi, the highest known point in Nigeria.

In the North, the Jos Plateau rises abruptly from a general level of about 609.5m in the Hausa Plains to an average level of some 1,219m but reaches 1,781.6m in Shere Hills. The area west of the River Niger is dominated by the plain, which rises gently from the coast northwards to the area of crystalline rocks where inselbergs rise abruptly above the surrounding plains. The Idanre Hills, the highest point of these inselbergs, rises to about 981m above sea level.
In general, the land surface of the country could be classified into three broad physical units or major relief features namely: the plains; the highlands; the troughs and the river valleys.

**Soils Characteristics**

The broad pattern of soil distribution in the country reflects both the climatic conditions and the geological structure; heavily leached, reddish-brown, sandy soils are found in the south, and light or moderately leached, yellowish-brown, sandy soils in the north. The difference in colour relates to the extent of leaching the soil has undergone.

Nigeria soils are highly weathered and are characterized by light texture, low pH, low organic matter, low potassium levels, variable phosphorous levels with clay contents ranging between 7%-43%.

**Surface and Ground Water Hydrology**

Nigeria has two major rivers, the Niger and the Benue, which traverse the northwest and northeast portion of the country, then merge at Lokoja before draining down to the Atlantic. There are several other rivers and quite a number of minor streams and rivulets that crisscross the entire Nigerian land mass. These include the Ogun, Oshun, Imo, Cross, Osse, Nun and the Anambra rivers in the south and the Kaduna, the Gongola, Katsina-Ala and the Hadeija in the North.

Generally the water quality in the rivers of Nigeria is very good. The average electrical conductivity in the main rivers ranges between 48-65 Umhos/cm² and the total dissolved solids (TDS) concentration is about 100mg/l. The pH is less than 6.5, although higher values were reported in swamps and floodplains with levels of 100-150 Umhos/cm². These rivers are also low in nutrients, with an average nitrogen content of 0.32mg/l and a total phosphorous content of 0.1 mg/l. The data indicate water of high quality according to FEPA limits.

**4.2.2 Biological Environment**

**Fauna**

Animals found in both forest and savannas include leopards, cats, monkeys, gorillas, and wild pigs. Today these animals can be found only in protected places as the Yankari Park, Gashaka Gumti Park, and Cross River Park. Rodents such as the squirrel, porcupine, and cane rat constitute the largest family of mammals. The northern savannah abounds in guinea fowl. Other common birds include quail, vultures, kites, bustards, and gray parrots. The rivers contain crocodiles and a great variety of marine life.

In the rain forest, few large animals notably gorillas, chimpanzees, baboons and monkeys are present. Crocodiles, lizards, and snakes of many species are also present. Hippopotamuses, elephants, giraffes, leopards, and lions now remain only in scattered localities and in diminishing number. Wildeats, however, are more common and widely distributed. Wildlife in the savanna includes antelope, lions, leopards, gazelles, and desert hyenas. Nigeria also abounds in bird life with a great number of species being represented.

**Flora**

Vegetation varies dramatically in relation to climate, soil, elevation, and human impact on the environment. In the low-lying coastal region, mangroves line the brackish lagoons and creeks, while swamp forest grows where the water is fresh. Farther inland, this vegetation gives way to tropical forest, with its many species of tropical hardwoods, including mahogany, iroko, and obeche.

North of the forest is the Guinea Savanna, a region of tall grasses and trees. The southern margin of the Guinea Savanna has been so altered by humans that it is also called the derived savanna. Beyond the Guinea savanna lies the Sudan Savanna, a region of shorter grasses and more scattered, drought-resistant trees such as the baobab, tamarind, and acacia. In the northeastern corner of Nigeria, the very dry semi-desert Sahel Savanna persists.
4.2.3 Socio-Economics

Demographics

Nigeria is the most populous country in Africa and ninth most populous country in the world. According to the 1991 census, the country’s population was 88.5 million; with an average population density of 96 persons per sq km.

Table 4.1: Demographic Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population (000s)</td>
<td>96,154</td>
<td>111,721</td>
<td>128,786</td>
<td>147,610</td>
<td>168,369</td>
<td>190,922</td>
</tr>
<tr>
<td>Urbanization level (%)</td>
<td>35.0</td>
<td>39.6</td>
<td>44.0</td>
<td>48.2</td>
<td>52.0</td>
<td>55.4</td>
</tr>
<tr>
<td>Urban population (000s)</td>
<td>33,664</td>
<td>44,184</td>
<td>56,651</td>
<td>71,121</td>
<td>87,557</td>
<td>105,699</td>
</tr>
<tr>
<td>Urban population growth rate (%)</td>
<td>5.53</td>
<td>5.44</td>
<td>4.97</td>
<td>4.55</td>
<td>4.16</td>
<td>3.77</td>
</tr>
<tr>
<td>Rural population growth rate (%)</td>
<td>1.65</td>
<td>1.55</td>
<td>1.32</td>
<td>1.17</td>
<td>1.1</td>
<td>1.06</td>
</tr>
</tbody>
</table>

Source: UN Habitat 2004

The United Nations estimated the population of Nigeria in 2003 to be 124 million, which placed it among the ten most populous nations in the world. The population density in 2002 was 141 per sq km. Regional differences are significant; population is densest in the south and sparsest in the north. According to the UN, the annual population growth rate for 2000–2005 is 2.53%, with the projected population for the year 2015 at 190 million (Table 4.1).

The UN Population Reference Bureau estimated that 44% of Nigerian population lived in urban areas in 2001. The principal cities include Lagos, Kano, Ibadan, Kaduna, and Port Harcourt. The prevalence of AIDS/HIV has had a significant impact on Nigeria’s population growth. In 2001, the United Nations estimated that 5.8% of adults between the ages of 15–49 were living with HIV/AIDS.

Ethnic Groups and Religion

Nigeria is composed of more than 250 ethno-linguistic groups. Three dominant ethnic groups are the Yorubas, the Hausas and the Igbos. The Yoruba predominate in the South West. The Igbo predominate in South East. The Hausa and Fulani constitute the largest single groups in North. Other important groups include the Kanuri; the Edo (Bini); the Ibibio; the Ijaw; the Tiv; and the Nupe.

English is the official language while the vast majority of the population conducts commercial activities in their ethnic language. The literacy level of the population is 57.1% (male: 67.3%, female: 47.3%). Nigerians are predominantly Muslims and Christians with few animists.

Land Use Pattern

The estimated land area of Nigeria is 924,000 km$^2$. Land use varies based on location and the needs of the community. However, the major uses of land revolve around agriculture, industry and social needs such as the provision of infrastructure. Recent data shows that about 60% of the land area of Nigeria is under various forms of food (crop and animal) production and forest plantation.

Land Tenure

The Land Use Decree of 1978 vests all land in the state through the office of the governor. Land is to be held in trust and administered for the use and common benefit of all Nigerians according to the provisions of the Act. By this legal instrument, the state replaced the traditional institutions of obaship and chieftaincy in their roles as keepers of communal land.

Control and management of land in urban areas is the responsibility of the state governor, while all other land (rural, public, etc.) is the responsibility of the Local Government of the area. The governor is empowered to designate certain areas as urban land and to grant statutory rights of occupancy of fixed periods and rights of access to any person, subject to
rental arrangements fixed by and payable to the state. The local government can grant a customary right of occupancy to land in the local government area (LGA) to any person or organization for agriculture, grazing, residential or other purposes.

**Economics**

Nigeria’s economy depends heavily on the oil sector, which contributes 95 percent of export revenues, 76 percent of government revenues, and about a third of gross domestic product (GDP). Despite the country’s relative oil wealth, poverty is widespread - about 37% of the population lives in extreme poverty (World Bank, 2006).

Nigeria’s major industries are located in Lagos, Sango Otta, Port Harcourt, Ibadan, Aba, Onitsha, Calabar, Kano, Jos and Kaduna.

**Facilities**

The main transportation means in Nigeria is the road. Water transportation is fairly developed in some coastal areas. Air transportation is considered fair with major airports in Lagos, Abuja, Port Harcourt, Kano and Kaduna. The railway sector has experienced a major decline in the last decades but efforts are being made to revive it.

Electricity is supplied through the national grid. The power supply is erratic; and government is promoting the development of independent power supply to augment the current inadequate supply.

With regard to educational facilities, Nigeria is reasonably served. There are over 65 universities consisting of federal, state and private owned. High schools in most states are insufficient and are in dilapidated state.

Presently the Federal Government is refurbishing all existing tertiary health institutions nationwide. There is at least 1 primary health care institution in each of the 744 LGAs.

**4.3 Status of Health Care Institutions and Facilities**

In Nigeria, there are more than 22,000 public and private healthcare institutions distributed among the 36 states and the federal capital. These institutions are categorized according to their administrative structure as follows:

**Tertiary Healthcare Institutions**

These are funded by the federal government to provide highly specialized services. They include:
- University Teaching Hospitals/Federal Medical Centres
- State Specialist Hospitals
- Medical Research Institutes/ Veterinary Research Institutes
- Pharmaceutical Research Institutes

**Secondary Healthcare Institutions**

These are funded by the states and provide specialized services to patients referred from the primary health care centres. They include:
- General Hospitals
- Missionary Hospitals
- Large Private Hospitals

**Primary Healthcare Institutions**

These are funded by Local Governments to provide general medical services. They include:
- Health Centres
- Veterinary Clinics
- Smaller private hospitals and clinics
- Health Stations/Traditional Health Clinics

The last national survey of healthcare facilities was conducted in 2002 by the FMOH. The survey provided a list of all the hospitals in the 36 states by local governments. Critical information e.g. number of beds, number of specialist etc were however not captured. In the course of preparing this plan, EnvironQuest conducted a comprehensive survey to inventory all health care facilities in the country, including such data as number of beds, doctors and nurses in each hospital.

The survey indicated that most of the healthcare facilities are in fairly good conditions while some requires rehabilitation. The health profile of the country according to World Bank Statistics (2006) is presented in the Table 4.2 below. The list of healthcare facilities in Nigeria including number of beds, doctors and nurses is provided in Table 4.3. The list is not exhaustive as there may be clinics that were not registered at the time of the field visit.

**Table 4.2: Health profile of Nigeria**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Values</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV prevalence (%)</td>
<td>5</td>
<td>2006</td>
</tr>
<tr>
<td>Incidence of tuberculosis (per 100 000 population)</td>
<td>290.3</td>
<td>2004</td>
</tr>
<tr>
<td>Prevalence of tuberculosis (per 100 000 population)</td>
<td>531.3</td>
<td>2004</td>
</tr>
<tr>
<td>Contraceptive prevalence rate (%)</td>
<td>12.6</td>
<td>2003</td>
</tr>
<tr>
<td>Physicians (number)</td>
<td>34,923</td>
<td>2003</td>
</tr>
<tr>
<td>Physicians (density per 1,000 population)</td>
<td>0.28</td>
<td>2003</td>
</tr>
<tr>
<td>Nurses (number)</td>
<td>210,306</td>
<td>2003</td>
</tr>
<tr>
<td>Nurses (density per 1,000 population)</td>
<td>1.7</td>
<td>2003</td>
</tr>
<tr>
<td>Dentists (number)</td>
<td>2,482</td>
<td>2003</td>
</tr>
<tr>
<td>Dentists (density per 1,000 population)</td>
<td>0.02</td>
<td>2003</td>
</tr>
<tr>
<td>Pharmacists (number)</td>
<td>6,344</td>
<td>2004</td>
</tr>
<tr>
<td>Pharmacists (density per 1,000 population)</td>
<td>0.05</td>
<td>2004</td>
</tr>
<tr>
<td>Community health care (number)</td>
<td>115,761</td>
<td>2004</td>
</tr>
<tr>
<td>Community health care (density per 1,000 population)</td>
<td>0.91</td>
<td>2004</td>
</tr>
<tr>
<td>Total expenditure on health as percentage of gross domestic product</td>
<td>5</td>
<td>2003</td>
</tr>
<tr>
<td>Government expenditure on as percentage of total expenditure on health</td>
<td>3.2</td>
<td>2003</td>
</tr>
</tbody>
</table>


### 4.4 Waste Management Facility

Nigeria has an acute waste management problem and presently does not have any proper disposal facilities. The country uses an open dump system in which sites are often located on the streets and roads. The high level of poverty observed in the country has lead to an increased number of people scavenging recyclable materials from open waste dumps.
<table>
<thead>
<tr>
<th>s/n</th>
<th>State</th>
<th>Tertiary</th>
<th>Secondary</th>
<th>Primary</th>
<th>Private</th>
<th>Public</th>
<th>Total Beds</th>
<th>Doctors</th>
<th>Nurses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abia</td>
<td>2</td>
<td>80</td>
<td>656</td>
<td>473</td>
<td>265</td>
<td>4,420</td>
<td>790</td>
<td>5,530</td>
</tr>
<tr>
<td>2</td>
<td>Abuja</td>
<td>2</td>
<td>17</td>
<td>243</td>
<td>225</td>
<td>37</td>
<td>3,540</td>
<td>298</td>
<td>2,280</td>
</tr>
<tr>
<td>3</td>
<td>Adamawa</td>
<td>1</td>
<td>12</td>
<td>650</td>
<td>51</td>
<td>612</td>
<td>4,680</td>
<td>568</td>
<td>3,976</td>
</tr>
<tr>
<td>4</td>
<td>Akwa Ibom</td>
<td>2</td>
<td>188</td>
<td>345</td>
<td>151</td>
<td>384</td>
<td>4,980</td>
<td>482</td>
<td>2,422</td>
</tr>
<tr>
<td>5</td>
<td>Anambra</td>
<td>1</td>
<td>576</td>
<td>282</td>
<td>661</td>
<td>198</td>
<td>5,896</td>
<td>1,021</td>
<td>7,147</td>
</tr>
<tr>
<td>6</td>
<td>Bauchi</td>
<td>1</td>
<td>21</td>
<td>1063</td>
<td>120</td>
<td>965</td>
<td>5,059</td>
<td>328</td>
<td>3,982</td>
</tr>
<tr>
<td>7</td>
<td>Bayelsa</td>
<td>1</td>
<td>15</td>
<td>151</td>
<td>6</td>
<td>161</td>
<td>3,210</td>
<td>372</td>
<td>2,548</td>
</tr>
<tr>
<td>8</td>
<td>Benue</td>
<td>2</td>
<td>102</td>
<td>1,228</td>
<td>534</td>
<td>798</td>
<td>4,185</td>
<td>586</td>
<td>4,488</td>
</tr>
<tr>
<td>9</td>
<td>Borno</td>
<td>2</td>
<td>38</td>
<td>440</td>
<td>44</td>
<td>436</td>
<td>6,655</td>
<td>368</td>
<td>3,738</td>
</tr>
<tr>
<td>10</td>
<td>Cross River</td>
<td>2</td>
<td>51</td>
<td>488</td>
<td>117</td>
<td>424</td>
<td>6,980</td>
<td>640</td>
<td>4,480</td>
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<td>127</td>
<td>560</td>
<td>276</td>
<td>413</td>
<td>6,400</td>
<td>580</td>
<td>4,980</td>
</tr>
<tr>
<td>13</td>
<td>Edo</td>
<td>3</td>
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<td>385</td>
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<td>Enugu</td>
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<td>200</td>
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<td>866</td>
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<td>297</td>
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<td>6,845</td>
<td>268</td>
<td>2,420</td>
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<tr>
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<td>Imo</td>
<td>2</td>
<td>179</td>
<td>712</td>
<td>667</td>
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<td>6,840</td>
<td>860</td>
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<td>5,826</td>
<td>438</td>
<td>3,820</td>
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<td>19</td>
<td>Kaduna</td>
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<td>15</td>
<td>1,137</td>
<td>333</td>
<td>821</td>
<td>10,280</td>
<td>1,680</td>
<td>7,680</td>
</tr>
<tr>
<td>20</td>
<td>Kano</td>
<td>2</td>
<td>42</td>
<td>604</td>
<td>27</td>
<td>621</td>
<td>12,860</td>
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<td>488</td>
<td>22</td>
<td>490</td>
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<td>680</td>
<td>5,760</td>
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<td>1</td>
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<td>839</td>
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<td>73</td>
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<td>370</td>
<td>8,640</td>
<td>1,340</td>
<td>9,380</td>
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<tr>
<td>25</td>
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<td>1,002</td>
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<td>3,541</td>
<td>23,820</td>
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<td>Nassarawa</td>
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<td>372</td>
<td>338</td>
<td>5,680</td>
<td>438</td>
<td>3,820</td>
</tr>
<tr>
<td>27</td>
<td>Niger</td>
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<td>6,230</td>
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<td>28</td>
<td>Ogun</td>
<td>3</td>
<td>842</td>
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<td>790</td>
<td>492</td>
<td>6,840</td>
<td>1,684</td>
<td>11,760</td>
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<tr>
<td>29</td>
<td>Ondo</td>
<td>1</td>
<td>164</td>
<td>611</td>
<td>290</td>
<td>486</td>
<td>4,845</td>
<td>1,453</td>
<td>10,156</td>
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<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td>37</td>
<td>Total</td>
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<td>---------------</td>
<td>----</td>
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<td>----</td>
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<tr>
<td>Osun</td>
<td>2</td>
<td>164</td>
<td>611</td>
<td>290</td>
<td>487</td>
<td>6,580</td>
<td>832</td>
<td>5,460</td>
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<tr>
<td>Oyo</td>
<td>2</td>
<td>43</td>
<td>1,240</td>
<td>765</td>
<td>520</td>
<td>9,580</td>
<td>1,620</td>
<td>11,340</td>
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<tr>
<td>Plateau</td>
<td>1</td>
<td>38</td>
<td>906</td>
<td>459</td>
<td>486</td>
<td>5,820</td>
<td>1,760</td>
<td>10,846</td>
<td></td>
</tr>
<tr>
<td>Rivers</td>
<td>1</td>
<td>40</td>
<td>631</td>
<td>381</td>
<td>291</td>
<td>9,860</td>
<td>1,842</td>
<td>11,242</td>
<td></td>
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<tr>
<td>Sokoto</td>
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<td>15</td>
<td>385</td>
<td>29</td>
<td>372</td>
<td>5,480</td>
<td>368</td>
<td>3,980</td>
<td></td>
</tr>
<tr>
<td>Taraba</td>
<td>1</td>
<td>3</td>
<td>586</td>
<td>189</td>
<td>401</td>
<td>4,320</td>
<td>540</td>
<td>3,890</td>
<td></td>
</tr>
<tr>
<td>Yobe</td>
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<td>10</td>
<td>253</td>
<td>0</td>
<td>264</td>
<td>2,680</td>
<td>368</td>
<td>3,182</td>
<td></td>
</tr>
<tr>
<td>Zamfara</td>
<td>1</td>
<td>28</td>
<td>300</td>
<td>10</td>
<td>319</td>
<td>3,310</td>
<td>302</td>
<td>2,980</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>58</td>
<td>5,097</td>
<td>22,272</td>
<td>11,356</td>
<td>16,071</td>
<td>243,463</td>
<td>33,853</td>
<td>234,765</td>
<td></td>
</tr>
</tbody>
</table>
Analysis of the above data clearly shows the distribution of health care facilities North East (12%); North West (16%); North Central (20%); South South (11%); South East (14%) and South West (26%). The south west has the largest the proportion of health care facilities in the country. This is mainly due to the large population of Lagos and Ibadan.

An evaluation of the bed capacity data of health care institutions shows the distribution being North East (12%); North West (20%); North Central (16%); South South (18%); South East (13%) and South West (22%). This further implies that the densely populated south-west region has about 53,562 beds compared to 189,901 beds for all the other regions of the country. A total of 73% of private and 36% of public hospitals are in the southern part of the country compared to 27% private and 64% public health care institutions in the northern part of the country. Detailed data for some of the facilities visited are presented in Table 4.4

Table 4.4: Health Care Waste Visited

<table>
<thead>
<tr>
<th>Hospital</th>
<th>State</th>
<th>Total Beds</th>
<th>Occupancy Rate (%)</th>
<th>Doctors</th>
<th>Nurses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagos University Teaching Hospital</td>
<td>Lagos</td>
<td>761</td>
<td>52</td>
<td>500</td>
<td>676</td>
</tr>
<tr>
<td>General Hospital</td>
<td>Lagos</td>
<td>292</td>
<td>80</td>
<td>71</td>
<td>240</td>
</tr>
<tr>
<td>National Orthopaedic Hospital, Lagos</td>
<td>Lagos</td>
<td>500</td>
<td>60</td>
<td>90</td>
<td>330</td>
</tr>
<tr>
<td>St. Nicholas Hospital</td>
<td>Lagos</td>
<td>45</td>
<td>60</td>
<td>16</td>
<td>68</td>
</tr>
<tr>
<td>Island Maternity Hospital</td>
<td>Lagos</td>
<td>145</td>
<td>73</td>
<td>24</td>
<td>149</td>
</tr>
<tr>
<td>University College Hospital</td>
<td>Oyo</td>
<td>960</td>
<td>62</td>
<td>274</td>
<td>1145</td>
</tr>
<tr>
<td>Group Medical Hospital, Ibadan</td>
<td>Oyo</td>
<td>24</td>
<td>25</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Alafia Hospital, Ibadan</td>
<td>Oyo</td>
<td>50</td>
<td>55</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Federal Medical Centre, Abeokuta</td>
<td>Ogun</td>
<td>200</td>
<td>80</td>
<td>139</td>
<td>239</td>
</tr>
<tr>
<td>State Hospital, Abeokuta</td>
<td>Ogun</td>
<td>175</td>
<td>80</td>
<td>41</td>
<td>163</td>
</tr>
<tr>
<td>Primary Health Centre</td>
<td>Lagos</td>
<td>10</td>
<td>55</td>
<td>1</td>
<td>27</td>
</tr>
</tbody>
</table>

The number of beds and percentage distribution per health care institutions in Lagos State is presented in Figure 4.2. In total there are 19,892 hospital beds in 2,686 healthcare institutions. An analysis of this data shows that the private hospitals have 17,147 beds, while government hospitals have 2,745 beds. Further analysis shows that 93.00% of the hospitals have 0-20 beds; 6.5% have beds 20-50 beds; 0.4% has beds in the range 50-150 beds; and 0.0% has 151-200 beds while 0.1% has 200-900 beds. When grouped by ownership, 84% of the hospitals in Lagos State are privately owned while 14% is government owned.

![Figure 4.2: Number of Beds for Hospitals in Lagos State](image_url)
Chapter 5.0: Analysis of Medical Waste Management in Nigeria

An analysis of the current situation was conducted with respect to segregation, collection, transportation, and disposal. Medical wastes including infectious wastes such as; swabs, syringes, blades, gloves are mostly mixed with municipal waste and disposed in open dumps where they are either burnt or left to decay.

Existing waste management facilities differ among hospitals, it consists mostly of:

- Incinerators built with primary and secondary burners, and in some cases, drum incinerators, which do not have air pollution abatement facilities;
- Open ditches;
- Pit latrines and soak-away;
- Transportation of medical waste to off-site disposal sites; and
- Use of public drainage for infectious liquid disposal.

In urban areas, unregulated practices by both public and private hospitals and private waste collectors has resulted in dumping of medical waste (infectious and sharps) at municipal dump sites. Scavenging at these disposal sites poses severe public health risks. Possibilities of infections are very high considering the fact that scavengers do not wear any form of personal protection.

### 5.1 Factors Impacting Existing Practices

- **Poverty Issues**

Most scavengers are driven by abject poverty, which forces them to seek marketable objects from waste dumps. The popular items for salvage include pure water sachets, aluminium materials, latex gloves and polyethylene carrier bags. The gloves are washed and sold to hair care salons where attendants unsuspectingly use the gloves to protect their hands from shampoos and hair dye. The carrier bags are usually recycled.

The potential health risk to the scavengers and their customers constitute great danger to public health. There is an urgent need to implement public awareness and safety measures to inform this group of stakeholders on potential risk associated with medical waste handling and where possible to make scavenging as safe as possible.

Hospitals, SEPAs, SMOHs and LGAs environmental and community development units need to minimize health risk to scavengers by:

- providing secure packaging and storage for waste in transit;
- providing pilfer proof waste transportation vessels at health care facilities and waste disposal sites;
- securing (fencing off) waste disposal sites to prevent both animal and human scavengers from accessing medical waste;
- providing alternative income generation activities to scavengers; and
- making waste reclamation into a hygienic and competitive business free of medical waste.

- **Obsolete Equipment**

Most health care facilities visited carry a large stock of obsolete equipment including x-ray machines; incubators; autoclaves; laboratory equipment; thermometers containing mercury; compressed air cylinders; glass bottles; defunct laundry equipment; electric cooking pots, hospital beds, wheel-chairs, and motor vehicles that litter and take up valuable storage space.

There is need to provide secure bonded rooms at designated locations nationwide from where pre-treated items could be disposed off in a manner posing minimum risks to the population.
5.2 Medical Waste Composition

The average distribution on types of medical waste for purposes of waste management planning according to Pruss, A. (1999) is approximately as follows:

- 80% general domestic waste;
- 15% infectious and biological (or pathological) waste;
- 3% chemical or pharmaceutical waste;
- 1% sharps; and
- Less than 1% special waste, such as radioactive, cytotoxic, photographic wastes, pressurized containers, broken thermometers, used batteries, etc.

The quantity of these wastes generated varies greatly between the different categories and location of health care facilities. Variations in the composition of waste raises serious issues at the local level which require different approaches with respect to necessary medical waste management procedures to be applied in order to achieve sustainability. The variations may be due to several factors among which are differences in health care facility specialization, numbers of qualified health care personnel available, medical waste management practices prevailing as well as recycling and reuse.

Medical waste composition and quantities were assessed in one tertiary, one secondary and one primary health care facility. It was discovered that most institutions do not calculate nor sort waste generated. Table 5.1 provide data for some of the facilities that have a record on composition and quantities of waste.

Table 5.1: Waste Quantities (kg/day) generated at Selected Hospitals

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Lagos University Teaching Hospital (LUTH), Ikeja</th>
<th>University College Hospital (UCH), Ibadan</th>
<th>Federal Medical Centre, Abeokuta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Waste</td>
<td>120</td>
<td>350</td>
<td>125</td>
</tr>
<tr>
<td>Sharps</td>
<td>10</td>
<td>3.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Infectious</td>
<td>15</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Non-Infectious</td>
<td>33</td>
<td>35</td>
<td>13.5</td>
</tr>
</tbody>
</table>

5.3 Medical Waste Handling Practices

Medical waste handling is critical in minimizing healthcare associated risks to human health and the environment. The most significant risk occurs during transportation, this highlights the need for regulations and control measures to control segregation, packaging, labelling, transportation and disposal. This study investigated some activities related to handling of medical waste in health care facilities and the following are the outcome:

Table 5.2: Medical Waste Handling Practice

<table>
<thead>
<tr>
<th>Handling Practices</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segregation of waste by type</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Re-use of medical waste e.g. sharps</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Disposal facilities (incinerator, open pit, pit latrine, etc.)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Scavenging medical waste</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Functional infection control committee</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Medical waste awareness programmes</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 5.2 above shows that some healthcare facilities segregate their waste and most do not, most healthcare institution do not reuse needles and syringes, most dispose of their waste using either incineration or burial, most do not have functional waste management or infection control committee and medical waste management programme. This finding confirms that health workers and especially those handling wastes are exposed to serious risks.
- Segregation of Medical Waste

Segregation of wastes (infectious, non-infectious, sharps, anatomical parts) generated within hospitals helps in identifying the categories of waste and significantly reduces the risk associated with waste handling. At the LUTH and UCH, wastes are segregated into various components. Sharps are systematically stored in separate containers; infectious wastes are stored in yellow coloured containers, anatomical wastes are stored in red coloured containers while other medical wastes are collected together into a variety of labelled waste bins and covered. This practice is however not followed in the other health care institutions visited where all wastes are dumped in the same waste bin.

- Injection Safety

The disposal of sharps is unsatisfactory in many public healthcare facilities. This poses significant risk to patients, health workers and the surrounding communities. Although the reuse of syringes and needles was not recorded in most healthcare facilities visited, this cannot be ruled out in the rural areas. Safe disposal of injection is a major cause of concern with respect to the spread of communicable diseases like hepatitis B and HIV/AIDS.

- Waste Collection

Few hospitals have treatment facilities (about 15%) for the wastes generated; hence most of the facilities transport waste off-site for disposal. Where there are disposal sites, the wastes are not removed on schedule and are not properly transported to the disposal site. At some of the private hospitals visited, collection of waste is limited to once a day when the cleaner comes in the morning to clean the entire facility. Storage and collection was observed to be most organized at general and teaching hospitals.

- Waste Transportation

At some of the facilities visited (LUTH, UCH and General Hospitals), wastes are gathered in bags and cartons and transported off-site in secure trucks. In the rural areas, the wastes are often buried or burnt within the facility. At the St. Nicholas hospital (Lagos), sharps and other wastes are transported to a private landfill for burial while anatomical and pathological wastes are buried at Atan Cemetery.

- Waste Disposal

Current disposal practices varied depending on the category of the facilities, and type of disposal facilities available. All categories of infectious wastes were burnt except placenta and other anatomical wastes that are buried. Most Teaching and General Hospitals in Lagos transport their sharps and other infectious wastes to the National Orthopaedic hospital (NOH) -Igbobi for incineration. The incinerator was installed in 2002 and is properly maintained. At the UCH Ibadan, the incinerator is poorly managed resulting in the emission of particulate matter, and other pollutants (toxic gases, metals) into the air. The incinerator is not adequately secured thereby exposing it to scavenging by birds, dogs and in rare incidences mental patients.

The scenario is different at some of the secondary, primary and private health centres visited. At the private clinics located in the semi-urban and rural areas, there are no significant differences in the way the medical waste and sharps are disposed. All waste are either buried or transported and dumped at the public dumpsite.

5.4 Responsibility for Medical Waste Management

Responsibilities for waste management are not well defined in most healthcare facilities except at the Teaching and General Hospitals. It was observed that there were no adequately trained and competent personnel assigned to waste handling at most institutions. Most institutions do not have an Environmental Health Officers and have delegated this duty to administrative staff.
Medical waste management committees should be constituted in all hospitals and should include:
- chief medical officer,
- head of hospital departments,
- chief pharmacists,
- radiation officer,
- financial controllers,
- senior nursing officer and
- hospital administrator.

Employers have a number of legal responsibilities which include:
- developing and maintaining a safe work environment and safe work practices;
- ensuring that hospital activities complies state and national environmental standards;
- providing staff training and education for the safe handling of waste.

Employees also have responsibilities which include:
- complying with safety instructions and use safe work practices for their own protection and for the protection other staff and the public;
- actively supporting environmental initiatives introduced by the waste management committee;
- comply with the requirements for the handling of chemical substances according to Material Safety Data Sheets (MSDS).

5.5 Medical Waste Generation

Medical waste generation depends on numerous factors such as established waste management methods, type of health-care establishment, hospital specializations, proportion of reusable items employed in health care, and proportion of patients treated on daily basis. The quantities of waste generated in healthcare facilities are calculated based on the number of patient per day. Some facilities have documented records while most do not.

Table 5.3: Medical Waste Generation according to National Income Level

<table>
<thead>
<tr>
<th>National Income Level</th>
<th>Annual Waste Generation (kg/head of population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Income Countries:</td>
<td></td>
</tr>
<tr>
<td>- all medical waste</td>
<td>1.1-12.0</td>
</tr>
<tr>
<td>- hazardous medical waste</td>
<td>0.4-5.5</td>
</tr>
<tr>
<td>Middle-Income Countries:</td>
<td></td>
</tr>
<tr>
<td>- all medical waste</td>
<td>0.8-6.0</td>
</tr>
<tr>
<td>- hazardous medical waste</td>
<td>0.3-0.4</td>
</tr>
<tr>
<td>Low-Income Countries:</td>
<td></td>
</tr>
<tr>
<td>- all medical waste</td>
<td>0.5-3.0</td>
</tr>
<tr>
<td>- hazardous medical waste</td>
<td>0.05-0.15</td>
</tr>
</tbody>
</table>


Table 5.4: Medical Waste Generation according to Healthcare Facilities Size

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Daily Waste Generation (kg/bed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Hospital</td>
<td>4.1-8.7</td>
</tr>
<tr>
<td>General Hospital</td>
<td>2.1-4.2</td>
</tr>
<tr>
<td>State Hospital</td>
<td>0.5-1.8</td>
</tr>
<tr>
<td>Primary Healthcare Centre</td>
<td>0.05-0.2</td>
</tr>
</tbody>
</table>

The national averages (kg/bed day) of waste generated by facility type for medical and general waste calculated from the survey are:

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Medical</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertiary Healthcare Facilities</td>
<td>0.06 – 0.20</td>
<td>0.10 – 0.68</td>
</tr>
<tr>
<td>Secondary Healthcare Facilities</td>
<td>0.05 – 0.30</td>
<td>0.10 – 0.50</td>
</tr>
<tr>
<td>Primary Healthcare Facilities</td>
<td>0.02 – 0.15</td>
<td>0.20 – 0.50</td>
</tr>
</tbody>
</table>

These values are used to estimate the national average based on the number of institutions in each categories.

Table 5.6 shows estimate of waste generation rate in selected tertiary, secondary, primary and private health-care facilities visited during study. LUTH, Idi Araba, LSUTH, Ikeja, NOH, Igbobi and General Hospital, Broad Street are the principal referral hospitals in Lagos, and the waste generated in these institutions represents about 50% of the daily wastes from the State.

5.5.1 National Waste Generation Estimate

Based on the quantity of waste generated in selected tertiary, secondary and primary healthcare facilities, the national estimate of waste generated in Nigeria was calculated based on the number of facilities in each of the three major categories.

Table 5.5: Estimate of Medical Waste Generation

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>No of Facilities</th>
<th>No of Beds/ Facility Type</th>
<th>National Waste Generation (Kg/patient day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medical Waste</td>
</tr>
<tr>
<td>Tertiary</td>
<td>58</td>
<td>18,280</td>
<td>2,559</td>
</tr>
<tr>
<td>Secondary</td>
<td>5,097</td>
<td>86,689</td>
<td>13,870</td>
</tr>
<tr>
<td>Primary</td>
<td>22,272</td>
<td>138,494</td>
<td>11,080</td>
</tr>
<tr>
<td>Total</td>
<td>27,427</td>
<td>243,463</td>
<td>27,509</td>
</tr>
</tbody>
</table>

Table 5.5 shows an estimate of daily national waste generation by all healthcare facilities. An estimated 108,569 kg of combined waste is generated daily nationwide. An analysis of this data shows that 25.34% (27,509 kg) are medical waste, bulk of which is disposed of indiscriminately. This clearly highlights the urgency of the potential environmental and public health risk involved in medical waste management.

There has never been any statistical record about the quantity of medical waste generated by hospitals in Nigeria. Earlier attempts have been fragmented e.g. Ibadan and Abuja Metropolis. Therefore there is no basis of comparison of quantity of medical wastes generated except in these areas. An analysis of data showed that 40% of the wastes were generated by the private hospitals.

A comparison of the percentages of different types of medical waste in Nigeria is given in Figure 5.1. This figure shows that 53% is domestic, 34% is infected and hazardous and 13% is recyclable wastes. These figures indicate that the focus should be the minimization of the infected-hazardous wastes in the implementation of the plan.

Figure 5.1 shows that secondary healthcare facilities generates 45% of the total medical waste produced in Nigeria, this is closely followed by the tertiary healthcare facilities (40%). Primary healthcare facilities generate only 15% of the waste. This distribution is mainly due to the number of beds in the secondary healthcare institutions. Figure 5.2 compare the average total waste (general and medical) waste generated by facility type. The distribution pattern is the same as noted in Figure 5.1.
**Figure 5.1: Medical Waste Generation by Facility Type**

- Primary: 45%
- Secondary: 15%
- Tertiary: 40%

**Figure 5.2: Average Total Waste Generation by Facility Type**

- Primary: 48%
- Secondary: 28%
- Tertiary: 26%
### Table 5.6: Total Waste Generated (Kg/patient/day) in selected hospitals in Nigeria

<table>
<thead>
<tr>
<th>Hospital Name</th>
<th>Location</th>
<th>Category</th>
<th>No. of Beds</th>
<th>Total Waste Generated (Kg/patient day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Health Care Center, Abeokuta</td>
<td>Ogun</td>
<td>Primary</td>
<td>10</td>
<td>0.02 / 0.7 / 0.72</td>
</tr>
<tr>
<td>Primary Health Centre, Ediba, Calabar</td>
<td>Cross Rivers</td>
<td>Primary</td>
<td>12</td>
<td>0.05 / 0.4 / 0.45</td>
</tr>
<tr>
<td>Comprehensive Health Centre, Ibusa</td>
<td>Delta</td>
<td>Primary</td>
<td>8</td>
<td>0.01 / 0.4 / 0.41</td>
</tr>
<tr>
<td>St. Nicholas Hospital, Lagos</td>
<td>Lagos</td>
<td>Secondary</td>
<td>45</td>
<td>0.23 / 0.78 / 1.01</td>
</tr>
<tr>
<td>Lagos Island Maternity Hospital</td>
<td>Lagos</td>
<td>Secondary</td>
<td>145</td>
<td>0.09 / 0.52 / 0.61</td>
</tr>
<tr>
<td>General Hospital – Lagos Island</td>
<td>Lagos</td>
<td>Secondary</td>
<td>292</td>
<td>0.06 / 0.23 / 0.29</td>
</tr>
<tr>
<td>Alafia Hospital, Ibadan</td>
<td>Oyo</td>
<td>Secondary</td>
<td>50</td>
<td>0.06 / 0.96 / 1.02</td>
</tr>
<tr>
<td>Group Medical Hospital, Ibadan</td>
<td>Oyo</td>
<td>Secondary</td>
<td>24</td>
<td>0.69 / 3.21 / 3.9</td>
</tr>
<tr>
<td>State Hospital Abeokuta</td>
<td>Ogun</td>
<td>Secondary</td>
<td>175</td>
<td>0.14 / 0.4 / 0.54</td>
</tr>
<tr>
<td>General Hospital, Minna</td>
<td>Niger</td>
<td>Secondary</td>
<td>236</td>
<td>0.1 / 0.32 / 0.42</td>
</tr>
<tr>
<td>Braithwaite Memorial Gen Hosp, PH</td>
<td>Rivers</td>
<td>Secondary</td>
<td>300</td>
<td>0.05 / 0.21 / 0.26</td>
</tr>
<tr>
<td>Godiya General Hosp., Birnin Kebbi</td>
<td>Kebbi</td>
<td>Secondary</td>
<td>29</td>
<td>0.10 / 0.44 / 0.54</td>
</tr>
<tr>
<td>University College Hospital, Ibadan</td>
<td>Oyo</td>
<td>Tertiary</td>
<td>960</td>
<td>0.04 / 0.37 / 0.41</td>
</tr>
<tr>
<td>Lagos State University Teaching Hospital</td>
<td>Lagos</td>
<td>Tertiary</td>
<td>489</td>
<td>0.09 / 0.37 / 0.46</td>
</tr>
<tr>
<td>National Orthopedic Hospital, Igbobi</td>
<td>Lagos</td>
<td>Tertiary</td>
<td>500</td>
<td>0.07 / 0.36 / 0.43</td>
</tr>
<tr>
<td>Federal Medical Center Abeokuta</td>
<td>Ogun</td>
<td>Tertiary</td>
<td>200</td>
<td>0.13 / 0.63 / 0.76</td>
</tr>
<tr>
<td>UNILORIN Teaching Hospital, Ilorin</td>
<td>Kwara</td>
<td>Tertiary</td>
<td>300</td>
<td>0.11 / 0.5 / 0.61</td>
</tr>
<tr>
<td>Federal Medical Centre, Yenagoa</td>
<td>Bayelsa</td>
<td>Tertiary</td>
<td>150</td>
<td>0.11 / 0.58 / 0.69</td>
</tr>
<tr>
<td>Federal Medical Centre, Asaba</td>
<td>Delta</td>
<td>Tertiary</td>
<td>140</td>
<td>0.12 / 0.61 / 0.73</td>
</tr>
<tr>
<td>Federal Medical Centre, Owo</td>
<td>Ondo</td>
<td>Tertiary</td>
<td>160</td>
<td>0.13 / 0.62 / 0.75</td>
</tr>
<tr>
<td>State Specialist Hosp, Ado-Ekiti</td>
<td>Ekiti</td>
<td>Tertiary</td>
<td>162</td>
<td>0.1 / 0.51 / 0.61</td>
</tr>
<tr>
<td>Federal Medical Centre, Lokoja</td>
<td>Kogi</td>
<td>Tertiary</td>
<td>69</td>
<td>0.07 / 0.49 / 0.56</td>
</tr>
<tr>
<td>Lagos University Teaching Hospital</td>
<td>Lagos</td>
<td>Tertiary</td>
<td>761</td>
<td>0.08 / 0.12 / 0.2</td>
</tr>
</tbody>
</table>
5.6 Assessment of Carcasses Requiring Disposal

An overview of the incidence of AI in each of the six zones is provided below.

**North-Central**
- Benue: Presence of H5N1 was confirmed in Udi Hills and Otukpo on 7-March-06
- Kogi: Presence of H5N1 confirmed
- Nasarawa: Presence of H5N1 was confirmed in the North East of the State.
- Plateau: Presence of H5N1 was confirmed in Jos, Plateau as of 22-February-06
- Abuja: Presence of H5N1 was confirmed as of 8-February-06.

**North-Eastern**
- Bauchi: Presence of H5N1 confirmed in Toro, Bauchi State as of 2-22-06
- Yobe: Presence of H5N1 confirmed

**North-Western**
- Kaduna: Presence of H5N1 confirmed as of 2-8-06.
- Kano: Presence of H5N1 confirmed as of 2-22-06.
- Katsina: Presence of H5N1 confirmed in capital city, Katsina as of 2-22-06.
- Sokoto: Presence of H5N1 confirmed

**South-Eastern**
- Anambra: Presence of H5N1 confirmed in Idemili as of 3-7-06

**South-South**
- Rivers: Presence of H5N1 confirmed in Port Harcourt as of 3-7-06

**South-Western**
- Lagos: Presence of H5N1 confirmed.
- Ogun: Presence of H5N1 confirmed in Ogun State as of 3-10-06

Table 5.7 shows that a total of 780,000 AI infected carcasses have been disposed off to date. It is estimated that an additional 500,000 – 1,500,000 birds may be infected and would require disposal.

**Table 5.7: Volume of Carcasses Disposed to date**

<table>
<thead>
<tr>
<th>Nos</th>
<th>State</th>
<th>Volume of Carcasses Disposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bauchi</td>
<td>107,495</td>
</tr>
<tr>
<td>2</td>
<td>Kaduna</td>
<td>49,189</td>
</tr>
<tr>
<td>3</td>
<td>Kano</td>
<td>265,853</td>
</tr>
<tr>
<td>4</td>
<td>Katsina</td>
<td>5,974</td>
</tr>
<tr>
<td>5</td>
<td>Plateau</td>
<td>79,028</td>
</tr>
<tr>
<td>6</td>
<td>Benue</td>
<td>destroyed before official intervention</td>
</tr>
<tr>
<td>7</td>
<td>Lagos</td>
<td>95,162</td>
</tr>
<tr>
<td>8</td>
<td>Ogun</td>
<td>85,210</td>
</tr>
<tr>
<td>9</td>
<td>Rivers</td>
<td>7,431</td>
</tr>
<tr>
<td>10</td>
<td>Sokoto</td>
<td>24,834</td>
</tr>
<tr>
<td>11</td>
<td>Anambra</td>
<td>1,645</td>
</tr>
<tr>
<td>12</td>
<td>Yobe</td>
<td>destroyed before official intervention</td>
</tr>
<tr>
<td>13</td>
<td>Taraba</td>
<td>2,921</td>
</tr>
<tr>
<td>14</td>
<td>Nassararawa</td>
<td>43,039</td>
</tr>
<tr>
<td>15</td>
<td>Abuja</td>
<td>206</td>
</tr>
<tr>
<td>16</td>
<td>Borno</td>
<td>4,610</td>
</tr>
<tr>
<td>17</td>
<td>Borno</td>
<td>322</td>
</tr>
<tr>
<td>19</td>
<td>Edo</td>
<td>210</td>
</tr>
</tbody>
</table>

Source: Nigerian AI Project Environmental Management Plan
Chapter 6.0: Medical Waste Generation and Management Practices

This section analyses the present status of medical waste generation and management in Nigeria and subsequently recommends guidelines for collection, on-site handling, storage, transportation, treatment and safe disposal of medical wastes. Current management practices constitute both a public health and environmental hazard. When dump sites are visited, many scavengers can be seen sorting for recyclable materials, a practice which is dangerous for the scavengers. In addition, it was found that some staff in healthcare facilities are unaware of the hazard of medical wastes. It is concluded that a new management system, which consists of segregation, material substitution, minimization, adequate treatment and sanitary land filling should be encouraged.

6.1 Waste Generation

The medical wastes are generated from various sources. These sources can be classified as major or minor. The major sources include tertiary and secondary institutions i.e. teaching and specialist hospitals while minor sources include primary health care institutions including private hospitals, private laboratories, public health centres, dental clinics and pharmacies. The composition and quantity of the waste is often a characteristic of the source. For example, the operating theatres and surgical wards generate mainly anatomical waste such as tissues, organs, body parts and other infectious waste.

- **Solid Waste**

Solid waste generation depends on numerous factors, such as category of health-care institution, the proportion of patients treated on a daily basis and the degree of specialisation of the health facility. Hence, the teaching and specialist hospitals generate larger quantities of waste per unit than other facilities. Solid wastes generated from healthcare activities include but not limited to the following:

- General waste – e.g. paper, cartoons, plastic, food items, bottles etc
- blood-soaked bandages
- culture dishes and other glassware
- discarded surgical gloves - after surgery
- discarded surgical instruments - scalpels
- needles - used to give shots or draw blood
- cultures, stocks, swabs used to inoculate cultures
- removed body organs - tonsils, appendices, limbs, etc.
- lancets - the little blades the doctor pricks your finger with to get a drop of blood

- **Liquid Wastes**

Liquid wastes generated from healthcare activities include excreta, bath water from wards and waste water from laboratories (specimens, reagents etc), operating theatres and mortuaries. Some have highly infectious potential. Excreta are channelled into septic tanks that are emptied periodically or into various types of treatment plants. Most of the other liquid waste are poured down the drains of sinks and flow into open drains (gutters) which enter the external sewerage system ending up in water bodies draining the area. In some cases (particularly in the rural areas where plumbing facilities are rudimentary) some of these liquid wastes end up on the ground or on plants in the vicinity of the facilities.

- **Air Emissions**

Air emissions generated from healthcare activities are few compare to solid and liquid waste. Emission sources include sterilisation process, catering and laundry activities. Other sources include open burning of refuse and incineration of infectious wastes. This emission may be in the form of vapour and smoke. Some facilities utilizes electric generators to augment power supply, these generating sets are powered by diesel or gasoline and result in emission of priority pollutants (NOx,SOx,CO₂ etc).
6.1.1 Waste Categories

Field visits conducted by EnvironQuest scientists to selected healthcare facilities as listed in Table 5.6 revealed the following classification of medical waste in Nigeria based on the point of generation, method of storage and the treatment options available by the health establishments:

### Table 6.1: Typical Waste Generated in Hospitals

<table>
<thead>
<tr>
<th>Classification / Description</th>
<th>Content / Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Waste</strong></td>
<td></td>
</tr>
<tr>
<td>this are similar to domestic waste, which are not harmful e.g. papers, cartoons, offices, kitchen etc.</td>
<td>cardboard, plastic materials, kitchen waste ash, saw dust, pieces of wood etc.</td>
</tr>
<tr>
<td><strong>Infectious Waste</strong></td>
<td></td>
</tr>
<tr>
<td>This are generated at in- and out-patients areas and are likely to contain pathogenic microbes</td>
<td>microbiological laboratory waste potentially infected blood and human tissue</td>
</tr>
<tr>
<td><strong>Sharps</strong></td>
<td></td>
</tr>
<tr>
<td>sharp edged waste stained or contaminated with blood or body fluids e.g. needles, syringes etc.</td>
<td>Needles syringes, surgical blades, scalpels, test tubes, ampoules, glass instruments, pipettes</td>
</tr>
<tr>
<td><strong>Patient Waste</strong></td>
<td></td>
</tr>
<tr>
<td>Include waste generated from in or out-patient activities, which may be contaminated with blood or body fluids from surgery, injection room etc</td>
<td>Stained or contaminated material (e.g. soiled cotton wool, used bandages/dressings, gloves, linen blood transfusion bags, urine, faeces</td>
</tr>
<tr>
<td><strong>Culture / Specimen</strong></td>
<td></td>
</tr>
<tr>
<td>Clinical specimen, laboratory culture and human tissue.</td>
<td>Culture plus specimen (e.g. experimental specimen tissue culture, urine, stool). Urine faeces (stool) from laboratory</td>
</tr>
<tr>
<td><strong>Pathological / Organic Human Tissue</strong></td>
<td></td>
</tr>
<tr>
<td>includes amputations and other body tissue resulting from surgery, autopsy, and birth. They require special treatment for ethical reasons.</td>
<td>Internal body organs, amputated limbs, placentas, foetus, human liquid wastes (urine, blood products)</td>
</tr>
<tr>
<td><strong>Hazardous Waste</strong></td>
<td></td>
</tr>
<tr>
<td>consist of materials hazardous characteristics and therefore require special management</td>
<td>pharmaceutical, laboratory, organic substances, heavy metals and other chemical contamination</td>
</tr>
<tr>
<td><strong>Pharmaceutical Waste</strong></td>
<td></td>
</tr>
<tr>
<td>These are waste generated from the pharmacy</td>
<td>Expired drugs, plastic or glass containers</td>
</tr>
<tr>
<td><strong>Photographic Chemical Waste</strong></td>
<td></td>
</tr>
<tr>
<td>Any waste material solid or liquid produced from image processing at the radiology department</td>
<td>Photographic developer/ Fixer solution X-ray photographic films</td>
</tr>
<tr>
<td><strong>Radioactive Waste</strong></td>
<td></td>
</tr>
<tr>
<td>Any solid liquid or pathological waste contaminated with radioactive isotopes of any kind</td>
<td>Solid- papers, gloves, cotton swabs, needles (sharps), equipment etc. excretion, gastric content Spent radiation sources,</td>
</tr>
<tr>
<td><strong>Laboratory Waste</strong></td>
<td></td>
</tr>
<tr>
<td>This is made up of basically spent chemicals for research and analytical laboratories and pharmaceutical companies</td>
<td>Acid, Alkali, organic substances, Solvents and heavy metals/Chromo sulphuric, Hydrochloric and Oxalic acid &amp; Glacial acetic acid</td>
</tr>
<tr>
<td><strong>Acids</strong></td>
<td></td>
</tr>
<tr>
<td>peracetic acid , acetic acid</td>
<td></td>
</tr>
<tr>
<td><strong>Alkali</strong></td>
<td></td>
</tr>
<tr>
<td>Sodium/Potassium Hydroxide, Ethanol, etc</td>
<td></td>
</tr>
<tr>
<td><strong>Solvents</strong></td>
<td></td>
</tr>
<tr>
<td>alcohol, formalin</td>
<td></td>
</tr>
<tr>
<td><strong>Organic Substances</strong></td>
<td></td>
</tr>
<tr>
<td>paraffin, phenol, and polyvinyl chloride tape</td>
<td></td>
</tr>
<tr>
<td><strong>Heavy Metals</strong></td>
<td></td>
</tr>
<tr>
<td>Mercury from thermometers</td>
<td></td>
</tr>
</tbody>
</table>
6.2 Waste Management Practices

6.2.1 Segregation of waste

- **Solid Wastes**

Some health institutions visited practice segregation based on WHO/FMOH infection control sensitisation programmes, although, there are no official waste segregation policies or system for categorisation of medical wastes. Sharps (needles and syringes) and pathological wastes (e.g. placenta and body parts) were observed to be separated from the rest of the waste in most facilities.

Needles and syringes were collected into specially designed boxes (Figure 6.1). When these boxes are not available, many institutions use improvised boxes with holes at the top. Few institutions especially in the rural areas however still combine sharps with general waste.

![Figure 6.1: Boxes for Sharps Disposal](image)

6.2.2 Treatment of Waste

- **Chemical Disinfection**

This is used in some facilities for treating pathological waste in the form of placenta tissue prior to burial. Few institutions chemically disinfect needles before burning or burial.

- **Sterilisation**

Autoclaves are principally used in most facilities to disinfect instruments and theatre linings and not for waste treatment. In rural facilities, steam disinfection by boiling is often employed, although this is not very effective as temperatures reached are not up to the required 1200°C attained in autoclaving.

6.2.3 Waste Disposal Practices

- **Burial**

Placentas are usually buried. Sometimes the hole is very shallow with a high potential for being dug up by animals. Few hospitals have private off-site sites for burial e.g. St. Nicholas Hospital, Lagos. Other body parts (e.g. amputated limbs etc) are incinerated where incinerators are available or buried in public cemeteries.
- **Incineration**

Modern and efficient incinerators are available only in tertiary health centres e.g. National Orthopaedic Hospital, Igbobi and University College Hospital, Ibadan. Improvised (brick and drum) incinerators were observed in some hospitals for needles and syringes after immunisations. They are quite effective, but generate considerable air pollution. In rural areas, the open burning is applied to treat general, sharps and infectious wastes.

- **Open Dump Sites**

Open dumps are the disposal method currently employed for most of the solid waste i.e. infectious, general, pharmaceutical and in some cases, sharps. Currently, the dumping grounds are not engineered to serve as sanitary landfill sites. They therefore constitute a high potential for the spread of infections through run offs during rains and contamination of surface and ground water.

- **Septic Tanks and Public Drains**

Excreta are channelled into septic tanks and emptied often or into treatment plants e.g. National Orthopaedic Hospital – Igbobi and LUTH. Other liquid wastes are emptied into sinks and drains thereby entering natural drainage systems. In rural areas, liquid wastes are discharged into bushes and may enter water bodies draining the area.

### 6.3 Potential Impacts of Existing Medical Waste Management Practices

- **Soil Pollution**

There is a high potential for infection and chemical contamination of soil, particularly from liquid wastes flowing into soil. The potential of contamination from untreated sharps, anatomical and infectious wastes buried or dumped indiscriminately may lead to the entry of pathogens and chemicals into the food chain.

- **Surface and Groundwater Contamination**

There is a high potential for infectious and chemical contamination of streams, rivers and lakes from effluents from healthcare facilities flowing into drains and run-off from soil during rains following dumping of infectious and chemical wastes. The potential for groundwater contamination from buried infectious wastes, sharps and body parts is also significant.

- **Occupational Health and Safety Hazards**

Most waste handlers are unaware of the potential risks involved in handling medical waste; in most cases they do not have adequate protective clothing and disinfectants. They are exposed to a high potential infection following injuries from sharps, handling of infectious materials and human parts.

There is the need for selection of environmentally and socially friendly options to minimize occupational injuries during collection, handling, storage, transportation, treatment and disposal of medical waste.

- **Transport of health-care wastes within the institutions**

WHO guidelines require that waste bags should be made of polyethylene with minimum thickness of 150 micron and resistant to puncture during transportation. In order to reduce the cost for this task, most of the plastic bags manufactured do not comply with this requirement. These bags are easily torn and their content which may also be infectious can spread into containers, vehicles and the environment.
Most of the waste bags used do not have the statement and the logo indicating their content. At LUTH, UCH and NOH, Igbobi it was observed that the waste handlers have nose mask, gloves and protective garments.

- **Storage at the temporary waste storage rooms**

Most of the medical institutions visited have no temporary storage areas for infectious waste; hence they are mixed with general municipal wastes. At the teaching hospitals (e.g. LUTH) and general hospitals (e.g. Island Maternity) it was reported that waste are moved three time daily to coincide with the shift changes by ground staff. These wastes were packed into a temporary storage area (Figure 6.2) from where the waste transporter comes to collect it for disposal every morning.

At LUTH, sharps are packed into special cartoons and transported off-site (NOH, Igbobi) for incineration every three weeks. At LSUTH, the domestic wastes are collected every three days from the temporary storage area (Figure 6.2), infectious wastes are not segregated but mixed with domestic waste which is picked up every three days by a PSP operator for disposal at LAWMA facilities. This practice poses significant health danger to the collector and scavengers at the dumpsites who may not be aware of the hazardous nature of the content.

![Figure 6.2: Temporary Storage Area at NOH, Igbobi](image)
Figure 6.3: Domestic Waste Dump Site at LSUTH-Ayinke House

Figure 6.4: Improvised Incinerator at UCH, Ibadan
6.4 Existing Disposal Facilities

There are disposal sites all over the country particularly open dumps. There are currently no sanitary landfills in Nigeria. These are unsuitable for the disposal of hazardous and medical waste and poses serious public health hazard. Few of these sites are discussed below:

Lagos

− **Ojota**

The dumpsite covers an area of about 42 hectares, and situated in the northwestern part of Lagos. It was originally a burrow pit from where lateritic soil was mined. The facility is fenced round and is presently managed by the Lagos Waste Management Authority (LAWMA). The dumpsite site is surrounded by industrial and residential communities; hence
it poses high risk to both ground and surface waters. There is also the risk of air pollution from open burning of wastes at the site. For the facility to be effective for carcass disposal, the ground it has to be reconstructed and properly lined to retain fluids and other effluents.

- **Isolo**

  The Isolo landfill is located in the West-Central area of Lagos and sits on 7.5 hectares. It is situated in a low-lying flood prone area west of residential facilities which poses a high possibility of groundwater contamination in the area. The dumpsite has been in operation since 1981 and is managed by Lagos State Waste Management Authority (LAWMA). All sorts of wastes are disposed off at this landfill including medical wastes. About 80% of the wastes received at this site are household wastes. Toxic and hazardous waste are reportedly not received at this landfill.

- **Agege**

  This landfill has been in operation since 1983 and is situated in the outer northwestern portion of Lagos. It covers an approximate area of 5 hectares and is bordered on all sides by residential communities. Within the facility is a 30 x 150 meter 7m deep retention pond. Waste including asbestos sludge from industrial facilities, domestic, medical and other toxic and hazardous wastes are dumped at this facility.

  The landfill is not lined and as such there is high risk of groundwater contamination (leachates) and air pollution (open burning). There is also potential risk to public health from scavenging.

- **Badagry**

  This landfill is located in a flood plain close to a waterway which drains into the Badagry creek. The landfill covers an area of approximately 9 hectares. It is within a generally flat terrain; hence possible contamination of both ground and surface waters is reduced. However, there is a public route adjacent to the site. Since the site is not fenced or secured and has no management of any sort, scavenging is highly probable.

  **Abuja**

  Waste is dumped at a designated dumpsite which covers approximately 4 hectares of land. All sorts of waste are dumped there including medical waste. There is no payment for disposal, this just a large area that is covered with scattered waste. There is also no coverage of dumped waste hence waste is easily blown by wind.

  **Kaduna**

  An excavated pit was formerly used as an illegal dumping site, but has now been converted to an official dumpsite where different kinds of waste are dumped including medical waste. The dumpsite is surrounded by residential communities and significant scavenging takes place.

  The site is at the high point relative to the town, which may increase the risk of ground water contamination down stream.

  **Rivers**

  This dumpsite is located in a suitable area far away from the villages and the town centre. It was properly fenced but the fence had been vandalized.

  **Yobe**

  The dumpsite is just an open space with no clearly defined boundaries. However, the area that is being used currently is about 0.5 hectares. It is situated on a hillside not far from a major tributary to the Gongola River. There are some residential communities located about 200m from the site. The waste disposed at this site comes from the town and the surrounding residential areas.
Anambra

The current dumpsite is shallow with mounds of wastes that resulted from industrial and other commercial activities. It is about 80m from a major river. The site is not fenced; therefore its boundaries are not well defined. As a result, waste is dumped indiscriminately around the site. There are scavengers who come to collect salvageable. The facility is surrounded by residential as well as commercial facilities.

6.5 Existing AI Infected Carcass Disposal System

The goal of carcass disposal is to eliminate pathogens in a timely, bio-secure, socially acceptable, and environmentally responsible manner. The current disposal practices employed in controlling AI infections in Nigeria are described below.

- Open Air Burning

This involves burning of carcasses either on-site (farm) or off-site (collective facility) fuelled by additional materials of high energy content e.g. diesel fuel, wood, charcoal etc. This procedure requires minimal logistics and yields relatively inert waste that does not attract pest and scavengers. (Figure 6.7).

However, open air burning poses significant environmental pollution concerns due to the emission of nitrogen oxides, sulphur oxides, carbon monoxides and suspended particulates matters. Smoke and dioxin inhalations depending on the fuel type can pose occupational health hazards. There is also the possibility of soil and groundwater contamination from the ash leachates if the combustion is incomplete.

![Figure 6.7: AI Infected Carcasses gathered in a dump for burning](image)

- Burial

In certain parts of the country where the water table is very low (e.g. Northern Nigeria) burial is being practiced. This method is convenient, logistically simple, relatively quick and eliminates the need for transportation of infectious materials.

Potential environmental impact or public health risks associated with burial of infected carcass is the contamination of ground and surface water with the products of carcass decay as well as leachates from the infected animals. Groundwater contamination could result in high levels of ammonia, total dissolved solids (TDS), chloride and biological oxygen demand (BOD), and possibly pathogens.
6.5.1 Potential Impacts of Existing Carcass Disposal Practice

- **Groundwater contamination**

There is the possibility of soil and groundwater contamination from the ash and leachates from open burning when combustion is incomplete and also from burial. Groundwater contamination could result in high levels of ammonia, total dissolved solids (TDS), chloride and biological oxygen demand (BOD), and possibly pathogens.

- **Air Pollution**

Open burning poses significant environmental pollution concerns due to the emission of nitrogen oxides, sulphur oxides, carbon monoxides and suspended particulates matters.

- **Occupational Health and Safety Hazards**

Smoke and dioxin inhalations depending on the fuel type (diesel, gasoline, kerosene, fire wood) can pose occupational health hazards.

6.6 Analysis of Existing Disposal Sites

There are presently no designated site for medical and hazardous wastes disposal in Nigeria. These categories of waste are disposed alongside general municipal waste in open dumps. This practice poses severe environmental and public health risk and further reiterates the need for urgent steps to redress environmental health problems.

Most of the existing sites are located in areas that are easily accessible by roadsides, and the FGN recently announced its plan to build landfill in Lagos, Ibadan and Enugu to serve the south west and south east regions of the country. In, Lagos, LAWMA plans to create separate section for medical and hazardous waste at its dumpsites to minimize the risk of occupational and public health hazards.
Chapter 7.0: Technologies for Medical and Carcass Waste Management

Medical wastes that are generated within a healthcare facility should follow an appropriate and well-identified stream from their point of generation until their final disposal. This stream is composed of several steps that include: generation, segregation, collection and on-site transportation and offsite transportation, treatment and disposal. The various medical wastes treatment and disposal options are briefly described below.

7.1 Medical Waste Treatment and Disposal Technologies

The choice of treatment and disposal method for medical wastes depends on factors, many of which depend on the local conditions:

- disinfection efficiency;
- health and environmental considerations;
- volume and mass reduction;
- occupational health and safety considerations;
- quantity and type of wastes for treatment and disposal;
- capacity of treatment and disposal technologies;
- infrastructure requirements;
- locally available treatment options and technologies;
- options available for final disposal;
- training requirements for operation of the method;
- operation and maintenance considerations;
- location and surroundings of the treatment site and disposal facility;
- investment and operating costs;
- public acceptability; and
- regulatory requirements.

The different available methods are considered below.

7.1.1 Sterilization

- **Autoclaving**

Steam autoclave treatment combines moisture, heat and pressure to inactivate microorganisms. Steam autoclaves are constructed with a metal chamber to withstand the increased pressure/temperature. Saturated steam is pumped into the autoclave at temperatures around 160°C. The pressure in the vessel is maintained at 5 bar gauge for a period of up to 45 minutes to allow the process to fully ‘cook’ the waste.

At the appropriate levels of time (> 60 min), temperature (>121°C), and pressure (100 kPa) effective inactivation of all vegetative microorganisms and most bacterial spores can be achieved. Preparation of material for autoclaving requires segregation to remove unsuitable material and shredding to reduce the individual pieces of waste to an acceptable size. Autoclaves are typically used in hospitals for the sterilization of reusable medical equipment. They allow for the treatment of limited quantities of waste and are therefore commonly used only for highly infectious waste, such as microbial cultures or sharps.

- **Microwave Irradiation**

Microwave irradiation is a thermal disinfection system designed for treating and rendering infectious medical waste safe for conventional disposal. In microwave treatment, a loading device transfers the wastes into a shredder, where it is reduced to small pieces. The waste passes through a preparative process of segregation to remove undesirable material, and then it is triturated, pulverized, and compressed prior to its disinfection. The shredded material is subjected to steam and heat by microwave energy to disinfection temperature.
Since the technology does not involve the application of steam, there is a minimal generation of wastewater stream, and with the appropriate conditioning it can be recycled to the system. Since electricity is the main source of energy for operating this technology, gas emissions are also minimal compared to autoclaving.

7.1.2 Chemical Disinfection

Chemical disinfection is used routinely in health care to kill micro-organisms on medical equipment and on floors and walls and is now being extended to the treatment of health-care waste. Chemicals are added to waste to kill (inactivate) the pathogens it contains; this treatment usually results in disinfection rather than sterilization. Chemical disinfection is most suitable for treating liquid waste such as blood, urine, stools, or hospital sewage. However, solid - and even highly hazardous - health-care wastes, including microbiological cultures, sharps, etc., may also be disinfected chemically, with some limitations. The most frequent chemical disinfectants are:

- Chlorine - is a very active against micro-organisms. In case of possible HIV/AIDS infectious materials, concentration of 5 g/litre of chlorine is recommended.
- Formaldehyde - which is an active gas against all micro-organisms except at low temperature (<20°C); the relative humidity must be near 7%. This disinfecting product is recommended for Hepatitis.

7.1.3 Incineration

Incineration is a high-temperature dry oxidation (combustion) process that reduces organic and combustible waste to inorganic and incombustible matter. The process is usually selected to treat wastes that cannot be recycled, reused, or disposed of in a landfill. Three basic kinds of incineration technology are of interest for treating health-care waste:

- double-chamber pyrolytic incinerators, which may be especially designed to burn infectious health-care waste;
- single-chamber furnaces with static grate, which should be used only if pyrolytic incinerators are not affordable;
- rotary kilns operating at high temperature, capable of causing decomposition of genotoxic substances and heat-resistant chemicals.

Incinerators designed especially for treatment of medical waste should operate at temperatures between 900 and 1200°C. All types of incinerator, if operated properly, eliminate pathogens from waste and reduce the waste to ashes. However, certain types of health-care wastes, e.g. pharmaceutical or chemical wastes, require higher temperatures for complete destruction.

<table>
<thead>
<tr>
<th>Suitable Waste</th>
<th>Unsuitable Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low heating value: above 2000 kcal/kg (8370 kJ/kg) for single-chamber incinerators, and above 3500 kcal/kg (14640 KJ/kg) for pyrolytic double-chamber incinerators.</td>
<td>• Pressurized gas containers.</td>
</tr>
<tr>
<td>• Content of combustible matter above 60%.</td>
<td>• Large amounts of reactive chemical waste.</td>
</tr>
<tr>
<td>• Content of non-combustible solids below 5%.</td>
<td>• Silver salts and photographic or radiographic wastes.</td>
</tr>
<tr>
<td>• Content of non-combustible fines below 20%.</td>
<td>• Halogenated plastics such as PVC.</td>
</tr>
<tr>
<td>• Moisture content below 30%.</td>
<td>• Waste with high mercury or cadmium content, such as broken thermometers, used batteries etc</td>
</tr>
<tr>
<td></td>
<td>• Sealed ampoules or ampoules containing heavy metals.</td>
</tr>
</tbody>
</table>

Incineration equipment should be carefully chosen on the basis of the available resources and the local situation, and of risk–benefit considerations balancing the public health benefits of
pathogen elimination before waste disposal against the potential risks of air or groundwater pollution caused by inadequate destruction of certain wastes.

- **Double Chamber Pyrolytic (Controlled Air) Incinerators**

  This the most reliable and commonly used treatment process for medical waste incineration. It comprises a pyrolytic chamber and a post-combustion chamber and functions as follows:

  - the waste is thermally decomposed through an oxygen-deficient, medium-temperature combustion process (800–900°C), producing solid ashes and gases. The pyrolytic chamber includes a fuel burner, used to start the process.

  - The gases produced in this way are burned at high temperature (900–1200°C) by a fuel burner in the post-combustion chamber, using an excess of air to minimize smoke and odours.

  Adequately maintained and operated pyrolytic incinerators of limited size, as commonly used in hospitals, do not require exhaust-gas cleaning equipment. Their ashes will contain less than 1% unburnt material, which can be disposed of in landfills.

- **Rotary Kilns**

  A rotary kiln comprises a rotating oven and a post-combustion chamber. They are suitable for burning chemical and medical waste. The axis of a rotary kiln is inclined at a slight angle to the vertical (3–5% slope). The kiln rotates 2 to 5 times per minute and is charged with waste at the top. Ashes are evacuated at the bottom end of the kiln. The gases produced in the kiln are heated to high temperatures to burn off gaseous organic compounds in the post-combustion chamber and typically have a residence time of 2 seconds.

  Rotary kilns may operate continuously and are adaptable to a wide range of loading devices. Those designed to treat toxic wastes should preferably be operated by specialist waste disposal agencies and should be located in industrial areas.

- **Single-chamber incinerator**

  In single chamber incinerators the combustion is initiated by addition of fuel and then continues unaided. Air inflow is usually based on natural ventilation from the oven mouth to the chimney; if this is inadequate, however, it may be assisted by mechanical ventilation. Periodic removal of soot and slags is essential.

  Atmospheric emissions will usually include sulphur dioxide, hydrogen chloride, and hydrogen fluoride, black smoke, fly ash (particulates), carbon monoxide, nitrogen oxide, heavy metals, and volatile organic chemicals. To limit these emissions, the incinerator should be properly operated and carefully maintained, and sources of pollution should be excluded from the waste to be incinerated whenever possible.

- **Drum Incinerator**

  A drum incinerator is the simplest form of single-chamber incinerator. It should be used only as a last resort as it is difficult to burn the waste completely without generating potentially harmful smoke. The option is appropriate only in emergency situations during acute outbreaks of communicable diseases and should be used only for infectious waste.

  The drum incinerator should be designed to allow the intake of sufficient air and the addition of adequate quantities of fuel—essential to keep the temperature as high as possible. A steel drum should be used, with both ends removed; this will allow the burning of one bag of waste at a time. A fine screen placed on the top of the drum will prevent some of the ash or light
material from blowing out. Another screen or fine grate should be placed under the drum, and a chimney may also be fitted (Figure 7.1). It can also be fabricated from sheet metal or clay.

![Figure 7.1: Schematic of a Drum Incinerator](Source: www.msf.or.jp)

**Key**

A. Top of drum (part not cut)
B. Hole cut for chimney
C. Large chamber (for refuse)
D. Cut-out of cover

1. Metal drum, 2001
2. Perforated metal plate
3. Perforations in the metal plate for draught -
4. Movable cover
5. Chimney
6. Fire chamber door (used to regulate the draught)
7. Metal grating to separate the refuse from the fire chamber
To operate the drum incinerator, a good fire should first be established on the ground underneath it. One bag of waste should then be lowered into the drum. Tying the bag to a stick with string will help to avoid burns. Wood should be added to the fire until the waste is completely burned. After burning is complete, the ashes from both the fire and the waste itself should be collected and buried safely inside the premises of healthcare facilities.

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**Brick Incinerator**

Brick incinerator may be built by constructing a closed area with brick or concrete walls. The efficiency of this type of incinerator may reach 80–90% and result in destruction of 99% of micro-organisms and a dramatic reduction in the volume and weight of waste. However, many chemical and pharmaceutical residues will persist if temperatures do not exceed 200 °C. In addition, the process will cause massive emission of black smoke, fly ash, and potentially toxic gases. Example of brick incinerator includes De Monfort Incinerator (Figure 7.2). It was designed at the De Monfort University, United Kingdom to meet the need for cheap and effective incinerators which can be built in developing countries.

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**Figure 7.2: Cross Section of De Monfort Incinerator**

Key/Notes:
1. Waste is loaded through the primary combustion chamber.
2. The waste is heated by radiation from the hot firebricks in the absence of air.
3. The waste nears is pyrolyzed and burned.
4. The ash fall through the fire grate…
5. The ash is removed once incineration process is finished.
6. Combustible gases such as carbon monoxide go through the gas transfer tunnel…
7. The secondary combustion chamber where they meet a further supply of air.
8. The hot dense gases in the chimney induce more air into the combustion chambers.

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### 7.1.4 Land Filling

This practice consists of disposing of medical waste directly in commercial licensed sites. It requires low investments but presents huge health and environmental risks when it’s improperly designed. However, land filling is better than leaving hazardous wastes accumulated at hospitals or other publicly accessible places. There are two distinct types of waste disposal to land—open dumps and sanitary landfills.

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- **Open dumps** are characterized by the uncontrolled and scattered deposit of wastes at a site; this leads to acute pollution problems, fires, higher risks of disease transmission, and open access to scavengers and animals. Medical waste should not be deposited on or around open dumps.

- **Sanitary landfills** are engineered to have advantages over open dumps; they geologically isolate waste from the environment. Disposing of medical waste in
sanitary landfills prevents contamination of soil and of surface water and groundwater, and limits air pollution, smells, and direct contact with the public.

In the absence of sanitary landfills, it is recommended that medical waste be deposited in special small burial pit that can be prepared to receive health-care waste only. The pit should be 2m deep and filled to a depth of 1–1.5m. After each waste load, the waste should be covered with a soil layer 10–15cm deep. If coverage with soil is not possible, lime may be deposited over the waste. In case of outbreak of an especially virulent infection (e.g. Ebola virus), both lime and soil cover may be added.

Access to this dedicated disposal area should be restricted, and the use of a pit would make supervision by landfill staff easier and thus prevent scavenging. A typical example of pit design for health-care waste is shown in Figure 7.3. Before health-care wastes are sent for disposal, it is prudent to inspect landfill sites to ensure that there is sensible control of waste deposition.

![Figure 7.3: Example of a small burial pit for health-care waste](image)

Land filling is considered as a “bottom of the list” option for disposal of untreated HCW, and is only recommended when the economic situation of the country does not permit access to environmentally safer technologies.

### 7.1.5 Open Air Burning

Open air burning of medical waste constitutes a major pollution and hazard to the environment. Since medical wastes are generally burned in a hole, the destruction is never complete: often the quantity of unburned residue constitutes 70% of the original wastes. This encourages children and scavengers to look for reusable objects.

Table 7.2 highlights the major advantages and disadvantages of each of the alternatives. Table 7.3 presents a comparison of the five considered alternative technologies on the basis of capital cost, operating cost, ease of operation, local availability of spare parts, local availability of operational skills, demonstrated reliability, durability, and environmental impacts.
# Table 7.2: Comparisons of Alternative Medical Waste Management Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capital Cost US $</th>
<th>Operating Cost US $/Tonne</th>
<th>Ease of Operation</th>
<th>Ease of Maintenance</th>
<th>Reliability</th>
<th>Environmental Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autoclaving</td>
<td>50,000-150,000</td>
<td>High</td>
<td>Requires very qualified staff</td>
<td>Spare parts not available locally</td>
<td>Can handle limited number of waste. Not appropriate for body parts and radioactive wastes</td>
<td>High: Generate contaminated wastewater</td>
</tr>
<tr>
<td>Microwaving</td>
<td>150,000-250,000</td>
<td>High</td>
<td>Required specialized staff</td>
<td>Spare parts not available locally</td>
<td>Reduction in waste volume. Most infectious wastes can be treated except hazardous or radioactive waste</td>
<td>Low</td>
</tr>
<tr>
<td>Incineration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrolitic incinerator</td>
<td>150,000-400,000</td>
<td>High</td>
<td>Requires qualified staff</td>
<td>Spare parts readily available</td>
<td>Large volume capacity. Reduction in waste volume. Destruction of sharps, infectious wastes</td>
<td>Low: Minimal air quality pollution.</td>
</tr>
<tr>
<td>Local incinerator</td>
<td>50,000-150,000</td>
<td>Low</td>
<td>Does not require qualified staff</td>
<td>Easy to maintain</td>
<td>Works effectively. Drastic reduction of waste volume</td>
<td>Medium: Generates significant pollutants</td>
</tr>
<tr>
<td>Open Air Burning</td>
<td>5,000</td>
<td>Low</td>
<td>Does not require skilled staff</td>
<td>Easy to operate</td>
<td>Does not completely destroy pathogens</td>
<td>High: Releases lots of air emissions</td>
</tr>
<tr>
<td>Chemical Disinfection</td>
<td>50,000-100,000</td>
<td>120-150</td>
<td>Require qualified staff</td>
<td>Availability of parts</td>
<td>Most medical wastes can be treated by this method except body parts and infected carcasses</td>
<td>High: Uses hazardous compounds that require comprehensive safety measures</td>
</tr>
<tr>
<td>Land Filling</td>
<td>2,000,000</td>
<td>Low operating cost</td>
<td>Do not require qualified staff</td>
<td>Most medical wastes are not completely destroyed by this method.</td>
<td>High: Ground water pollution from leaching. Air pollution poses environmental risk from scavenging</td>
<td></td>
</tr>
</tbody>
</table>

Source: WHO 1999, Johannssen 2000
<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autoclaving</td>
<td>− Output is non-hazardous material that can be land filled with municipal waste.</td>
<td>− Relatively expensive to install and operate</td>
</tr>
<tr>
<td></td>
<td>− Effective inactivation of all vegetative micro-organisms</td>
<td>− Requires boiler with stack emissions controls</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Cannot be used to treat some special wastes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Generates wastewater that needs special treatment</td>
</tr>
<tr>
<td>Microwaving</td>
<td>− Output is non-hazardous and can be land filled with municipal waste.</td>
<td>− Highly sophisticated and complex</td>
</tr>
<tr>
<td></td>
<td>− Good disinfection efficiency</td>
<td>− High investment and running costs</td>
</tr>
<tr>
<td></td>
<td>− Reduction of waste volume</td>
<td>− Only solids can be treated and only once shredded</td>
</tr>
<tr>
<td></td>
<td>− Environmentally sound. No air pollution</td>
<td>− Cannot be used to treat pharmaceuticals, and cytotoxic waste</td>
</tr>
<tr>
<td>Incineration</td>
<td>− Adequate for infectious, chemical and pharmaceutical waste.</td>
<td>− Highly skilled operators required</td>
</tr>
<tr>
<td></td>
<td>− Very high disinfection efficiency</td>
<td>− No reduction of the weight of the waste treated</td>
</tr>
<tr>
<td></td>
<td>− Residues can be disposed in landfill</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− complete destruction of the waste reduces health risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− Fully destroys micro-organisms and sharps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− Reduces significantly volume and weight of the waste</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− Destroys all types of organic waste</td>
<td></td>
</tr>
<tr>
<td>Chemical Disinfection</td>
<td>− Reduction of weight and volume of waste</td>
<td>− Requires highly qualified technicians for operation of process</td>
</tr>
<tr>
<td></td>
<td>− Highly efficient disinfection under good operating cost</td>
<td>− Chemicals used (chlorine, aldehyde and phenolics) are hazardous and require comprehensive safety measures</td>
</tr>
<tr>
<td></td>
<td>− Environmentally sound</td>
<td>− Inadequate for pharmaceuticals, chemicals and some infectious waste</td>
</tr>
<tr>
<td></td>
<td>− Suitable for treating liquid wastes such as blood, urine stools</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− Relatively low investment cost</td>
<td></td>
</tr>
<tr>
<td>Land Filling</td>
<td>− Simple and inexpensive to operate</td>
<td>− Poses the risk of contamination to ground water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Special health-care waste is not treated and remains hazardous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Potentially long/costly transportation to landfill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Not recommended for non-sharp waste</td>
</tr>
</tbody>
</table>

Source: Safe Handling of Health Care Waste WHO, 1999
7.1.6 Recommended Options for Medical Waste Treatment and Disposal

Based on the above economic and technical analysis, the following options in Table 7.4 are recommended:

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Recommended Technology</th>
</tr>
</thead>
</table>
| Primary Healthcare Facility (Rural Area) | - Burial/Pit Latrine  
- Brick or Drum incinerator |
| Primary Healthcare Facility (Urban Area) | - Burial;  
- De Monfort Incinerators  
- Chemical disinfection |
| Secondary Healthcare Facility e.g. General Hospital | - Burial  
- De Monfort Incinerators  
- Autoclaving |
| Tertiary Healthcare Facility e.g. University Teaching Hospitals | - Burial  
- Pyrolytic incinerator  
- Autoclaving |
| Regional Waste Disposal Sites | - Modern Pyrolytic Incinerators  
- Sanitary Landfill |

7.2 Carcass Waste Treatment and Disposal Technologies

The disposal of AI infected carcasses depends primarily on the volume of birds, logistics of disposal, environmental considerations, disease agent considerations, availability of the technology, cost etc. Strategies for carcass disposal—especially large-scale carcass disposal require preparation well in advance of an emergency in order to maximize the efficiency of the response.

The overall approach for an avian influenza outbreak is a three-pronged strategy of depopulation (culling), followed by proper disposal of animal carcasses, and disinfection of farms and equipment used in the response (USDA 2005). A brief summary of these waste management options is provided below. Further details are provided in the Environmental Management Plan (EMP) for the Nigeria AI project, which has been prepared as a separate document.

7.2.1 Composting

Carcass composting is a natural biological decomposition process that takes place in the presence of air (oxygen). The carcasses should be incorporated within 24 hours of death and promptly covered with bulking material. As the temperature of the compost pile increases, organic materials break down into relatively small compounds, soft tissue decomposes, and bones soften partially. In the second phase, the remaining materials, mainly bones, break down fully to dark brown or black humus containing primarily non-pathogenic bacteria and plant nutrients. For this option to be effective, composting materials e.g. poultry litter, wood chips, sawdust, corn stalks etc need to be available.

Composting limits the risk of groundwater and air pollution contamination, the potential for farm-to-farm disease transmission, and transportation costs associated with off-site disposal. Additionally, there is the benefit of producing a potentially useful product, compost. It has been proven that the AI virus may be inactivated within 3 hours at temperature above 57°C, which is well within the temperature range of composting.

7.2.2 Burial

This method involves depositing carcasses below ground level and covering them with soil, no additional inactivation of pathogens is required. It is a logistically simple and relatively quick procedure. If performed on-site, it eliminates the need for transportation of infectious
materials. It does however require an environmental assessment because of the potential contamination of groundwater aquifers if leachate is not controlled. Two techniques are considered under this option.

- **Trench Burial**
  
  Trench burial involves the excavating soil, placing the dead carcasses in the ground and covering them with excavated material. It is an inexpensive procedure and requires little expertise. It is convenient, logistically simple and relatively quick especially for daily mortalities.

- **Mass Burial**
  
  This is similar to trenching however, the length and depth of the excavated pit is dependent on the amount of dead birds. The most significant advantage of mass burial is the capacity to dispose of a large volume of carcasses at one time.

Site conditions, need to be carefully assessed to ensure there will not be contamination of groundwater or surface waters by either the AI virus or conventional pollutants, such as total dissolved solids, nitrate, or ammonia from the decaying carcasses. When making decisions regarding on-site burial, the following should be considered:

- Consult with the appropriate agencies to obtain soil maps and drainage information.
- Determine a sufficient distance from the proposed burial site to groundwater wells and surface waters such that the AI virus will no longer be viable by the time groundwater migrates to such locations.
- Consider practices to ensure groundwater is not contaminated by conventional pollutants, such as total dissolved solids and ammonia. Site-specific factors should be considered such as 1) soil type (e.g., sandy areas) and 2) depth to groundwater (e.g., seasonally high).
- Evaluate the potential for the carcasses to rise to the surface after burial.
- Consult with the landowner in those cases where producers do not own the land to determine if the landowner will permit burial.

### 7.2.3 Incineration

Incineration thermally decomposes matter through oxidation, thereby reducing and minimizing the wastes, and destroying their toxicity. When properly designed and operated it offers reliability, safety and efficiency. There are three broad categories of incineration techniques: open-air burning, fixed facility incineration, and air-curtain incineration.

- **Fixed Incineration**
  
  Fixed whole carcass incineration occurs in an established facility in which whole carcasses or carcass portions can be completely burned and reduced to ash. Effective inactivation of pathogens is attained. The exhaust emissions can be subjected to air scrubbing procedures to meet environmental standards. A fixed facility incineration is wholly contained and usually highly controlled. It is typically fuelled by diesel, natural gas, or propane. The exhausts may be fitted with afterburner chambers to completely burn hydrocarbon gases and particulate matter from the main combustion chamber.

- **Open Air Burning**
  
  This involves burning of carcasses either on-site (farm) or off-site (collective facility) fuelled by additional materials of high energy content e.g. wood, charcoal etc. This procedure can be conducted on-site with minimal logistics. However, it could adversely impact the environment (air, water and soil). It takes an extended period of time to complete and has no verified pathogen inactivation capacity. There is also a possibility of particulate transmission from incomplete combustion.
Controlled Burning (Air Curtain) Incineration

Controlled Burning incineration involves a machine that fan-forces a mass of air through a manifold, thereby creating a turbulent environment in which incineration is accelerated up to six times faster than open-air burning. The equipment for this process can be made mobile and be taken on-site but the potential of fire hazard must be considered. Because it can be used on-site, there is no requirement for transportation of the animal material. It also produces effective inactivation of pathogens and may actually achieve very high temperatures (1000 °C).

7.2.4 Isolation

In tropical areas like Nigeria, the deactivation of the virus is fairly rapid; this makes isolation of carcasses a viable option. Considerations for this option should include a covering with plastics bags/containers prior to isolation to improve handling and to prevent the spread of the virus and control odors. This option also can be used in combination with other on-site options e.g. composting and burial. If the isolation is sufficient to deactivate the virus, the material may be buried on-site or sent off-site to a landfill or incinerator.

7.2.5 Landfills

The landfilling process involves the deposition (burying) of carcasses in licensed commercial sites. Because the sites have been previously licensed, all environmental variables such as leachate management, gas management, engineered containment, flooding and aquifers have already been considered. However, if the area is open and uncovered for extended periods of time, there is a risk for potential emission, and there could be resistance from the public to such an approach.

Engineered landfills generally require containment liner, e.g. clay, impermeable membrane e.g. high-density polyethylene and final cover e.g. clay or topsoil, depending on the type of wastes.

7.2.6 Alkaline hydrolysis

Alkaline hydrolysis uses sodium hydroxide or potassium hydroxide to catalyse the hydrolysis of biological material (proteins, nucleic acids, carbohydrates, lipids) into a sterile aqueous solution consisting of small peptides, amino acids, sugars, and soaps. Heat is applied (150°C) to accelerate the process. The only solid by-products are the mineral constituents of the bones and teeth of animals. This residue (2% of the original weight of the carcass) is sterile and easily crushed into a powder. The temperature and alkali conditions of the process destroy the protein coats of viruses and the peptide bonds of prions. Both lipids and nucleic acids are degraded.

The process is carried out in an insulated steam-jacketed, stainless steel pressure vessel with a sealed lid. The vessel operates at 70psig to achieve 150°C. The process does not release any emissions into the atmosphere and causes only minor odour production. The end product solution can be released into the sanitary sewer with proper monitoring of pH and temperature according to guidelines. The total process time for alkaline hydrolysis digestion of carcass material is 3-8 hours depending on the disease agent e.g. bacterial and viral contaminated waste (4 hours), transmissible spongiform encephalopathy waste (6 hours). The end product is a sterile alkaline solution with soap-like odour.

7.2.7 Rendering

Rendering of animal mortalities involves the conversion of carcasses into carcass meal, melted fat and water using mechanical processes (e.g. grinding, mixing, pressing, decanting and separating), thermal processes (e.g. cooking, evaporating, and drying), and sometimes chemical processes (e.g. solvent extraction). It produces an effective inactivation of all pathogens with the exception of prions (an infectious viral protein particle) where infectivity
is only reduced. Typical medium sized rendering plant could process 12 tonnes of birds per hour of operation. The plant can operate within environmental standards.

The main processes involve size reduction followed by cooking and separation of fat, water, and protein materials using techniques such as screening, pressing, sequential centrifugation, solvent extraction, and drying. The resulting carcass meal can sometimes be used as an animal feed ingredient. If prohibited for animal feed use, or if produced from keratin materials of carcasses such as hooves and horns, the product will be classified as inedible and can be used as a fertilizer. Tallow can be used in livestock feed, production of fatty acids, or can be manufactured into soaps.

### 7.2.8 Technology and Site Selection Guidelines

The major factors that may influence the choice of technique for carcass disposal includes:

- **Availability of capacity** - where the number of carcasses to be disposed of is high, the capacity of the adopted technologies could be inadequate.
- **Cost** - technologies for carcass disposal and specially those using sophisticated equipment are very costly.
- **Environmental concerns** - the different technologies for carcass disposal have different effects on the environment. For instance open burning will produce smoke and smells; burial might lead to gas production, risk of contamination of air, soil, surface and sub surface water.
- **Pathogen inactivation** - the chosen disposal procedure must give optimal safety as regards to the inactivation of the pathogen.
- **Occupational health safety** - carcasses in decomposition pose a potential health risk for the persons handling them during the disposal process. Workers should be sufficiently protected (protective clothing, gloves, face masks, spectacles, vaccination, anti viral medicines, regular health checks) against infection with a zoonotic pathogen such as avian influenza.

The major determining factors in selecting a site for carcass disposal include the volume of birds, bio-security concerns over the movement of infected animal and environmental conditions of the proposed site. Other factors include the topography, proximity of human communities, soil type, groundwater depth, and accessibility (condition of roads).

**Burial**

To select suitable site for carcasses burial the following should be considered among other factors:

- Soil properties (texture, permeability, surface fragments, water table depth etc.,)
- Slope or topography;
- Hydrological properties;
- Proximity to water bodies, roadways, residences, municipalities, or property lines;
- Accessibility; and
- Subsequent intended use of site

**Composting**

Potential compost sites should minimize potential environmental impacts and should meet the following minimum requirements:

- have minimal interference with traffic and other operations.
- be minimum of 500m downwind of nearby communities to minimize potential impacts (e.g. odour or dust)
- be located in a well drained area at least 2 m above the high water table level;
− be about 300m from sensitive water resources, with an adequate slope (2-5%) to prevent pooling of water; and
− be well aerated to maintain uniform temperature and moisture content throughout the composting process

**Incineration**

Incineration of animal carcasses has potential to impact air quality and odour. the following measures should be adopted to minimize the effects:

− Locate incinerator downwind of neighbouring community;
− Use a large incinerator to reduce the period of incineration.
− Construct a trench for open burning about 500m from neighbouring communities; and
− Place incinerator in an inconspicuous places

Table 7.5 summarizes the different disposal methods as well as the advantages and disadvantages of each method.
## Table 7.5: Summary of Disposal Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rendering</td>
<td>− Production of safe and valuable end product</td>
<td>− Very expensive</td>
</tr>
<tr>
<td></td>
<td>− Convert carcasses to useful by-products</td>
<td>− Requires storage prior to transportation, which could attract flies and scavengers.</td>
</tr>
<tr>
<td></td>
<td>− Temperature adequate to destroy AI virus</td>
<td>− Vehicles and personnel travelling between the farm and rendering plant can compromise bio security</td>
</tr>
<tr>
<td></td>
<td>− Prompt transportation to rendering plant reduces spread of disease</td>
<td></td>
</tr>
<tr>
<td>Burial</td>
<td>− Capacity to dispose of large volume of carcasses in emergency situation.</td>
<td>− Site availability and land-use incompatibility</td>
</tr>
<tr>
<td></td>
<td>− On-site burial mitigate the risk of virus dissemination</td>
<td>− Groundwater could be contaminated, depending on burial location.</td>
</tr>
<tr>
<td></td>
<td>− Low cost</td>
<td>− Spread of diseases during transport from farm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− It does not inactivate all pathogenic agents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− requires long term maintenance/monitoring</td>
</tr>
<tr>
<td>Incineration</td>
<td>− Complete destruction of infective pathogens</td>
<td>− High fuel requirement (expensive)</td>
</tr>
<tr>
<td></td>
<td>− Over 95% waste reduction and reduces carcasses to ash</td>
<td>− Lack of local expertise except for brick and drum incinicators</td>
</tr>
<tr>
<td></td>
<td>− Highly bio-secure</td>
<td>− High operating cost (especially fuel cost)</td>
</tr>
<tr>
<td></td>
<td>− Less air pollution</td>
<td>− Poorly designed managed incinerator may impact air quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Potential for surface and groundwater contamination from carcass storage</td>
</tr>
<tr>
<td>Open air burning</td>
<td>− Relatively inexpensive</td>
<td>− Negatively impact air quality through emission of PM, CO₂</td>
</tr>
<tr>
<td></td>
<td>− Cremation is not affected by surface water, groundwater, soil, and topographical conditions</td>
<td>− Labour and fuel intensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>− Potential groundwater and soil contamination</td>
</tr>
<tr>
<td>Composting</td>
<td>− Inexpensive and environmentally sound</td>
<td>− Bulking material are readily available</td>
</tr>
<tr>
<td></td>
<td>− On-farm composting is considered bio secure</td>
<td>− Poorly managed compost units may attract disease vectors and scavengers</td>
</tr>
<tr>
<td></td>
<td>− Proper composting generates minimal odour and fly problems</td>
<td>− Risk of disseminating the virus if the composting area is not effectively secured/isolated</td>
</tr>
<tr>
<td></td>
<td>− Final product can improve soil till and fertility.</td>
<td></td>
</tr>
<tr>
<td>Landfill</td>
<td>− Proven very effective</td>
<td>− It is expensive and serves only as a means of containment rather than elimination</td>
</tr>
<tr>
<td></td>
<td>− Ensures long term disposal of large volume</td>
<td>− Potential spread of disease agent during transportation to landfill.</td>
</tr>
<tr>
<td></td>
<td>− Pose little risk to environment</td>
<td>− requires continuous long term costly monitoring and managing of facility</td>
</tr>
<tr>
<td>Alkaline Hydrolysis</td>
<td>− Process release no gaseous emissions</td>
<td>− Limited capacity for destruction of large volumes of carcasses</td>
</tr>
<tr>
<td></td>
<td>− Combination of sterilization and digestion</td>
<td>− Expensive</td>
</tr>
<tr>
<td></td>
<td>− Generates limited odour</td>
<td>− Carcasses need to be moved off-sites to designated facilities</td>
</tr>
<tr>
<td></td>
<td>− Reduction of waste volume and weight by as much as 97 %</td>
<td>− Risk of disease spread during transportation</td>
</tr>
<tr>
<td></td>
<td>− Complete destruction of pathogens, including prions</td>
<td>− Potential issues regarding disposal of effluent</td>
</tr>
</tbody>
</table>
### Table 7.6: Environmental and Economics Comparison of different carcass disposal methods

<table>
<thead>
<tr>
<th>Disposal Options</th>
<th>Economics (Cost US$)</th>
<th>Environmental</th>
<th>Water</th>
<th>Health</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capital</td>
<td>Operating</td>
<td>Air - emission of air pollutants (SOx, NOx PM)</td>
<td>Soil - contamination from dioxins and OCBs (pyre)</td>
<td>Water - potential groundwater contamination from hydrocarbon fuels</td>
</tr>
<tr>
<td>Incineration</td>
<td>22,000.00</td>
<td>820.00</td>
<td>- none</td>
<td>- none</td>
<td>- odour generation</td>
</tr>
<tr>
<td>Open Burning</td>
<td>7,500.00</td>
<td>250.00</td>
<td>- emission of air pollutants (SOx, NOx PM)</td>
<td>- contamination by leachate from ash during rainfall</td>
<td>- potential groundwater contamination from fuels</td>
</tr>
<tr>
<td>Land Fill</td>
<td>2,200,000.00</td>
<td>720.00</td>
<td>- emission of green house gases</td>
<td>- contamination by leachate</td>
<td>- leachate from poorly designed landfills</td>
</tr>
<tr>
<td>Burial</td>
<td>11,500.00</td>
<td>720.00</td>
<td>- emission of air pollutants (SOx, NOx PM)</td>
<td>- contamination by leachate</td>
<td>- contamination by leachate</td>
</tr>
<tr>
<td>Compost</td>
<td>15,200.00</td>
<td>800.00</td>
<td>- contamination by leachate</td>
<td>- contamination by leachate</td>
<td>- vector attraction</td>
</tr>
<tr>
<td>Rendering</td>
<td>38,000.00</td>
<td>250.00</td>
<td>- emission of air pollutants (SOx, NOx PM)</td>
<td>- none</td>
<td>- elevated BOD, phosphorous, suspended solids &amp; nitrogen in wastewater</td>
</tr>
<tr>
<td>Alkaline hydrolysis</td>
<td>1,100,000.00</td>
<td>250.00</td>
<td>- none</td>
<td>- contamination from spillage of chemicals</td>
<td>- contamination from surface run-off</td>
</tr>
</tbody>
</table>

Note: Operating cost is calculated per ton
7.2.9 Recommended Options for Carcass Disposal

The costs (capital and operational), volumes of carcasses and availability of the required equipment were considered in recommending appropriate disposal methods for Nigeria (Table 7.6). Based on these, the following options are considered best for the Nigerian environment.

- Incineration is the most effective option for pathogen destruction although it is expensive and its waste product (ash) has no significant environmental impacts and could be disposed of in a landfill.

- Open burning is recommended if it can be conducted far away from residential communities and water resources. It is effective against pathogens, inexpensive and the required inputs are readily available. However, a monitoring programme needs to be put in place to address potential environmental concerns.

- Composting is recommended for managing high mortality rates. If conducted properly, it is environmentally safe and effectively destroys pathogens. It is relatively inexpensive and generates end product that could improve soil fertility.

7.3 Guidelines for Selecting Carcasses Disposal Options

Major issues related to carcass disposal method include the number of animals involved, biosecurity concerns over movement of infected and exposed animals, people and equipment, environmental concerns, and the psychological distress and anxiety experienced by producers and emergency workers.

A disposal option hierarchy is incapable of fully capturing and systematizing the relevant dimensions at stake, and decision makers need to consider all available means. It therefore requires a comprehensive understanding of carcass disposal technologies and must reflect a balance between the scientific, economic, and social issues at stake. Timely slaughter, maintenance of security and prevention of further spread of disease, are the essential considerations in terms of disease control. Annex 2 provides flowcharts to guide in choosing the most appropriate options based on local condition (rural or urban area).
Chapter 8.0: Financing Options and Private Sector Participation

8.1 Financing Options

In Nigeria waste management is strictly the responsibility of the States and Local Governments. This approach has however not been effective with regards to the numerous heap of waste seen on the street of the major cities in the country and existing waste management infrastructures. It is noteworthy to mention that there is no sanitary landfill in any of the 36 states of the federation but only open dumpsites with their attendant health and environmental problems.

Budget allocation to waste management in the states is meagre compared to the population and volume of waste generated per annum in the states. The SEPA/SMEnv and waste management authorities where they exist need to actively seek private sector investment in upgrading existing infrastructure on a build, own and operate (BOO) or build, own and transfer (BOT) basis. This is the only way to improve existing and current waste management effort in the country considering the limited resources of the government.

The current budget allocation needs to be increased about 2000-5000% for the existing situation to be effectively tackled. Development partners (World Bank, IFC, WHO etc) need to urgently come to the assistance of the country to prevent the major public health problem that might arise from the existing situation.

8.2 Private Sector Participation

Private sector participation (PSP) in waste management including medical waste is possible at state and local levels. Private waste collectors may be contracted to provide waste transportation from individual healthcare facilities to designated disposal facilities within each local government. At the state level, major private operators may sign a contract to Build, Operate, and Transfer (BOT) or Build, Own, and Operate (BOO) specialized waste management treatment or disposal facilities for medical and hazardous wastes.

As with the other sectors of the economy, the private sector can play a significant role in providing waste treatment and disposal services if the Federal Government provides an enabling environment and clear set of rules about division of responsibilities between the contracting parties (i.e. regulatory authority, healthcare facility, and private operator). The essential conditions for private sector participation are transparency, competition, and accountability. Adequate budget provision is also required at the healthcare facility or the local authority level to pay the private operator.

8.3 Public-Private Partnership

Based on the experience of other developing countries, the only logical option is to integrate PSP into waste management in Nigeria. Effective public-private partnership has been demonstrated by the various privatisations and commercialisations of government entities and allowing the private sector to drive the economy and be its engine of growth.

PSP operation in Nigeria is most visible in Lagos and Abuja. In Abuja, private contractors registered with the Abuja Environmental Protection Bureau (AEPB), collect waste generated from residences and industrial facilities for disposal at government operated dumpsites. This arrangement has been effective and sets the pace for such initiative in other parts of the country. Meanwhile in Lagos, the introduction of PSP operators has started to yield result considering the reduced heap of waste in the different parts of the state.

Under the existing arrangement certain operators can be designated to collect special wastes from medical and industrial facilities for safe transport in special containers and vehicle to
government operated facilities. The waste management authorities, however, would need to invest in creating separate areas at the dumpsite for the disposal of such special wastes.

The polluter pay principle is been practiced in some part of the country (it was as discovered during the field visits that the LUTH and all General Hospitals in Lagos transport their medical waste to the National Orthopaedic Hospital (NOH), Igbobi for treatment and disposal, since it has a functional diesel powered incinerator which was installed in 1999. To cover the operational cost NOH Igbobi charges other public hospitals for their waste (N90 for each cartoon of sharps and N500 for per kg of infectious wastes).

This arrangement should be encouraged in all the other states in view of the fact that securing funds to procure and install new equipment is a major challenge. Under the present teaching hospital rehabilitations, the major TH should source external funding to acquire treatments technologies e.g. incinerator with excess capacity to service other hospitals in the states.
Chapter 9.0: Training and Capacity Building

To achieve effective medical waste management in Nigeria, appropriate trainings of the healthcare facilities management and relevant institutions personnel at the Federal, State and Local levels are urgently required. The necessary trainings for the various institutions and agencies involved in medical waste management are presented in Tables 9.1 - 9.3, which also outlines the essential training for effective disposal of AI infested carcasses.

9.1 Training Needs Assessment

Correct attitudes for effective medical waste management result from knowledge and awareness regarding the potential risk of healthcare and administrative procedures for handling the waste. Apart from a general understanding of the requirements of waste management, each category of personnel (doctors, nurses, ward attendants, cleaners, administrative staff, waste transporters, dumpsite hospital etc.) needs to be trained. For the training to be successful and to lead to the desired objective, participants must become aware of the risks linked to medical waste management.

The principal groups involved in waste generation and management are:

- Primary group: (i) management and administrative staff; (ii) medical and laboratory staff; (iii) ward attendants, caretakers, ground workers and other support staff; and
- Secondary group: patients, visitors, scavengers and the local communities, waste collectors/transporters, disposal site operators etc.

The training needs identified based on interview of the categories of actors involved are presented below:

Healthcare Staff

Administrative staff

- Information on potential risks and advice about health and security
- Basic knowledge of procedures of medical waste collection, storage, transportation, treatment and final disposal including the management of risks.
- Use of protection and security equipment
- Medical waste management guidelines
- Financial resources to be allocated to waste management.

Doctors, nurses, midwives, etc.

- Information on the risks; advice about health and security
- Basic knowledge about procedures of HCWM waste collection, storage, transportation, treatment and final disposal including the management of risks.
- Use of protection and security equipment (protective clothes)
- Strategies to control and ensure that used disposable equipment/materials are placed in appropriate disposal and collection facilities and to ensure that all patients are safe from injury or hazards resulting from medical waste
- HCW segregation at source
- Staff orientation on the guidelines for waste management
- Good practices on medical waste

Cleaners, ward attendants, grounds attendants, other personnel in touch with waste, etc.

- Information on the risks; advice about health and security
- Basic knowledge about procedures of medical waste collection, storage, transportation, treatment and final disposal including the management of risks.
- Collection and transportation of waste containers
- Use of protection and security equipment (protective clothes)
- Good practices on medical waste
Waste Management Company Personnel

**Waste Management Operators**
- Information on the risks; advice about health and security
- Basic knowledge about procedures of wastes handling, including risk management.
- Use of protection and security equipment.

**Waste Transportation Staff**
- Risks linked with waste transportation;
- Procedures for waste handling: loading and unloading;
- Equipment such as vehicles for waste transportation;
- Protection equipment.

**Treatment Systems Operators**
- Treatment and operating process guidelines;
- Health and security related to the operating system;
- Procedures in emergency cases and help;
- Technical and maintenance procedures;
- Control of waste production;

**Disposal Managers**
- Information about health and security
- Control of scavenging activities and recycling of used instruments;
- Protection equipment and personal hygiene;
- Secure procedures for the management of wastes at the disposal site;
- Measures concerning emergency cases and help.

**Others**

**Patients and visitors**
- Advice on basic medical waste management
- Proper use of waste containers

### 9.1.2 Training Strategy and Plan

The training strategy shall operationalize the NMWMP in all healthcare facilities by promoting the emergence of professionals in waste management; raising the sense of responsibility of healthcare personnel; and safeguarding health and security of health staff and waste handlers. The training plan shall be structured around the following principles:

- **Train-the-trainers:** this involves training the senior officer in healthcare facilities. The training sessions will be held in every healthcare facilities in the state.
- **Training healthcare staffs:** already trained senior staff member will train other healthcare centres staff member. These training sessions will be held in each local government area (LGA) and will be conducted by the already trained key staff; and
- **Training medical waste management supporting staffs** in health centres (ward attendants, ground workers, cleaners). These training sessions will be held in every healthcare facility and will be conducted by already trained hospital staff.

The training modules will include proper handling of medical waste: sustainable management process (collection, storage, transportation, treatment, and disposal); best practices; maintenance and protection measures. The training of medical and paramedical staff remains a priority if the program is to have a major impact on medical waste management. The training plans for medical waste and AI infected carcasses are provided in Table 9.1 and 9.2.
Table 9.1: Summarized Medical Waste Training Plan

<table>
<thead>
<tr>
<th>Training Subject</th>
<th>Category of Target Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Basic Knowledge about Medical Waste</td>
<td></td>
</tr>
<tr>
<td>Waste categories</td>
<td>✓</td>
</tr>
<tr>
<td>Hazardous potential of certain waste categories</td>
<td>✓</td>
</tr>
<tr>
<td>Transmission of hospital acquired infection</td>
<td>✓</td>
</tr>
<tr>
<td>Health risk for health care personnel</td>
<td>✓</td>
</tr>
<tr>
<td>Proper behaviour of waste generators</td>
<td></td>
</tr>
<tr>
<td>Environmentally sound handling of residues</td>
<td>✓</td>
</tr>
<tr>
<td>Waste avoidance and reduction possibilities</td>
<td>✓</td>
</tr>
<tr>
<td>Identification of waste categories</td>
<td>✓</td>
</tr>
<tr>
<td>Separation of waste categories</td>
<td>✓</td>
</tr>
<tr>
<td>Knowledge about appropriate waste containers</td>
<td>✓</td>
</tr>
<tr>
<td>Proper handling of waste</td>
<td></td>
</tr>
<tr>
<td>Adequate waste removal frequency</td>
<td>✓</td>
</tr>
<tr>
<td>Safe transport containers and procedures</td>
<td>✓</td>
</tr>
<tr>
<td>Recycling and re-use of waste components</td>
<td>✓</td>
</tr>
<tr>
<td>Safe storage of waste</td>
<td>✓</td>
</tr>
<tr>
<td>Cleaning and maintenance of collection, transportation and storage facilities</td>
<td>✓</td>
</tr>
<tr>
<td>Cleaning and maintenance of sanitation facilities, drains and piping</td>
<td>✓</td>
</tr>
<tr>
<td>Handling of infectious laundry</td>
<td>✓</td>
</tr>
<tr>
<td>Handling of chemical and radioactive waste, outdated drugs</td>
<td>✓</td>
</tr>
<tr>
<td>Maintenance of septic tanks and other sewage treatment facilities</td>
<td>✓</td>
</tr>
<tr>
<td>Maintenance and operation of incinerator for infectious waste</td>
<td>✓</td>
</tr>
<tr>
<td>Maintenance and operation of waste pit and landfill site</td>
<td>✓</td>
</tr>
<tr>
<td>Safety regulation in waste management, protective clothing</td>
<td>✓</td>
</tr>
<tr>
<td>Emergency regulations in waste management</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of a waste management system</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>Establishment and implementation of a waste management plan</td>
<td>✓</td>
</tr>
<tr>
<td>Sampling of waste quantities, monitoring and data collection</td>
<td>✓</td>
</tr>
<tr>
<td>Monitoring and supervision of waste management practices</td>
<td>✓</td>
</tr>
<tr>
<td>Cost monitoring of waste management</td>
<td>✓</td>
</tr>
<tr>
<td>Establishment of a chain of responsibilities</td>
<td>✓</td>
</tr>
<tr>
<td>Set-up of occupational safety and emergency regulations</td>
<td>✓</td>
</tr>
<tr>
<td>Interaction with City assemblies or private sector waste handling structures</td>
<td>✓</td>
</tr>
<tr>
<td>Public relation and interaction with local community</td>
<td>✓</td>
</tr>
</tbody>
</table>

Note
A - Management & Administrative Staff
B - Medical Laboratory Staff
C - Ward attendants, caretakers, ground workers and other support staff
D - Patients & Visitors
E - Waste Management Facility Operator
F - Waste Collection & Transportation Staff
G - Treatment Systems Operators
H - Disposal Managers
### Table 9.2: Summarized Carcass Management Training Programme

<table>
<thead>
<tr>
<th>Training Subject</th>
<th>Category of Target Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td><strong>AI and AI Infected Carcass: Introduction</strong></td>
<td></td>
</tr>
<tr>
<td>Potential Hazards associated with medical waste</td>
<td>✓</td>
</tr>
<tr>
<td>Transmission of virus from carcass to human</td>
<td>✓</td>
</tr>
<tr>
<td>Health risk for carcass handling personnel</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Carcass Handling</strong></td>
<td></td>
</tr>
<tr>
<td>Needs and proper use of PPE</td>
<td>✓</td>
</tr>
<tr>
<td>Regulations and policies regarding Public and Environmental Health protection</td>
<td>✓</td>
</tr>
<tr>
<td>Techniques on prevention of equipment and personnel contamination</td>
<td>✓</td>
</tr>
<tr>
<td>Personnel health monitoring</td>
<td>✓</td>
</tr>
<tr>
<td>Procedures for deterring scavengers</td>
<td>✓</td>
</tr>
<tr>
<td>Loading and unloading carcass procedure</td>
<td>✓</td>
</tr>
<tr>
<td>Emergency response procedure</td>
<td>✓</td>
</tr>
<tr>
<td>Appropriate decontamination procedures</td>
<td>✓</td>
</tr>
<tr>
<td>Proper handling of chemicals (disinfectants)</td>
<td>✓</td>
</tr>
<tr>
<td>Proper documentation and reporting procedures</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Carcass Disposal</strong></td>
<td></td>
</tr>
<tr>
<td>Fire outbreak preparedness and contingency plan</td>
<td>✓</td>
</tr>
<tr>
<td>Environmental and Public Health protection Regulations/Policies</td>
<td>✓</td>
</tr>
<tr>
<td>Health and safety precautions on AI infested carcass disposal</td>
<td>✓</td>
</tr>
<tr>
<td>Need for regular environmental monitoring (air, water &amp; soil) at the disposal site</td>
<td>✓</td>
</tr>
<tr>
<td>Proper and timely reporting to the relevant authorities</td>
<td>✓</td>
</tr>
<tr>
<td>Health consequences of poor disposal management</td>
<td>✓</td>
</tr>
<tr>
<td>Fire outbreak preparedness and contingency plan</td>
<td></td>
</tr>
<tr>
<td>Appropriate decontamination procedure</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Key**

A - Carcass handlers  
B - Carcass transporters  
C - Disposal Site Operators  
D - Supervisors  
E - Disposal Site Security  
F - Government Agencies e.g. SEPA, FMOH, FMEnv, LGA etc
9.2 Cost Estimates

- Medical Waste Management Training

The cost estimates are based on the assumption that resource persons and participants will be sourced within the states and the federal capital territory. It is proposed that the training programme will be implemented within the first two years of the plan implementation period. The total cost is estimated (Table 9.3) at US $1,100,000.00.

<table>
<thead>
<tr>
<th>Program</th>
<th>Target Group</th>
<th>Days</th>
<th>Number/ Frequency</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train-the-trainer</td>
<td>Doctors, Environmental Health Officers etc</td>
<td>3</td>
<td>2</td>
<td>100,000.00</td>
</tr>
<tr>
<td>Hospital Staff</td>
<td>Medical Staff, nurses</td>
<td>3</td>
<td>2</td>
<td>200,000.00</td>
</tr>
<tr>
<td>Support Staff</td>
<td>Ward attendants, cleaners etc</td>
<td>3</td>
<td>5</td>
<td>800,000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1,100,000.00</strong></td>
</tr>
</tbody>
</table>

- Carcass Disposal Training

The cost estimates covers one year training for all the personnel involved nationwide, based on the assumption of 60 Carcass Handlers; 60 Carcass transporters, 40 Disposal facility operators; 20 Supervisors (from LGAs); 40 Security officers and 10 Institutions & Govt Agencies for all the states and the federal capital territory. These estimates do not include allowance for travel expenses, as it is assumed that resource persons will be sourced within each state. The total cost is estimated (Table 9.4) at US $150,000.00.

<table>
<thead>
<tr>
<th>Program</th>
<th>Target Group</th>
<th>Days</th>
<th>Frequency</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSE Precautions</td>
<td>Carcass Handlers, Carcass Transporters, Disposal Facility Operator, Supervisors, Security Officers</td>
<td>5</td>
<td>2</td>
<td>75,000.00</td>
</tr>
<tr>
<td>Carcass Handling Risks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code of Hygiene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loading and Unloading Procedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio-security Procedures</td>
<td>Government Agencies</td>
<td>5</td>
<td>2</td>
<td>75,000.00</td>
</tr>
<tr>
<td>Public Health Monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scavengers Deterring Procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation /Reporting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>150,000.00</strong></td>
</tr>
</tbody>
</table>
Chapter 10.0: Monitoring and Evaluation

Monitoring is required to follow-up on decisions made to intervene in various activities of medical waste management in order to protect human health and the environment. This can be achieved through periodic internal and external processes of monitoring and evaluation on a continuous basis, at all institutional levels. In this way management will be able to assess compliance with regulatory requirements at national, state and local levels.

To ensure that objectives of the National Medical Waste Management Plan are achieved, the implementation of the plan has to be monitored by both internal and external bodies including the Federal and States Ministries of Health and Environment. These agencies will determine their respective monitoring tools. The monitoring and evaluation (M&E) will assist in evaluating the strengths and weaknesses of the plan and the activities implemented under it. Where the weaknesses exist, the plan will be revised and improvements will be made.

10.1 Monitoring and Evaluation Objectives

The aim of the M&E is to establish appropriate criteria to address potential negative impacts of existing MWM and to ensure that unforeseen impacts are detected and the mitigation measures implemented at an early stage. Specific objectives of the monitoring plan are to:

- ensure that any additional impacts are addressed appropriately;
- check the effectiveness of recommended action plans and mitigation measures;
- ensure that the proposed mitigation measures are appropriate;
- demonstrate that medical waste management is being implemented according to plan and existing regulatory procedures; and
- provide feedback to implementing agencies in order to make modifications to the operational activities where necessary.

10.2 Monitoring Indicators

The following will be used to monitor progress in implementing the medical waste management plan:

- Development of National Environmental Health Policy and technical safety guidelines on medical waste management;
- Enactment of necessary legislation governing, regulating and creating community awareness campaigns addressing medical waste concerns;
- Development of relevant institutional arrangements to plan and implement policies for addressing medical waste concerns;
- Development of human resource capacity in all health care facilities;
- Development of an Management Information System (MIS) on waste generation;
- Development of collaborative mechanisms with private sectors and development partners to finance waste treatment/disposal facilities; and
- Development of database for inventorying the types of waste and volume generated by health-care institutions nationwide

The monitoring of environmental effects is necessary to ensure that predicted impacts are addressed effectively and efficiently through the mitigate measures indicated. Specific monitoring indicators for consideration include the following:

**Internal Packaging and Storage**

- Separation of waste (at point of generation)
- Storage bins / bags
- Frequency of removal
External Packaging and Storage
- Segregation of waste
- Storage area
- Frequency of waste removal
- Amount of waste generated per day

Transportation
- Identification of waste management contractor (accredited or certified)
- Conditions for transportation
- Equipment/vehicles (to prevent scattering, spillage, odour nuisance and leakage).

Treatment and Disposal
- Incineration
- Sterilisation by Heat
- Disinfection by steam
- Chemical disinfection
- Sanitary Landfill

Administration
- Establishment / functioning of a Waste Management Committee
- Availability of waste management plans
- Collection and Analysis of data

10.3 Monitoring Plan
An effective control of medical waste and monitoring of facilities should be carried out regularly, in order to maintain and improve management of the waste. Measures should be adopted to ensure that problems and risks involved are identified while enhancing safety and preventing the development of future problems.

Compliance and enforcement with legislation shall be ensured through co-ordinating and regulatory bodies. These bodies should include FMOH, FMEnv, SMOH, SEPs. They shall undertake regular monitoring of these facilities, with the aim of establishing long-term sustainability in medical waste management. The bodies shall ensure compliance with the following:
- Segregation i.e. sharps, pathological, hazardous and radioactive waste from other waste. Picture stickers shall be used in rural areas for identification.
- Collection routines including packaging and labelling
- On-site treatment procedures like sterilisation, disinfection and incineration. It should be ensured that the incinerator plant continually burns its materials at a temperature of 1200°C and above to eliminate the release of dioxins.
- Storage into appropriate, labelled and adequate containers for both internal and external storage.
- Transportation i.e. needs and conditions including certification.
- Worker safety measures
- Disposal at sanitary landfills, cemetery or crematorium.

To ensure effective record keeping, each health institutions shall keep records on:
- The type and volume or weight of waste generated
- The means of transportation, type and volume transported
- Commissioned waste contractor (company name, type of license, treatment and disposal).
- Disposal method - volume incinerated, volume treated and disposed

These records shall be kept at the Public Health Unit of the health institution for a minimum of five (5) years, before being sent to the archives. Monthly returns shall be prepared and submitted to the SMOHs and SEPs. Annual waste generation reports should be prepared by
each health institution and copies sent to the SMOHs and SEPAAs who will consolidate the data for each state and forward it to FMOH and FMEnv. The monitoring plan as presented in Table 10.1 requires the following components to ensure effective results:

- Relevant baseline data against which to monitor project results;
- Verifiably objective indicators for each project for which monitoring will be conducted;
- An independent body responsible for monitoring;
- Capacity for monitoring;
- Monitoring on a regular basis;
- An effective monitoring reporting mechanism including feedback and commitment to action on monitoring results and recommendations.
<table>
<thead>
<tr>
<th>Table 10.1: Monitoring and Evaluation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
</tr>
<tr>
<td><strong>Generation/Segregation</strong></td>
</tr>
<tr>
<td>To ensure all generated wastes from HCF is collected and properly segregated</td>
</tr>
<tr>
<td>Employ environmentally sound waste segregation practices</td>
</tr>
<tr>
<td>To ensure development of Occupational health and safety guidelines</td>
</tr>
<tr>
<td><strong>Collection/Transportation</strong></td>
</tr>
<tr>
<td>Determine types of wastes, total inventory of medical waste and assess its impact</td>
</tr>
<tr>
<td>To ensure that collection (packaging, labelling) and transportation is done in environmentally sound manner</td>
</tr>
<tr>
<td>Environmental guidelines for solid and hazardous waste management</td>
</tr>
<tr>
<td><strong>Treatment and Disposal</strong></td>
</tr>
<tr>
<td>Ensure that no chemicals and wastewater from equipment washing, at HCF are introduced into sewage system. Monitor air quality at the incineration plant</td>
</tr>
<tr>
<td>Investigate whether recommended treatment and disposal methods are practiced</td>
</tr>
<tr>
<td>To ensure effective record keeping of medical wastes disposed.</td>
</tr>
<tr>
<td><strong>Training and Awareness</strong></td>
</tr>
<tr>
<td>Investigate whether training have been conducted and the effectiveness of such training</td>
</tr>
<tr>
<td>Develop fliers, posters and other appropriate aids on medical waste issues</td>
</tr>
</tbody>
</table>
### 10.4 National Medical Waste Management Action Plan

The detailed plan for implementation of the NMWMP is presented in Table 10.1. It identifies the indicators to be tracked, specific tasks to be executed and assigns responsibility for waste collection to specific agencies.

For the national plan to be effectively implemented, all healthcare facilities in the country need to develop standardized plans based on their existing needs. Such plans should focus on treatment, recycling, transportation and disposal options though safe and cost effective treatment and disposal methods.

The most critical needs for the implementation of the national plan are funding and skilled/well-trained manpower. The critical issues identified during the study include the following:

- Inadequate legal, regulatory and administrative framework for waste management
- Poor medical waste management practices in healthcare facilities and government disposal sites with regard to handling and disposal
- Lack of waste generation data
- Inadequate waste treatment and disposal equipment
- Inadequate knowledge among those involved in medical waste management
- Lack of awareness on medical waste among health workers and the general public
- Poor management practices at hospitals and dumpsites
- Lack of code of conduct and technical guidelines for safety measures

#### 10.4.1 Priority (Three Year) Action Plan

A schedule of activities and strategies to ensure this plan reach its objectives is presented in Figure 10.1. The priority areas that need immediate action are:

- Strengthening public and private sector involvement
- Building management capacity at all levels
- Coordinating, monitoring and evaluating medical waste management

**Strengthen management capacity**

- Facilitate policy development to guide revision of relevant legislation by year 2007
- Establish a comprehensive framework with strong community involvement for effective development of medical waste management by year 2008
- Ensure that all generation sources of infectious and hazardous waste is segregated from municipal/household waste by year 2008

**Provide support to the public and private sector**

- Ensure that appropriate environmentally sound transport and disposal methods are applied at all healthcare facilities and municipal dumpsites by year 2009
- Develop national medical waste inventory system and by year 2008

**Improve Health Management Information System (HMIS)**

- Improve medical waste information system
- Incorporate statistics into health information system health-care waste by year 2008

**Enhance public awareness in medical waste management**

- Develop communication strategy to create awareness on potential risks by year 2008
- Incorporate medical waste management into medical, nursing and paramedical institutions curricula by year 2008
- Promote education component of medical waste management into Primary Health Care by year 2008
<table>
<thead>
<tr>
<th>Nos</th>
<th>Activity</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>provide appropriate collection, storage and segregation containers at all medical facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>develop national environmental health policy to include medical waste management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>revise national hazardous waste management regulations to include medical waste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>propose medical waste management regulations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>facilitate the procurement of medical waste management facilities in hospitals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>procure equipment for public hospitals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>conduct comprehensive waste audit of all hospitals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>develop monitoring and supervisory framework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>establish medical statistics reporting system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>conduct trainings and workshops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>develop and produce public awareness materials e.g. posters, billboards etc</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>conduct situational analysis and develop funding framework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>develop standardize reporting format for use by medical institutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>develop three-tiers monitoring and evaluation systems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig 10.1: Three Year Medical Waste Management Programme Plan
Strengthen monitoring and evaluation of medical waste management

- Ensure financial management systems accountability and transparency through in medical waste management by year 2009
- Formulate resource mobilization framework by year 2009
- Develop indicators for reporting by various stakeholders by year 2009
- Develop monitoring and evaluation system at federal, state and local government levels by year 2009

10.4.2 Implementation Arrangements

- **Strengthen management capacity**
  FMOH will be responsible for revision of regulation, policy development efforts and establishing a collaborative framework with other stakeholders including states and local government. These activities should be conducted in the first year of the national action plan by the Department of Public Health Services.

  - **Provide support to the public and private sector**
    FMOH and SMOHs will be responsible for ensuring that both public and private healthcare institutions receive assistance in deploying safe practices and equipment. They will cooperate with the local governments to introduce improved medical waste management systems in all hospitals. FMOH and FME will regulate the medical waste management in health facilities, SMOH will supply health facility managers with equipment and materials, and execution of improvement programs will be conducted by health facility managers and their staff.

  - **Improve Health Management Information System (HMIS)**
    FMOH is responsible for developing an inventorying system. The SMOH and state hospital boards will assist the FMOH in deploying this system within the first two years of the plan.

  - **Enhance public awareness in medical waste management**
    The Health Education Department of the FMOH will lead the activities intended to make the general public aware about the risk involved in medical waste handling. SMOHs will support the FMOH and supervise implementation at the local government levels. These activities will take place within year two and three of the plan through radio and television messages, posters, etc.

  - **Strengthen monitoring and evaluation of medical waste management**
    The training activities to improve monitoring activities shall be by the FMOH in collaboration with respective state and local government agencies. Specific training activities will be done in the first two years of the plan implementation. The control and monitoring of the priority action plan implementation should be done by the SMOHs which will ensure monthly monitoring, while the yearly follow up will be realized by FMOH/FME.

  - **Private Sector Involvement**
    FMOH will liaise with states and local governments who are currently operating public-private waste management schemes to engage contractors on a pilot basis for collection of medical waste in order to optimise the utilisation of the existing waste collection system.

  - **Evaluation and Supervision**
    The overall evaluation of the plan should be assigned to consultants to ensure objectivity. This evaluation should be done annually during the three year implementation period.
<table>
<thead>
<tr>
<th>Nos</th>
<th>Activity</th>
<th>Human Resources</th>
<th>Funding (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>provide appropriate collection, storage and segregation containers at all medical facilities</td>
<td>waste management and procurement specialist</td>
<td>3,000,000</td>
</tr>
<tr>
<td>2</td>
<td>develop national environmental health policy to include medical waste management</td>
<td>environmental management specialist, environmental health and public health management specialist</td>
<td>200,000</td>
</tr>
<tr>
<td>3</td>
<td>revise national hazardous waste management regulations to include medical waste</td>
<td>environmental law practitioners and consultants</td>
<td>15,000</td>
</tr>
<tr>
<td>4</td>
<td>propose medical waste management regulations</td>
<td>consultants, environmental health and public health management specialist</td>
<td>15,000</td>
</tr>
<tr>
<td>5</td>
<td>facilitate the procurement of medical waste management facilities in hospitals</td>
<td>procurement and financial management specialists</td>
<td>5,000,000</td>
</tr>
<tr>
<td>6</td>
<td>procure equipment for public hospitals</td>
<td>procurement and financial management specialists</td>
<td>5,000,000</td>
</tr>
<tr>
<td>7</td>
<td>conduct comprehensive waste audit of all hospitals</td>
<td>consultants, medical waste management specialists etc</td>
<td>1,000,000</td>
</tr>
<tr>
<td>8</td>
<td>develop monitoring and supervisory framework, develop standardize reporting format for use by medical institutions</td>
<td>consultants, monitoring and evaluation specialists</td>
<td>50,000</td>
</tr>
<tr>
<td>9</td>
<td>establish medical statistics reporting system</td>
<td>consultants, database designers &amp; administrators, software engineers</td>
<td>200,000</td>
</tr>
<tr>
<td>10</td>
<td>conduct trainings and workshops</td>
<td>consultants, medical waste management specialists etc</td>
<td>1,000,000</td>
</tr>
<tr>
<td>11</td>
<td>develop and produce public awareness materials e.g. posters, billboards etc</td>
<td>print and electronic media agencies graphic artist etc</td>
<td>250,000</td>
</tr>
<tr>
<td>12</td>
<td>conduct situational analysis and develop funding framework</td>
<td>Consultants, public/private sector funding specialists</td>
<td>100,000</td>
</tr>
<tr>
<td>13</td>
<td>develop three-tiers (national, state and local government) monitoring and evaluation systems</td>
<td>consultants, monitoring and evaluation specialists</td>
<td>150,000</td>
</tr>
</tbody>
</table>
### Table 10.3: Monitoring Action Plan Framework

<table>
<thead>
<tr>
<th>Objective</th>
<th>Responsible Agency</th>
<th>Performance Indicator</th>
<th>Frequency/Means of Verification</th>
<th>Cost US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constitute national technical committee on medical waste by Year 2007</td>
<td>FGN</td>
<td>- Inauguration of committee</td>
<td>- Inauguration of committee</td>
<td>N/A</td>
</tr>
<tr>
<td>Revise existing waste management legislation to include medical wastes</td>
<td>FMOH/FMEnv</td>
<td>- Copy of new regulation with medical waste management section</td>
<td>- Publication of revised legislation</td>
<td>N/A</td>
</tr>
<tr>
<td>Establish an effective institutional and legal framework for medical waste management</td>
<td>FMOH/FMEnv</td>
<td>- Convene national workshop to address medical waste management</td>
<td>- Bi-annual though 2008</td>
<td>100,000</td>
</tr>
<tr>
<td>Develop detailed medical waste management guideline</td>
<td>FMOH/FMEnv</td>
<td>- Copy of guideline</td>
<td>- publication of guideline</td>
<td>50,000</td>
</tr>
<tr>
<td>Develop national occupational health and safety guidelines for different industries include healthcare facilities</td>
<td>FMOH/FMEnv</td>
<td>- Copy of guideline</td>
<td>- Publication of OSH guideline</td>
<td>50,000</td>
</tr>
<tr>
<td>Establish a framework for public involvement</td>
<td>FME/FMOH</td>
<td>- Establish framework with full public involvement, hold public hearings</td>
<td>- Convene national hearings in 2007</td>
<td>100,000</td>
</tr>
<tr>
<td>Ensure environmentally sound technology and disposal methods are in place</td>
<td>FME/FMOH</td>
<td>- Facilitate the building of a major treatment and disposal facilities in the six zones by year 2009</td>
<td>- Commissioning of facilities</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Ensure at least one special purpose waste collection truck is functional in each state</td>
<td>FME/FMOH</td>
<td>- Facilitate funding and technical assistance to procure by Year 2009</td>
<td>- Commissioning of trucks</td>
<td>200,000</td>
</tr>
<tr>
<td>Develop a national record and reporting system for medical wastes generated per state</td>
<td>FMOH/SMOH/FME/FSEPA</td>
<td>- Information management system in place by Year 2008</td>
<td>- Quarterly reports from year 2009</td>
<td>150,000</td>
</tr>
<tr>
<td>Establish a monitoring and supervisory programme for health care facilities and disposal sites</td>
<td>FMOH/SMOH FMEnv/SEPAs</td>
<td>- Conduct visits to each medical waste management facility in the nation</td>
<td>- Visit reports</td>
<td>150,000</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Enhance public awareness of medical waste management by Year 2008</td>
<td>FMOH/SMOH FMEnv/SEPAs FMOI/SMOI NGOs/CBOs Dev Partners</td>
<td>- Number of ongoing public awareness programmes</td>
<td>- Quarterly via different media</td>
<td>100,000</td>
</tr>
<tr>
<td>Develop communication strategy to create awareness on potential risks through workshops and seminars</td>
<td>FMOH/SMOH FMEnv/SEPAs FMOI/SMOI NGOs/CBOs</td>
<td>- Conduct 3 seminars in each region by year 2007</td>
<td>- Quarterly</td>
<td>100,000</td>
</tr>
<tr>
<td>Develop brochures, posters and billboards on medical waste issues</td>
<td>FMOH/SMOH FMEnv/SEPAs FMOI/SMOI NGOs/CBOs</td>
<td>- Brochures, pamphlets and posters available in the three major languages</td>
<td>- Presence of materials in major cities and rural areas</td>
<td>100,000</td>
</tr>
<tr>
<td>Set up financial management and accountability system for plan implementation</td>
<td>FMF FMOH FMEnv</td>
<td>- Financial and accounting records</td>
<td>- easy accessibility of audited report at SMOHs</td>
<td>150,000</td>
</tr>
<tr>
<td>Develop indicators for reporting by various stakeholders</td>
<td>FMOH/SMOH FMEnv/SEPAs</td>
<td>- Set up mechanism for documenting, publishing and disseminating medical waste data</td>
<td>- acceptance of indicators by various stakeholders</td>
<td>100,000</td>
</tr>
</tbody>
</table>
Chapter 11.0: Public Awareness and Consultation

To ensure the successful implementation of this plan, the FMOH has responsibilities to effectively engage stakeholders in achieving its objectives for the benefit of all. The implementation of the plan depends on the meaningful participation of all stakeholders for success. The public awareness process will be focused on informing the general public and scavengers about potential dangers associated with medical waste handling.

The scope of this Public Awareness Plan includes the entire 36 states of the federation where the plan will be implemented. It describes the avenues that will be used to convey the plan implementation information to the public.

11.1 Objectives

This public awareness/consultation plan provides a framework for achieving effective stakeholder involvement and promoting greater awareness and understanding of issues so that the plan can be effectively implemented on-time to the satisfaction of all concerned.

To ensure effective implementation of this plan, the FMOH shall be committed to the following principles:

− promoting openness and communication;
− ensuring effective stakeholder involvement in the development of the project;
− increasing public knowledge and understanding of the project implementation process;
− using all strategies and techniques which provide appropriate, timely and adequate opportunities for all concerned parties to participate; and
− evaluating the effectiveness of the engagement plan in accordance with the expected outcomes.

11.2 Potential Stakeholders

The potential stakeholders in the implementation of this plan include the following:

− Patients and visitors
− Government Agencies e.g. Ministries of Health, Environment and Information
− Medical and Paramedical Professionals
− Educational Institutions e.g. Medical Schools, Teaching Hospitals
− Planning Authorities e.g. Town Planning
− Waste Management Authorities
− Other Regulatory bodies e.g. Nigerian Medical Association etc.

11.3 Consultation Strategies

The scope of this Public Awareness Plan includes the entire 36 states of the federation where the plan will be implemented. This Public Awareness Plan describes the avenues that will be used to convey the plan implementation information to the public.

The focus of this public involvement program/plan is to inform the public and invite input relating to the plan and its implementation. As elements of the plan proceed from planning into execution, the FMOH’s objective will be to maintain the public awareness and understanding of the plan. The implementing agencies (FMOH, FMEnv etc) shall execute a program comprising seven strategic elements to accomplish the public awareness objective. A comprehensive public awareness program will include the following:

- Develop and distribute a project newsletter
- Develop presentations and organise seminars and workshops
- Develop and maintain a project web site
- Develop radio and television adverts
- Establish and maintain a project telephone information line
- Prepare project press releases
- Prepare posters and erect billboards

The objective of the public awareness program is to convey information to the public and interested groups. By utilizing a multi-faceted approach to convey information, the success of the effort is optimized. The Public Awareness Plan describes the general approach and specific benefits of each element of the program.

- Newsletters

Newsletters will be written in all major Nigerian languages to include project progress and information, calendars of events, telephone numbers, and information about the web site, location maps, and photographs of ongoing efforts. The newsletters will be printed and distributed quarterly throughout the implementation period. Newsletters differ from press releases in that a newsletter will have a smaller audience, greater depth of reporting, and more issues presented than a press release. Each newsletter will explain how to provide input into the plan. Newsletter shall be distributed through the 36 states and the federal capital in hospitals and other healthcare facilities.

Newsletter distribution points will be identified on the project Web site, and via press releases distributed to the local media. Although the primary method of distribution will be at established distribution points, newsletters will be mailed out upon specific request.

Articles contained in the newsletters will focus on timely or current major events or activities. In addition to stories, each newsletter will include items that will appear consistently from newsletter to newsletter. Such items are questions and answers columns, invitations for questions and comments, project office locations, the website address, a calendar of events and project office telephone numbers.

- Seminars and Workshops

Seminars and workshops will offer the public an opportunity to listen to the experts on different aspects of the plan. These meetings will be broadcasted on local television and radio stations. This will offer the public a convenient opportunity to take advantage of this information.

Newsletters, website, and press releases will advertise the schedule of seminars and workshops. Four seminars and workshops shall be conducted annually throughout the period of the plan implementation. Other presentations will also be made throughout the plan implementation period on an as need basis but will be limited to a reasonable number.

- Web-site

A website will be developed to make the implementation program accessible to those who have internet resources. The site will allow information to be updated constantly. The proposed website shall include at least the following:

- Home page, and general project information,
- Map-based project information
- Graphics (drawings, and photos)
- Contact information (phone and mail) for questions and comments
- Current newsletter
- Comment form

The website shall be updated on a monthly basis as the plan implementation activities progresses. Frequent updating of site information will lead to constant evolution of the site, making it interesting for the viewer. The website shall be online by October 1, 2007.

- Radio and Television Adverts

Radio jingles and TV adverts/announcements shall be developed and aired in all the states of the federation in all major languages. Pertinent information will be offered at intervals to
maintain viewers’ interest on the topic. Two radio jingles and two TV announcements shall be broadcasted in English and the major languages every month, totaling 48 radio and TV messages in major languages per annum.

- **Telephone Information Line**

Dedicated telephone lines will be installed at the FMOH AI project office to provide interested parties with an opportunity to leave questions or comments on a voice mail system. Callers may leave messages and questions for senior project staff to address. The telephone line will be listed in newsletters and press releases.

- **Press Releases**

The implementing agencies will prepare press releases for distribution to the general public at each project milestones. Although press releases are limited on the number of items discussed, they have a wider audience than do newsletters. As with newsletters, press releases will be prepared at periods when public awareness of the project's status is encouraged or when significant milestones occur.

To optimize the benefit of press releases and newsletters, both elements of the Public Awareness Plan must be coordinated. Coordinating the distribution of both forms of information dissemination will optimize the public awareness process. Public Awareness Plans are most effective when several strategies are implemented as part of a coordinated program. In certain situations, a single media approach may suffice.

- **Posters and Billboards**

Posters and billboards shall be pasted and installed in strategic places to make them accessible to the general public. A total of 74 billboards and 7200 posters will be distributed across the 36 states and the federal capital.

The public awareness plan would be effective since several medium would be used as part of a coordinated program. Although some strategies may be more effective than other elements, combining several techniques and different media in conveying plan/project information to the public would creates an optimal approach.

Interlaced throughout the design of the public awareness program is flexibility. While the public awareness program is structured, it is flexible enough to respond to changing project requirements and public demands. This Public Awareness Plan sets the direction of the public communication avenues. Effectively responding and anticipating the public's questions and concerns will be the measure of success of the plan.

The plan and cost of implementing the public awareness strategies is presented in Table 11.1

**Figure 11.1: Three Year Public Awareness Plan**

<table>
<thead>
<tr>
<th>Media</th>
<th>Number of Messages</th>
<th>Frequency</th>
<th>Duration</th>
<th>Cost (US$)</th>
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<tr>
<td>Radio</td>
<td>3 (Hausa, Yoruba and Igbo) languages</td>
<td>2 per month</td>
<td>5 years</td>
<td>20,000</td>
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<td>Television</td>
<td>3 (Hausa, Yoruba and Igbo) languages</td>
<td>2 per month</td>
<td>5 years</td>
<td>60,000</td>
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<td>Newsletter</td>
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<td>5 years</td>
<td>20,000</td>
</tr>
<tr>
<td>Press Releases</td>
<td>3 (Hausa, Yoruba and Igbo) languages</td>
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<td>5 years</td>
<td>20,000</td>
</tr>
<tr>
<td>Posters &amp; Billboard</td>
<td>3 (Hausa, Yoruba and Igbo) languages</td>
<td>2 per month</td>
<td>5 years</td>
<td>40,000</td>
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<tr>
<td>Website</td>
<td>1 English language</td>
<td>Monthly update</td>
<td>5 years</td>
<td>10,000</td>
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<tr>
<td>Total</td>
<td></td>
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Annexes
## Annex 1: List on People and Institutions Contacted

<table>
<thead>
<tr>
<th>Name</th>
<th>Health Care Institution</th>
<th>Position/Status</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Dapo Majekodunmi</td>
<td>Saint Nicholas Hospital</td>
<td>Medical Director</td>
<td>263-5508/76/08035064444</td>
</tr>
<tr>
<td>Chief Matron Oyaide</td>
<td>Lagos State Teaching Hospital</td>
<td>Chief Matron</td>
<td>08023061739</td>
</tr>
<tr>
<td>Mr T.A Awaye</td>
<td>University College Hospital, Ibadan</td>
<td>Chief Environ,Health Officer</td>
<td>08038088076</td>
</tr>
<tr>
<td>Mr. Ola Familusi</td>
<td>Group Medical Hospital, Ibadan</td>
<td>Operations Manager</td>
<td>08033467709</td>
</tr>
<tr>
<td>Dr. Ayinde Akintunde</td>
<td>Alafia Hospital, Ibadan</td>
<td>Chief Gyneecologist</td>
<td>08037179610</td>
</tr>
<tr>
<td>Mrs Adeyanju</td>
<td>Family Health Centre, Abeokuta</td>
<td>Chief Nursing Health Officer</td>
<td>08035718914</td>
</tr>
<tr>
<td>Mrs. Maternity J Shode</td>
<td>Lagos State University Teaching Hospital</td>
<td>Chief Matron</td>
<td>xxx</td>
</tr>
<tr>
<td>Engr. P.T Dare</td>
<td>National Orthopedic Hospital, Igbobi</td>
<td>Ag. Chief Engineer</td>
<td>4935220 Ext 105</td>
</tr>
<tr>
<td>Mrs A.A Ayodele</td>
<td>Lagos Island Maternity</td>
<td>Chief Matron</td>
<td>xxx</td>
</tr>
<tr>
<td>Dr. Omaau I.J.</td>
<td>Mai Jam'a Clinic, Bauchi.</td>
<td>Medical Director</td>
<td>077/542226</td>
</tr>
<tr>
<td>Bala Musa Mohd</td>
<td>Comprehensive Health Centre, Tashan Babme Balg, Bauchi</td>
<td>2nd O/C in Charge</td>
<td>08022364357</td>
</tr>
<tr>
<td>Alex. I. Okafor</td>
<td>Arewa Medical Clinic, Gombe</td>
<td>Medical Director</td>
<td>08069652822</td>
</tr>
<tr>
<td>Mrs Victoria V. Bottsha</td>
<td>Primary Health Care Clinic, Township Jos North LGC.</td>
<td>Chief Nursing &amp; Health Officer</td>
<td>08035955527</td>
</tr>
<tr>
<td>Hajia Aishat T. Dalhatu</td>
<td>Primary Health Care Centre, Doma Rd. Lafia, Nasarawa State.</td>
<td>Ass. Chief Nursing Officer</td>
<td>08045452389/09065421602</td>
</tr>
<tr>
<td>H.G. Wurim Long</td>
<td>JUTH, Jos</td>
<td>Administrative Officer</td>
<td>08066025580</td>
</tr>
<tr>
<td>Dr. Abdullahi Musa</td>
<td>Sandaji Medical Centre, Shandam Rd, Lafia, Nasarawa State.</td>
<td>Medical Officer</td>
<td>08033254549</td>
</tr>
<tr>
<td>Dr. A.A Aderibigbe</td>
<td>Primary Health Centre, Olorunda L. govt. Igbonina-Osogbo.</td>
<td>Director</td>
<td>08033772033</td>
</tr>
<tr>
<td>Dr T.O Oladele</td>
<td>Alafia Leke Specialist Hospital Osogbo, Osun-State</td>
<td>Director</td>
<td>08038375052</td>
</tr>
<tr>
<td>Dr. Pias Okpoko</td>
<td>Supreme Faith Hospital, Ado Ekiti.</td>
<td>Medical Director</td>
<td>08035794329</td>
</tr>
<tr>
<td>Dr. Egunlusi Adelusi Mathew</td>
<td>State Specialist Hospital, Ado Ekiti.</td>
<td>Chief Medical Director</td>
<td>08035032538</td>
</tr>
<tr>
<td>Mrs Durodola V.O</td>
<td>Basic Health Centre Odo Ado, Ado-Ekiti</td>
<td>Chief Nursing Health Officer</td>
<td>xxx</td>
</tr>
<tr>
<td>Dr. R.S Faasid</td>
<td>State Specialist Hospital, Akure.</td>
<td>Chief Medical Director</td>
<td>08054068003</td>
</tr>
<tr>
<td>Abiodun M. Ajayi</td>
<td>Miracle Hospital, Akure</td>
<td>Medical Director</td>
<td>08033704967</td>
</tr>
<tr>
<td>Mrs Atolagbe</td>
<td>PHCN, Akure South L. Govt.</td>
<td>Chief Nurse 1</td>
<td>xxx</td>
</tr>
<tr>
<td>Dr. A.E Ayinde</td>
<td>State Hospital Ijebu Ode</td>
<td>Chief Consultant (O&amp;G)</td>
<td>08033527927</td>
</tr>
<tr>
<td>Mrs F.A Adekoya</td>
<td>Primary Health Dept. Ijebu Ode L. govt.</td>
<td>Monitoring &amp; Evaluation Officer</td>
<td>08055305280</td>
</tr>
<tr>
<td>Dr. Robor Phillip</td>
<td>BMSH General Hospital, Port Harcourt</td>
<td>Head Clinical Service</td>
<td>08032258162</td>
</tr>
<tr>
<td>Mr Nathaniel</td>
<td>Aggrey Clinic</td>
<td>Head Clinical Service</td>
<td>08023957623</td>
</tr>
<tr>
<td>Name</td>
<td>Contact Information</td>
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<tr>
<td>Dr. Ikechukwu Iyeke</td>
<td>Medical Director, Kula Health Centre lare Akuku Toru L.G.A Rivers State, 08069262257</td>
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<tr>
<td>Engr. A. Ibrahim</td>
<td>Asst.Dir. Engineering Services, 080371343305</td>
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<tr>
<td>Mrs. J. A Oyebanji</td>
<td>Chief Nursing Officer, Obi Specialist Hospital, Obi-Ilorin, 08035811929</td>
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<tr>
<td>Ibrahim Garba</td>
<td>M2E Officer, DSNO Ilorin West L. Govt., 08030634520</td>
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<tr>
<td>Israel O. Popoola</td>
<td>Medical Officer, Olalomi Hospital, Stadium Rd., Ilorin, 08035037785</td>
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<tr>
<td>Odebeaku (Mrs)</td>
<td>Matron In Charge, Niger Hospital, Lokoja, 08025440838</td>
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<tr>
<td>Godfrey Ndukwe</td>
<td>In Charge (Senior Nurses), Godiya Hospital, Birni Kebbi, 08032949912</td>
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<tr>
<td>Dr. A.I. Ukatu</td>
<td>Medical Director, Mayo Clinic Primary Health Centre, Birni Kebbi, 08038269351</td>
<td></td>
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<tr>
<td>Dr. A. Abubakar Koko</td>
<td>Head Clinical Service, Sir Yahaya Memorial Hospital, Birni Kebbi, 068320350</td>
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<tr>
<td>Mrs. Makajuola A.O</td>
<td>Community Health Officer, Primary Health Care Centre, Orita Challenge, Ibadan, 08060975052</td>
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<tr>
<td>Mrs. Ogbonna</td>
<td>Community Health Officer, kings Cross Hospital, off Ganiyu Bello St., Felele, Ibadan, 08024927175</td>
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<tr>
<td>Ayodele Adebanjo .K.</td>
<td>Administrative Officer, New Millenium Clinic, 110 Ahmadu Bello Way, Katsina State, 065-431615</td>
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<tr>
<td>Hussaina Salami</td>
<td>Chief Nursing Officer, General Hospital, Gusau, 08032898331</td>
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<td>Rev. Sr. Josphine</td>
<td>Matron In Charge, Danla Hospital &amp; Maternity Home, Kasuwan Daji Rd., Gusau, 063-200459</td>
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<tr>
<td>Lawali Bello Kausa</td>
<td>Community Health Officer, WC WC Tundun Wada, Gusau, 08026876097</td>
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<tr>
<td>Abba Dano El Hamzat</td>
<td>Hospital Secretary, Usman Danfodiun University Hospital, Sokoto, 060230334/08039677452</td>
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<tr>
<td>Ibrahim. A. Husseni</td>
<td>Dep. Dir. Nursing Services, Specialist Hospital, Sokoto, 060-232040</td>
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<tr>
<td>Garba S/Paina</td>
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<tr>
<td>Dr. Bala Saidi</td>
<td>Medical Director, Specialist Hospital, Yola, 08036239191</td>
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<tr>
<td>Haj. Utiya Iya</td>
<td>DPHC, Yelwa Health Clinic, Yola North L. Government, 08027085127</td>
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<tr>
<td>Dr. Oriorwo Niyi</td>
<td>Medical Director, Peace Hospital, Yola, 08035383837</td>
<td></td>
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</tr>
<tr>
<td>Dr. Yusuf Nura</td>
<td>Medical Director, Federal Medical Centre, Birni Kudu Jigawa State, 08027473447</td>
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<tr>
<td>Dr. Jimoh Lucius</td>
<td>Medical Director, International Hospital/Clinic, Dutse, 08036238210</td>
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<tr>
<td>Muhammad Yahuya</td>
<td>Principal Envir. Health Officer, Primary Health Care Dept., Birni Kudu Jigawa State, 08065033265</td>
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<tr>
<td>Dr. Dennis Ehiaboro</td>
<td>Medical Director, Oxford Hospital, Kadiri-Kaduna, 062-233408</td>
<td></td>
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<tr>
<td>Mrs. Ngozi Jumbo</td>
<td>Pub. Health Nursing Officer, Primary Health Care Centre, Eziamma, Aba North, 08037089694</td>
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<tr>
<td>Dr. E.O. Eke</td>
<td>Medical Director, Egon Clinic 33 Park Rd., Aba, Abia State, 082-225626/08033338104</td>
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<tr>
<td>M. C. Ogbonna</td>
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<tr>
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<tr>
<td>Dr. D.G. Elesin</td>
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<tr>
<td>Dr. Adeshina Anthony Sunday</td>
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<td></td>
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<tr>
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<tr>
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<td>----------------------------------------------------</td>
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<tr>
<td>Dr. Dapo Gwagwalada</td>
<td>Gwagwalada Specialist Hospital, Abuja</td>
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<tr>
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<td>PmRO</td>
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<td>Dr. E.O Sibeudu</td>
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<td>Medical Director</td>
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<tr>
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<td>Federal Medical Centre, Yenagoa</td>
<td>Head Clinical Service</td>
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<tr>
<td>Edith Ogbomo</td>
<td>Health Care Centre, Yenagoa</td>
<td>Head Nurse</td>
<td>08025530495</td>
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<tr>
<td>Bright Samkey</td>
<td>Tobis Clinic &amp; Consultants Agudama Epie, Yenago.</td>
<td>Manager</td>
<td>08037996651</td>
</tr>
<tr>
<td>Dr. N Onwughalu</td>
<td>Amanyke Cottage Hospital, Umuewella Awka</td>
<td>Medical Director</td>
<td>08055549127</td>
</tr>
<tr>
<td>Dr. P.O Ogumbowale</td>
<td>Brown Hospital, Ijebu Ode</td>
<td>Medical Director</td>
<td>037-423759</td>
</tr>
<tr>
<td>Ume Maria (Mrs)</td>
<td>Izhiambo Maternity &amp; Health Care Center</td>
<td>Ass.Comm.Health Officer</td>
<td>08020926051</td>
</tr>
<tr>
<td>Dr. Clinic. Egbuome</td>
<td>ST. Theresa Hospital Abakaliki</td>
<td>Medical Director</td>
<td>08037502003</td>
</tr>
<tr>
<td>Dr (Mrs) J.C Udi</td>
<td>Federal Medical Centre, Asaba Delta</td>
<td>Consultant</td>
<td>08023278466</td>
</tr>
<tr>
<td>Mrs Clinic. Okolie</td>
<td>Comprehensive Health Center, Ibusa</td>
<td>Midwife</td>
<td>08033222995</td>
</tr>
<tr>
<td>Vivian Enebeli</td>
<td>Temple Clinic</td>
<td>Nurse</td>
<td>046307625</td>
</tr>
<tr>
<td>Dr. J.M Hasssan</td>
<td>General Hospital, Minna</td>
<td>Chief Medical Officer</td>
<td>066-222492</td>
</tr>
<tr>
<td>Dr Odigwe Fidelis</td>
<td>Savannah Hospital, Minna</td>
<td>Medical Director</td>
<td>08035534312</td>
</tr>
<tr>
<td>Dr. A.A Olatinian</td>
<td>Bay Specialist Hospital</td>
<td>Medical Director</td>
<td>066-222299</td>
</tr>
<tr>
<td>Maria E. Effiong (Mrs)</td>
<td>General Hospital, Anua, Uyo, Akwa Ibom</td>
<td>Matron in Charge</td>
<td>08026096099</td>
</tr>
<tr>
<td>Mrs Cecilia Ntuk Ekanem</td>
<td>Primary Health Care Centre, Uyo, Akwa Ibom</td>
<td>Deputy Director Nursing</td>
<td>08023777196</td>
</tr>
<tr>
<td>Mr. LI Chukwu</td>
<td>Owerri General Hospital, Owerri, Imo State</td>
<td>Ass.Chief Soc.Welfare officer</td>
<td>08038693765</td>
</tr>
<tr>
<td>Okoronko H.O</td>
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Annex 2: Decision-making Flowcharts

Annen 2a Healthcare Facilities in urban area

1. Waste Minimization
2. Segregation
3. Sharps in boxes
4. Infectious non-sharps in bags/containers
5. Non-infectious
6. Municipal Waste stream
7. Contact general/teaching hospital with waste treatment facilities
8. Waste Incinerator
9. Waste dumpsite
10. Recycling: Check number of injections against number of safety boxes
11. Disinfect syringes, needles and other infectious waste.
12. Safe transport to offsite treatment or disposal facility
13. Encapsulate needles
Annex 2b Healthcare Facilities in semi-urban area

Waste Minimization

Segregation

Sharps in boxes

Infectious non-sharps in bags/containers

Non-infectious

Municipal Waste stream

Waste treatment facilities

Modern treatment facility available or arrangement with larger health care facility possible with safe transport

Transport to offsite facility for treatment

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Annex 2c Healthcare Facilities in rural area

- **Waste Minimization**
  - **Segregation**
    -**Sharps in boxes**
      - On-site treatment
        - Space available on premises (People living <50m)
          - No
          - Yes
            - Destroy or remove needles with cutters or encapsulate methods
              - Burial Pit on premises
        - No
          - Infectious non-sharps in bags/containers
            - Densely populated area (People living <50m)
              - Possibility to train staff and allocate resources to incineration
                - Acceptable operating conditions for incineration
                  - Small Incinerator
                    - Yes
                      - Ash
        - Yes
          - Non-infectious
            - Incineration used for infectious waste
              - Municipal Waste stream
                - No
          - On-site treatment
            - No

- Municipal Waste stream