

Chapter 6 Management of Industrial, Toxic,
and Hospital Waste



CHAPTER 6 MANAGEMENT OF INDUSTRIAL, TOXIC, AND HOSPITAL WASTE

6.1 Waste Generation (Industrial Waste)

Industrial waste is defined here as the waste generated from production process in factories. It includes both hazardous and non hazardous waste, but not the waste from annexed restaurant of establishments and non production business activity.

Statistic data is not available concerning the generated amount of solid industrial waste in Morocco. There is, however, a research concerning waste effluent. It will be referred as necessary since industrial waste is related to liquid waste.

There is no quantitative information concerning solid waste except the one obtained from the current Study. Therefore, the Study will analyze industrial waste in a qualitative way. Information concerning the generation of industrial waste, which is obtained in the Study Team's survey; will be presented in a succeeding report.

Types of industrial waste would be assessed by knowing the types of production of a factory.

6.2 Management Generation

6.2.1 Institution (Management of Industrial and Toxic Waste)

1) Institution

Industry represents 17 % of GNP of Morocco with an important concentration of economic activities in the coastal area between Kenitra and El Jadida. This coastal area, which includes Kenitra, Rabat, Casablanca and El Jadida, represents 2 % in terms of land territory, but it has a share of 80 % of the whole country in terms of industry. It has a positive effect on employment but has a less positive impact on the environment. In this part we will analyze the industrial environmental activities, which include:

- a. Institutional framework
- b. Legal aspects
- c. Government role and activities
- d. Private sector waste management

2) Institutional Framework

We will analyze the national level first and then the local level.

At the national level the institutional situation is rather confused. We saw in section 4.1. that MoC&I is in charge of supervising establishments' activities that include industrial waste. According to Dahir August 25, 1914, MoPW authorizes the creation of and controls establishments classified as potentially hazardous, i.e. those categorized as class 1. MoE is responsible for promotion of environmental protection, and give guidelines to

avoid industrial pollution. Present discussions on the regulation needed to implement the Dahir August 16, 1995 on water, provide evidence of different environmental strategies.

It is clear that there are no rules established for supervision concerning SWM of industrial waste at the national level.

At the local level communes are entitled to authorize the creation of establishments classified as potentially hazardous, i.e. those belonging to classes 1 and 2. But they have no technical department competent to make impact studies and environmental audits.

We now examine whether or not the legal definition of industrial and toxic waste is sufficient for institutional responsibilities to be clearly defined.

3) Legal Aspects

In section 4.2., we analyzed the existing laws related to SWM. We saw that there is no specific law concerning SWM in general and no specific law concerning industrial and hazardous waste in particular. The only legal text available is the Decree of August 25, 1914.

This decree puts the establishments which present insanitary, inconvenient or hazardous actions under the control and the supervision of the administrative authority. It provides three categories of classification according to the risks they represent. The owners of first and second-class establishments are required to apply for administrative permission before starting their activity. It falls within the responsibility of the Ministry of Public Works in the first case and the communal authority in the second. Third class establishment must only give a declaration to the communal or local authority.

However, even though an establishment is not classified in the first two categories, its construction or operation may be suspended by order of the Ministry of Public Works when it seems to generate risks of an insanitary, inconvenient or hazardous nature. In such cases, the Minister sets a deadline of four months to decide on the classification of the activity in question and on the granting of the subsequent permission. The establishment in question may continue its activity if the Minister did not decide otherwise.

The law fixes the administrative procedure, lays down restrictions concerning sites of the establishments, regulates the general or special prescriptions to which they can be subject, and organizes a system of supervision and penalties.

A proposed law updating this Decree is under discussion but has not been written yet. A precise definition of different categories of waste, namely, household, commercial, industrial, hospital, and hazardous waste has to be done.

An existing law only calls for permission for setting up a factory and enterprise's responsibility for not annoying local residents as mentioned earlier.

Therefore, under the current legal arrangements, it is impossible to legally restrict air and water pollution of the following cases. They are air pollution of multiple sources

affecting human health but not polluting the neighboring area directly, and water pollution by factory's waste water polluting water resources. It is also impossible to restrict pollution caused by waste because polluters waste are mixed into other waste, making it difficult to identify polluters and their influence to the environment.

A change with some impact is about to be made. Law on Water of August 1995, prohibits an activity that causes water pollution by the article 54, and calls for permission of discharging waste water by the article 52 and 53. Although standards for the prohibition and permission of the discharge are to be detailed, bringing the law into effective will make two things clear. One is an enterprise's responsibility for preventing negative impact to the environment and the other one a financial responsibility for making such prevention.

This law is practically the first one restricting discharge of industrial waste water to prevent environmental pollution caused by industrial activities. Therefore, practical use of this law can lead to an established administration for restriction in the field of the environmental.

The Water Law, when enforced, will bring a large influence to regulatory laws for industry's generation of air polluting matters and industrial waste.

A precise definition of different categories of waste, which are household, commercial, industrial, hospital, and hazardous waste, has to be done in order for the proper treatment of industrial waste and hazardous waste. It is necessary to make a clear definition by a law concerning different types of responsibilities for treating different types of waste; treatment standards; standards for establishing a treatment facility; making a report; and administrative power.

A law concerning treatment of industrial waste should employ a polluter-pays-principal (P.P.P.), which was adopted in the OECD meeting of May 24 - 26, 1972 and now is a worldwide standard. The principal calls for polluters to pay the costs for maintaining the favorable environment, which is defined by authority's restrictions. Although the principal was not aimed to be applied to developing countries, it is a welcome step for Morocco to take in the principal since her economy is advancing and her relationships with the European market are increasing its importance.

4) Government Roles and Activities

So far the central government plays two roles in this sector. MoPW controls classified establishments and MoC&I advises industries how to prevent pollution.

Inspection of Classified Establishments

The inspection of classified establishments is done by officers of the Criminal Investigation Department and by professional personnel of the MoPW specially appointed for this purpose.

The persons entitled to carry out inspections have the right to enter industrial establishments at any time and to make, within these establishments, any investigation which they consider necessary.

In practice these controls and/or supervision are very limited. There are only two inspectors who are engineers attached to the Department of Technical Affairs. Also penalties are inadequate as they have not been adjusted since 1937. Administrations may in theory close industrial establishments but so far this procedure has never been applied.

Spiting of the decree of 1914 that admits the right of inspection, an effective inspection is almost impossible since there are no laws clearly defining illegal activities of industries damaging the environment.

Information on Prevention of Pollution

A UNIDO financed project, « Industrial & Environmental Development Strategy » propagates appropriate preventive measures to factories to avoid pollution. It includes training, education, and technical workshops. The project is coordinated by a Steering Committee of which project is the head of the Planning Department of MoC&I, and is composed of relevant ministries (MoE, MoPW) and industrial associations (from fiber manufacturers, chemical industry, agro-industry, cement, sugar, and leather). A seminar to be attended by more than 100 managers from industry will take place this year.

The committee has set up an action plan with international experts. Informational material will be issued in 1997, including one on solid waste.

Until now there is no environmental tax, subsidies or other economic incentives for promotion, recycling, or waste reduction. A committee, chaired by MoE, has been organized to prepare a « Fund for Industrial Pollution Control », which is intended to provide low interest loans. 20 factories have been identified as potential recipients.

Information on Establishments' Activities Polluting the Environment

MoC&I's 1994 study on manufacturing industry's pollution loads to the environment is one and only information of its kind in Morocco. Unfortunately, the study report did not specify its process of estimating the loads. Information on types of polluters and pollutants are lacking in the report.

MoC&I has a data base concerning enterprises, but it does not provide pollution loads to the environment by enterprises. Information especially on industrial and hazardous waste generation has not been accumulated enough, and this prevents the central government to give enterprises instructions for preventing environmental pollution properly, or to create a policy for the instruction.

Concerning checking pollutant emission inside enterprises, an in-site inspection by MoE inspectors is not legally allowed and is currently very difficult.

Information on Impact to the Environment by Enterprises' Activities

MoE and MoPW have conducted researches on impact that enterprises' activities gave to the environment. The MoE' study, which belongs to a project to make a monograph of the country's environment, is about the situation of environmental pollution in the areas where industry is heavily concentrated. The MoPW study is about environmental pollution by waste water that enterprises discharged into rivers, whose water is important for the water resource management.

5) Private Sector Waste Management

a. Internal Institution of SWM of Establishments

Communes usually provide a service of waste collection in urban areas. But as there is no definition of what constitutes household refuse, commercial waste, industrial waste or hazardous waste, there is no precise definition of what kinds of waste are collected by the commune. Industrial wastes are generally not collected by communes. Industrial waste mixed with domestic waste is collected by communes. According to the industries which answered to the questionnaire, their waste are disposed in the communal disposal site in general.

Some industrial operators have facilities for internal treatment of process water or for neutralization of acid or basic solutions. But they have no special treatment for solid waste, which is directly dumped on the disposal site of the commune by the trucks of the industries.

Some companies collect used papers, cardboard, and metal, but there are no specialized private companies to collect industrial waste. No treatment plants for industrial waste, neither public nor private, exist in Morocco.

b) Institutional Arrangements of Establishment's Waste

The grate majority of companies (9 out of 11) have special guidelines from the President concerning waste management and there is a section designed for this management (9 out of 11).

Although presidents of large enterprises find it necessary to take the environment into their considerations, there are several written in-house rules defining workers roles for implementing the presidential commands. Such rules have been made at 5 factories out of 11.

Many factories have a special section for waste treatment, but their main tasks are operation work such as collecting the factory waste. It is essential that the sections are generally not made for managing the treatment of industrial waste and waste water.

Treating waste water and industrial waste properly is not a goal in the enterprises' management in a practical sense. With limited exceptions, most factories have no standards set for waste treatment.

Five factories out of 11 are keeping data on the amount of waste treated, while 6 factories out of 11 have analyzed the quality of waste. These facts can lead to the another fact that qualitative and quantitative SWM is not done enough.

The Study was done on the factories of relatively large size and of representative profiles. After analyzing what the study has found, it can be concluded that factories have no goal set for treating industrial waste and waste water, partially due to the absence of legal regulations over the industrial waste and waste water. Without the goal, treatment facilities will inevitably be staffed insufficiently. For promoting enterprises to set a SWM goal of advanced level, it is essential to establish governmental regulations with clearly defined social responsibilities of enterprises' for treating industrial waste and liquid waste.

6.2.2 Improvement Projects

Industrial technology including processing and pollution control technology constantly undergoes changes. This section presents information on some studies and plan for improvement of industrial waste disposal known so far to the Study Team.

1) Demonstration Projects Proposed by the World Bank

In connection with the Environment Management Project financed by the World Bank, the Bank proposed that the following demonstration projects should be implemented by the Moroccan government with bilateral assistance. The source of the below information a, b and c are the World Bank President Report on Environmental Management Project issued in August 1993.

a. Recovery of Chromium Effluent from Tanneries in Dokkarat (near Fes)

The objective is to introduce a simple and efficient technology to recycle the industrial water used in leather tanning and to recover chromium, a toxic substance, from the water effluent for its reuse. The environmental benefit resulting from this sub-project is the decrease of toxic substance in water. So far no financial commitment has been made.

b. Handling of Olive Press Juice from a Group of Mills in Dokkarat

The objective is to decrease of the high BOD/COD content in the Sebou river produced by the juice and properly dispose of the solid wastes resulting from olive oil production. The main environmental benefits are the improvement of water quality of the Sebou river, the largest in Morocco and prevention of water shortage in the industrial and tourist city of Fes.

This project is going to be implemented by Wilaya of Fes, RADES (Local Agency for Water and Electricity) and the factory by using the fund of the EU.

c. Waste Water Treatment from a Sugar Plant (SUNAG II) and an adjacent Alcohol Plant (SOTRAMEG)

The purpose of this demonstration is to treat the liquid wastes from both plants jointly and generate methane from the wastes for energy production. The main environmental benefits resulting from this operation are improved quality of treated water by more than 90 % and the prevention of groundwater contamination. So far no financial commitment has been made.

2) Plan for Grouping Polluting Factory and Common Treatment of Effluent and Sludge in Mohammedia

In Mohammedia urban commune, the association of tanneries of Morocco requested the government to sell a land to be used for developing an industrial estate to which the tannery factories would be relocated, and effluent and sludge would be treated by common treatment facilities. It seems so far that the association has not reached an agreement with the government concerning the land price.

(This information was obtained by the Study Team when it visited a tannery factory in Mohammedia.)

3) Plan for Development of an Incinerator for Industrial Waste in Casablanca

In Casablanca, some chemical manufacturers and pharmaceutical manufacturers made a preliminary proposal to develop an incinerator for treatment of industrial waste generated from their factories. They asked for technological assistance from the Ministry of Industry. A feasibility study has not been conducted yet. However, it seems that some more factories need to participate in the project to make the incineration feasible. (This information was obtained by an official of the MoE.)

4) Environmental Auditing

There is an initiative driven by the Moroccan industrial enterprises to introduce an environmental auditing system as proposed by ISO 14000. The introduction of such system would be particularly necessary for enterprises which are responsible for pollution of water of the sea and rivers, in particular, Sebou river.

An environmental auditing system should examine the necessity for introducing not only the end-of-pipe treatment but less polluting process technologies (clean technologies), which contributes to more effective pollution control in many cases.

6.2.3 Industrial and Hazardous Waste; Technical Aspect

Industrial waste are generated by a variety of industries and accordingly there are numerous management systems, depending on waste quality. The description of technical aspects associated with management of industrial and hazardous wastes described here, is based on visits to a number of plants and the results of the questionnaire survey and provides a general idea of the situation in Morocco. It should not be considered a comprehensive evaluation of the management of all the industrial and hazardous wastes generated in Morocco.

1) Generation and Storage

At present definite classifications for industrial and hazardous wastes do not exist in Morocco. The significant problems related to the management of factory generated wastes can be summed up as follows;

- Factory wastes are managed as domestic wastes without taking into consideration any specific measures
- Waste amounts generated are, in the most cases not recorded
- Most sludge generated in the production process is drained into the sewage system or water bodies without any treatment
- Proper facilities for storage of generated wastes at the factories prior to their removal from the premises are not available
- No accounting system is maintained at the factories to calculate the costs of the waste transport
- Keeping track of the generated waste in terms of amounts and where it is going is not done

2) Transport

Transport of the "unclassified" waste generated at the factories is in principle arranged by the generators themselves, either using their own trucks or sub-contracting to private companies. Under these practices the following problems have been identified:

- Other than for recycling purposes, wastes are in principle transported with hazardous and non-hazardous wastes mixed together
- Drivers are unaware of the nature of the wastes they are transporting
- In the case of sub-contracting the transport, generators are mostly unaware of the destination of the transported waste
- Sub-contracted transport companies select some materials for recycling by manual separation and their workers are unaware of the dangers of the waste they are handling
- Sub-contracted companies are not technically or administratively capable to handle the transported waste
- Equipment used in the transport is, in many cases not suitable

3) Treatment and Disposal

Treatment of industrial and hazardous wastes such as volume reduction, harmlessness and stabilization is hardly practiced in Morocco. Generated wastes are disposed of and/or discharged at municipal dumping sites, public sewerage, water bodies, inside the factory grounds, or other unknown places. Under these practices the following problems have been identified :

- No treatment of harmlessness is done for generated hazardous waste such as mercury mud, plating waste, oil sludge
- No specific disposal sites exist for hazardous waste and/or, in case that hazardous waste is disposed at municipal dumping site, no specific location inside the site is secured for the waste
- At the municipal dumping sites, no checks are done, or records kept for the type and amount of in-coming wastes
- Scavengers are operating at the municipal dumping site without any caution/knowledge for hazardous waste which may be dumped there
- Animals such as sheep, cattle etc. are grazed at municipal dumping site which may contain hazardous waste
- Liquid industrial waste (supposed to contain hazardous waste such as waste acid and waste alkali) is discharged to public sewerage and/or water bodies such as river, sea etc. without any treatment
- It is surmised, in case wastes are disposed at the factory ground individually, that wastes are disposed without any consideration for the contamination to groundwater
- Industrial and hazardous wastes such as waste acid, waste alkali, waste oil, waste flux, heavy metal contained waste, etc. are disposed and/or discharged without any treatment. Especially the following specific wastes are considered to be the problem-waste in Morocco:
 - Waste acid, waste alkali and waste liquid (which contained chromium, zinc etc.) generated in pickling and metal plating process
 - Mercury-mud generated in sodium hydroxide production process
 - Chromium contained waste liquid generated at bark tannery
 - Lead contained pigment waste (as the waste product and packing waste) generated at coating production industry
 - Waste liquid generated in photo development process
 - PCB-flux contained in electric products such as condenser, transformer etc.
 - Waste flux generated at precision machine industry
 - Lead contained waste liquid of accumulator generated at mobile maintenance workshop
 - Strong waste liquid generated in production process of fat and oil, sugar etc.
- In the near future, wastewater treatment facilities should be established at many factories in accordance with the application of effluent standard for industrial wastewater. On this occasion, the treatment and disposal of large amount of

sludge generated in the treatment facilities will be a significant issue.

4) Conclusion

The poor condition of industrial solid waste management is due to the strong lack of treatment and disposal standards. Consequently industrial concerns are not in a position to develop treatment and disposal targets. In order to improve these conditions it is necessary to tackle the issue on two fronts; one is to establish landfill facilities standards and the second to set standards for harmlessness and stabilization of hazardous waste. These standards should be established based on an understanding the following conditions:

- Industrial solid waste quality and quantity
- Characteristics of hazardous waste
- Technical guidelines for treatment and disposal that need to be introduced

6.2.4 Environmental Aspect (Industrial Waste)

Enough studies have not been made concerning environmental impact caused by the treatment of industrial waste. In Morocco, it is not proper to examine only industrial solid waste since liquid waste, such as waste liquid and sludge, is discharged into rivers.

It has been pointed out that some environmental impact have been brought onto Sebou river and sea areas along Mohamedia and Casablanca. Types of pollutants have not yet been found out concerning the above impact cases. No studies were known concerning analysis of impact on ecosystem of the area and pollution of fish and shellfish.

Factories producing sodium hydroxide use mercury in its process. Waste effluent and mud containing mercury are assumed to be discharged into sea water. The sea water has its way out unlike bay, and this may be helping ease the impact. The production process itself is the same as the one of Minamata's mercury pollution in Japan. Therefore, environmental studies should be done sufficiently.

Solid industrial waste of a small amount is generally disposed of at municipal disposal sites. Due to the lack of analyzed data concerning the composition of industrial waste, any judgment cannot be made about the danger of environmental impact due to disposal sites.

According to the Study Team's survey, factories generally dispose of or stock the industrial waste generated from its operation in large amounts. Environmental impacts by the disposal or stock cannot be figured out.

It is necessary to grasp the quality of industrial waste. It is also necessary to analyze the environment where possible health-threatening waste is discharged and disposed of.

Since heavy and chemical and machinery industries are not developed in Morocco, generation quality of industrial waste is not large relative to that of municipal waste.

6.3 Management of Hospital Waste

6.3.1 Introduction

In most Moroccan hospitals, hazardous hospital waste is not separated from other general waste of hospitals. Infectious waste is stored in bags, bins, or containers together with other general waste of hospitals in general. The mixed hospital waste is then collected by the communes, and disposed of at the municipal disposal sites which accepts all kinds of solid waste.

The Moroccan hospital do not use incinerators except for a few hospitals in Rabat as described later.

There are no laws concerning management of hospital waste. The government has not issued any official guidelines neither. Although MoH has issued a notice on handling hospital waste, no any hospitals studied did not know the notice.

In 1993, WHO experts visited Ibn Sina Hospital in Rabat, and prepared an action plan for hospital waste management. However, the hospital did not implement the action plan due to non-availability of financial supports and of follow-up programs.

There are many roles to be played by the central government for the introduction of appropriate hospital waste management to the Moroccan hospital.

In July 1995, the National Committee for Hospital Waste Management was formed within the Ministry of Health. The Committee is responsible for preparing regulations and guidelines concerning hospital waste management, and training of hospital employees.

6.3.2 Institution

Management of hospital waste involves different actors : Ministry of Public Health (MoH), MoE, other governmental structures, hospitals and eventually private contractors. We will describe:

- a. Institutional framework
- b. Legal aspect
- c. Governmental role
- d. Institutional arrangements inside hospitals
- e. Private waste management contractors

1) Institutional Framework

So far management of hospital waste has not been implemented, because this matter has not been considered as a priority. However MoH has decided that it is necessary to introduce an appropriate hospital waste management for health and environmental sanitation in the country. The national institutional framework of MoH we describe in this section, is responsible for introducing an appropriate hospital waste management, organization, system and procedure, within the Moroccan hospital.

Central institution includes:

1. The National Health Organization
2. The Commissions of inspection of health care centers
3. The National Committee for Hospital Waste Management

a. The National Health Organization

This organization has 3 levels corresponding to geographical area, starting at the top with the Ministry itself, composed of the General Inspection, the General Secretary and 5 directorates such as:

- Directorate of hospitals and ambulatory care
- Directorate of population
- Directorate of finance
- Directorate of resources
- Directorate of epidemic disease

At the second level, the Chief Director of the province and prefecture health office represents the MoH at the level of the province/prefecture level.

As for the first level; the chief director of the municipal, communal or rural health office, is appointed by the President of the commune and has a multisectorial responsibility:

- Education (waste disposal, pollution, water and sewage)
- Sensitization
- Prevention and Care

He is assisted by itinerant male nurses in charge of a geographical area of the commune.

b. The Commission of Inspection of Health Care Centers

Through the circular N° 16DE/10 dated July 4th, 1994 addressed to the representatives of the MoH in the Wilayas, Prefectures and Provinces, the MoH recalls a previous circular N°40236 dated November 2nd, 1992 which emphasize on hygiene and cleanness in health care centers.

Consequently, commissions of inspection have been created. They are composed of:

- A Chief Doctor
- The Provincial Economical Administrator
- The Provincial Animator of Hygiene
- The Provincial Animator of Health Education

The main purpose of this commission is to contribute by their action to the reduction of contamination and to improve the image of health centers.

In order to meet these objectives, the commission must focus on three directions:

- 1 - Maintenance, cleaning and designation of the various premises in the medical centers
- 2 - Collection and disposal of solid and liquid waste
- 3 - Preventive measures to ensure the microbiologique quality of the food prepared for the patients and the hospital staff

The members of this commission must control and co-ordinate their action with the Chief doctor of each health care center.

A quarterly report stating the current situation, the problems encountered and the various measures taken, shall be sent to the Directorate of epidemiologic and sanitary programs (department of hygiene).

c. The National Committee for Hospital Waste Management

This committee is composed of:

- Hospital directors
- Representatives of various departments ; epidemiology, equipment, planning, population, human resources, regulation
- Supervisors of the National institute for sanitary administration

This committee has been formed in July 1995 according to instructions given by the MoH. Their main task is to elaborate a national strategy for hospital waste management and disposal such as:

- Regulation of hospital waste management and disposal
- Training of IEC (Information, Education and Communication) of the people working in the field of health and hospital users
- Technical procedure of intra-hospital sorting and collection
- Technological and financial means and feasibility studies

A weekly meeting is held in order to fulfill these objectives whose deadline lies in the delivery of a synthetic document presented to the MoH.

It is clear that the actual system is insufficient to cope with the huge task of education, training, sensitization of the medical corps at all levels.

There is apparently no link between national and local context, and no organization have been developed in order to get some kind of feedback.

2) Legal Aspect

In the Moroccan legislation, there is no specific texts related to hospital waste. We can only rely on reglementary texts aimed to public hygiene through measures provided by the law on sewage, therefore it could have some kind of basic connection with solid waste and by extension hospital waste.

For instance, the law N°1-76-583 dated September 1976, mentions that the president of the municipal council is entitled to take the necessary measures in order to insure public health and hygiene.

Another text, the Viziriel dated April 8th, 1941 fixes the attribution of the municipal office of hygiene such as : « the salubrity of establishments(...) » but no indication on solid waste.

Elsewhere, there are decrees which could be considerate as being related to hospital waste because related to the attribution and organization of the MoH.

The decree dated February 25th, 1976 stipulating that the MoH is in charge of :
« The planification of concerted actions at the level of communities (...) » and « The teaching of hygiene rules to individuals as well as collectives(...) ».

The Decree dated November 21st, 1994, says in its first article « The minister of public health is in charge of the elaboration and the putting into practice of the governmental policy in the domain of population' health »

Article 2 : « While applying the legislative and regular provisions, the minister of public health ensures the protection of the public establishments which are connected to him ».

Article 8 : « The direction of epidemiology and fight against diseases is to ensure epidemiological supervision of the population(...) and comprises the division of hygiene of the area which is composed of:

- The service of basic cleaning
- The service of healthiness of the environment. »

We somehow find in these two decrees some kind of concern and sensibility towards hygienic rules.

These texts present a basis of a policy towards public health, but it is necessary to go further, deeper and in a more precise order to be followed easily and applied (on the spot) on a day to day basis. A definition of hospital waste has to be given.

3) Government Role

MoE has participated to a pilot in Agdal hospital on Luxembourg financing. Waste are sorted into household waste (from the canteen) which are placed in black bags, and infectious waste placed in red plastic bags. This experience has been limited because of lack of proper treatment installation.

So far, no specific controls have been implemented by MoE, or MoH on hospital waste collection or treatment.

At the commune level, hospital waste are collected. Generally, household waste from hospitals and infectious hospitals waste are mixed together. There are disposed at the

dumping site without any particular hygiene protection. The commune does not have control over solid waste management in hospitals.

Discussion on treatment of infectious hospital waste has not yet been developed between Communes and Urban Communes, and medical establishments.

4) Internal Institutional Arrangements of Hospital

The Study Team conducted a questionnaire study at three large hospitals, which has representing profiles of Morocco's hospitals. The Study found that there are no institutional arrangements established for the waste treatment in these hospitals.

No overall management system of hospital waste in the hospitals is established. Heads of the hospitals hold no concerted responsibilities for hospital waste. Even in an exceptional case of a hospital in Rabat, which has set up norms for hospital waste management, the hospital did not implement the norms. In the other two hospitals, there are no such norms. As these facts logically show, there are neither standards for separating general and infectious waste, nor for sorting of waste. There are no standards for storing injection needles, which may be contaminated with pathogen. Among the three hospitals, none of them has set up a thier own committee for hospital waste management.

Although some hospitals have a section for waste collection inside the hospitals, some others do not. Hospitals without such a section seem to have their cleaners collect and transfer hospital waste to storage. The cleaners, however, have received no careful instruction for handling hospital waste.

Autoclaves are located especially in establishments inspecting pathogens. a hospital in Rabat

At a hospital in Rabat, under the responsibility of such a establishment's director, waste contaminated with pathogens are separated from general waste, and are made pathogen--free by an autoclave before the waste are carried out of the hospital.

Although the study covered large hospitals, the hospital waste management in small hospitals is assumed to be similar. Infectious hospital waste are generated at any hospitals and clinics, but institutional arrangement inside hospitals for managing the waste is not established.

5) Private Waste Management Contractors

No private contractors have been identified so far, although there has been studies and propositions attempts from private companies such as TPA (Teenicas de Proteccion Ambiental SA Spain) for waste disposal, and CODIS (a Morocco-French company) for waste collection and disposal.

Meanwhile, it is interesting to underline that hospital waste coming from various health care centers located in Rabat, are taken to an incinerator operated by a private company SANIPLOMB.

Private contractors will focus on this market if there is a basic regulation to back up their actions (or their investment in the case of a treatment plant), completed with the perspective of a financial benefit.

6.3.3 Hospital Waste; Technical Aspect

1) Generation and Storage

Generated hospital waste includes pathogenic, infectious and domestic wastes. In the visited hospitals the following points were observed:

- Pathogenic wastes are placed in red bags with disinfectants and are removed from the hospital premises 2 or 3 times weekly (Rabat hospital)
- Infectious wastes generated in operating rooms and laboratories are put in separate bags
- Other infectious wastes (syringes, medical bandages and dressings, etc.) are in many instances mixed with domestic waste generated at the hospital
- Pathogenic wastes and wastes generated at operating rooms and laboratories are placed in such locations as washrooms or corridors before being removed from the premises
- Mixed domestic and infectious wastes are removed from the rooms and kitchens, etc. by a private company (Rabat hospital) and put in corridors, until they are taken to the pick up point of the urban commune vehicle
- At the pick up point all the waste infectious and domestic wastes are mixed together
- Much waste was found scattered on the hospital grounds, including infectious wastes (syringes, bandages, empty medicine bottles, etc.)
- Estimates of overall generated amounts are available at the hospitals but no evidence of detailed recording by waste type was found

2) Collection and Transport

Pathogenic wastes are transported by hospital arranged transport to the cemeteries for burial. Some infectious waste is transported to the incinerator. But the majority of the mixed infectious and domestic wastes are transported by the urban commune where the hospital is located.

- Communal containers (size 4 to 6 m³) are placed on the hospital grounds and are removed regularly
- Wastes are brought out to the containers by the hospital staff or the hired private company
- Urban Commune workers handling the waste, clearing around the container and filling it are mostly not wearing any protective gloves or boots
- Manual recycling at the hospital communal container by urban commune workers and scavengers was observed

3) Treatment and Disposal

Some of infectious wastes generated at hospital are treated for harmlessness by using autoclave and incinerator (Rabat hospital), while, majority of infectious waste in Morocco are disposed at municipal dumping sites mixed with domestic waste without any treatment. Under these practices the following issues have been identified:

- Incinerator is not operated properly, such as control of combustion temperature, waste combustion itself, fuel for accelerate the burning, emission gas treatment, etc.
- Workers operating the incinerator are not trained well for operation of the facility and handling of infectious waste
- No operational records of the incinerator
- Diffusion ratio of treatment systems/facilities for infectious waste, such as steam stabilization, incineration, thermal inactivation, chemical disinfection etc. in Morocco is low
- No specific disposal sites are exist for infectious waste and/or, in case that mixed infectious and domestic wastes are disposed at municipal dumping site, no specific location inside the site is secured for the waste
- Scavengers are operating at the municipal dumping site without any caution / knowledge for infectious waste
- Animals such as sheep, cattle etc. are grazed at municipal dumping site which supposed to contain infectious waste

4) Conclusion

It is necessary at the generation points to strictly separate infectious wastes from non-infectious wastes. Norms for containers of infectious waste should be specified. In principle infectious waste should be rendered harmless and disinfected before discharge outside the hospital grounds. Autoclave method alone cannot cover the treatment of infectious wastes, and incineration and chemical treatment are also considered necessary.

These facilities will be introduced gradually, and in the meantime standards for their operation shall be developed and more control in handling of these wastes shall be promptly introduced. For the time being landfill shall be applied.

6.3.4 Environmental Aspect (Hospital Waste)

1) Actual Conditions and Sources of Contamination (collection, transport)

a. General Conditions

The key point for proper treatment of hospital waste is separation at source between infected and non infected waste. If this source separation is not effective, storage, collection and disposal are potential sources of risks. In Morocco, this basic requirement for sanitary treatment is not effective.

Existing conditions are a source of contamination for the waste handling staff at hospital and for the workers of the municipal collection services. This staff is not informed about the risk they are exposed to in their work activities.

b. Case of Rabat

In Rabat hospitals, there are attempts to separate waste at source, with colored plastic bags. Infectious waste must be conditioned in red plastic bags exclusively. However, in practice, waste separation at source is not correctly conducted. Rules are not respected and infectious waste are sometimes found in red bags, or inversely. When waste bags are put in the container for collection, no separation is made.

The hospital staff, which handle the waste, is generally sensitized to the risks they are exposed to.

2) Actual Conditions and Sources of Contamination (treatment)

a. Disposal

Non contaminated hospital waste are collected for disposal at the municipal site. In the case of Rabat, failure of the system of separation at source means that infectious waste are mixed with normal waste and collected by municipal services. In the Marrakech and Casablanca hospitals, the situation is similar because:

- There is no separation at source in both cases;
- There is no any sterilization process of waste in one case.

The disposal of medical waste at municipal landfill is a source of contamination of the waste sector workers and of the natural environment. Given the existing conditions, the health risk is very high.

b. Incineration

There is a collective incinerator managed by the Moulay Abdellah hospital in Rabat. This incinerator presents health risks because of the following conditions:

- the incinerator is not equipped with an auxiliary combustion technology; it means that incineration is incomplete, and that non incinerated particles are remaining in the ashes;
- the incinerator is equipped with emission gas treatment devices (dust collector and scrubber); however, the scrubber is not very functional, which constitutes a source of potential air contamination by germs.
- The hospital is surrounded by a residential zone. The population is exposed to the existing risks.

**Chapter 7 Recycling Business and SWM
Equipment Manufactures /
Consultants**



CHAPTER 7 RECYCLING BUSINESS AND SWM EQUIPMENT MANUFACTURERS/CONSULTANTS

7.1 Recycling Activities of Informal Sector

7.1.1 Scavenger's Activity

Days in at dumping sites, days out on town, scavengers pick up recyclable waste to sell. They look for plastic, cardboard, metal, aluminum, and glass at dumping sites, in street garbage containers, or simply on the roads.

Scavengers earn little. Their daily earnings are estimated from 20 DH to 40 DH. Most of them have no other ways to make money. Scavenging knows no gender or no age.

As it is frequently the case with developing countries, scavengers deal with a large portion of recyclable materials of the country's whole.

The number of scavengers at the dumping site of Akreuch varies from 30 to 100 according to the different sources, and is most likely 50 as an official estimated. Site visiting confirmed 30 to 40 of them at work. It is somehow practical to estimate that the number of scavengers there is about 50. The number of street scavengers who work in Rabat city area is not estimated. The number of street scavengers in Casablanca is estimated 100 by an official. Scavengers were found on all the dumping sites visited by the Study Team.

Scavengers live at or around dumping sites most of time, and their sanitation is extremely inferior. There are usually no tap water and electricity supplies, and toilets for them. They may have accidental contacts to industrial and hospital waste. While not confirmed, average life expectancy must be short, and mortality rate would be high. Such issues are to be considered by a social approach rather than by SWM approach.

7.1.2 Collection Crew's Activity

Urban Communes' collection crews are also active in separating recyclable items during the collection of waste. They pick up plastics and cardboards, and each of the workers can earn 100 to 400 DH from the activity.

While not officially sanctioned by the Urban Commune officials, this activity is tolerated because crews require an additional income due to their low level salary of 1500 DH/m.

7.1.3 Role of Intermediate Persons

Most of recyclable materials that scavengers have collected do not go to factories directly. Intermediate persons called "glassi" take the role of go-between here.

Trades between glassi and factories are irregular and informal. Most of the glassi keep no record of transactions, no name of their clients and have no specific date to do transaction.

Three glassi exist in Akruesh dumping site, and another three in the city area of Rabat. In Casablanca there are seven large glassi; one authorized and six unauthorized. An official estimated another 30 small ones in Casablanca.

7.1.4 Flow of Recyclable Materials in Informal Sector

A case study on informal sector recycling was done in Rabat and Casablanca.

Starting from scavengers at Akruesh dumping site and in Rabat city area, recyclable materials eventually find themselves useful at factories as follows. Materials collected by scavengers and collection workers are sold to local glassi who clean, sort, and store them. Larger glassi located in Casablanca buy the materials from the local glassi and transport them to Casablanca, where industry is huge. The Casablanca glassi sell the materials to factories, which use them as raw materials for production.

7.1.5 Price of Recyclable Materials

Prices of recyclable materials when glassi sell to factories largely depend on what they are. Details are given in the table 7.1-1.

Table 7.1-1 Selling Prices from Glassi to Factories

Unit: DH/kg

	Glassi in Rabat	Glassi in Casablanca
Plastic	2.0	4.0 - 5.0
Cardboard	0.6	0.3
Paper	0.6 - 0.75	0.3
Metal	0.3	0.35
Aluminum	3.50	accept none
Glass (broken)	0.2 - 0.25	0.05 - 0.2
Glass (bottle)	0.8 (DH/bottle)	0.5 - 1.0

Price of glass depends on its quality and type.

Note: Results are based on a number of glassi interviews in Rabat and Casablanca.

7.1.6 End-users

Informal sector that it is, the glassi have only a slight idea about which factory is using the materials. The Study, however, found three names of glassi; SEVAM, CMCP, and IFRIQUIA PLASTIC. A glass bottle manufacturer SEVAM is a dominant buyer of recyclable glasses. CMCP is the nation's largest paper manufacturer. IFRIQUIA PLASTIC is also well known among glassi. These endusers are operating along the coastal zone stretching from Casablanca to Kenitra. Steels collected by scavengers are presumably sold to iron mills in Nador.

Factories are eager to use the recycled materials since new raw materials cost more. For example, SEVAM uses 15,000 tons/year (40% of total amount used) of recycled glasses and plans to increase the number. CMCP has the same tendency.

7.1.7 Total Amounts of Materials Recovered by Informal Sector

The amounts of recyclable materials that glassi deal with depend on the size of glassi. The table 7.1-2 shows the amounts related to small, medium, and large glassi. The large glassi is an authorized one in Casablanca area. Figures for small and Medium glassi were obtained based on interviews in Rabat ad Casablanca.

The Dealing amount of Medium glassi is about 20 t/m and is very small. Sales of the glassi can be estimated as 30,000 DH/m by assuming about 15,000 DH for remuneration for scavengers, and another, utmost, 15,000 DH/m for margins, transportation, and storage. The benefit that the glassi enjoy is estimated very low.

Average selling price of recyclable materials to endusers can be 1.5 DH/kg, which is \$0.18 /kg, and is rather high when compared to international prices.

Cardboards and papers occupy a very important place of glassi business. The business can survive because of the low labor costs, which are even lower than the material costs.

Table 7.1-2 Amount of Recycle Materials at Glassi's by Size

	Unit: kg/month		
	Small Glassi	Medium Glassi	Large Glassi
Plastic	1,000	1,000	8,000
Cardboard	1,000 - 1,500	8,000	12,000
Paper	300	8,000	8,000*
Metal	300	1,000	12,000
Aluminum	100 - 200	200	200*
Glass	800	2,000	16,000

Total amounts of recycled materials in Rabat and Casablanca can be estimated as follows. The figures concerning Casablanca were estimated, taking variation of glassi into consideration; 1 large glassi, 6 medium ones, and 30 small ones, according to Casablana Wilaya.

Table 7.1-3 Amounts of Recyclable Materials at Glassi by Areas

	Unit: kg/month		
	Akruesh	Rabat	Casa
Plastic	12,200 - 15100	3,000	15,000
Cardboard	N/A	17,000 - 17,500	61,000 - 61,500
Paper	N/A	16,300	56,300
Aluminum	80 - 120	500 - 600	1,500 - 1,600
Metal	N/A	2,300 - 2,400	18,300
Glass	N/A	6,000	28,800
Total	---	45,100 - 45,800	180,900 - 181,500

The total collected amounts in Rabat and Casablanca divided by their populations respectively are 0.86 kg/person and 0.83 kg/person annually. The results are similar to each other.

These amounts are relatively low 1 % of the per capita amount of waste generated, which is assumed to be 200 kg.

The estimation done here is based on rough estimations of scavengers and glassi. Their estimations are not precise but should not be underestimated for they do their business on a weight basis. Therefore, estimation in this section will give an advantage to grasp the recycling by informal sector. Quantitative research should be followed.

7.2 Recycling Industry

Section 7.1 of this chapter discussed the role of the scavengers, collection crews and intermediate processors "glassi" in the recycling activity. While these players have important roles in collecting the recyclable materials and preliminary processing, they do not have the resources to process the materials completely to the satisfaction of the end users nor to transport the materials to the end users. It is therefore assumed that there are private companies or recycling centers which fulfill those duties.

Such companies are of scales that cannot be hidden and even though they may be operating without formal registration, it is assumed that they are known to the urban communes cleansing sections, especially since collection crews sell them recyclable materials.

The Study Team attempted to identify such recycling operators through the questionnaire survey but unfortunately all the communes answered that they have no knowledge of such recyclers. Examples of two operators follows.

1) Rabat Recycler Center

The Study Team visited a large recycling center in Youssefia Urban Commune, Rabat, which was discovered while following a collection truck to observe the collection and haulage operation. The center was on private land and there were about 10 persons. Glass (by color), plastic bottles, PET bottles, paper, cardboard and cans were being

separated. Labels were being removed and glass washed. All the materials were said to be transported to Casablanca by the center's transport. The collection truck had come to the center to deliver the materials separated during the collection work. The center was fenced in and had an administration office and some washing facilities.

2) Paper Producer Affiliated Recycling Company

The Study Team visited CMPC, a large paper fabrication company, occupying 70% of the national production in paper, and 25% in corrugated cardboard. In the production process the company uses 3,000 ton/month of old corrugated cartoon and cuttings from print shops, 1,500 ton/month of local old newspapers, and 1,000 ton/month of old newspapers imported from Europe. The 4,500 ton monthly of recycled paper is provided to the company by its partner recycler company, stationed in Casablanca. The Study Team plans to visit this company to collect more information on its activity and on similar companies once an appointment can be set up.

Similar to this paper fabrication company, it is assumed that major recycled glass and plastic end users may also have established similar recycling companies. The Study Team attempted to contact such companies but so far without success. More effort will be made to develop a more comprehensive understanding of the "formal" recycling industry.

It is however clear that no governmental agency is aware of the full extent of this recycling industry at present. It is considered that there is a strong potential for promoting recycling activity in Morocco. It is therefore very important to make efforts to collect data on this industry and the very important issue of market demand and support its activity wherever possible.

7.3 SWM Equipment Manufacturers in Morocco

The Ministry of Industry provided the Study Team with a list of the Moroccan manufacturers of vehicles and SWM equipment. Questionnaires of annual production and selling prices were sent to around 8 companies and 4 replied. In principle all collection vehicle types are assembled in Morocco, with the local component varying from 10 to 40%. Details are shown in Table 7.3-1.

Table 7.3-1 Collection Vehicles Produced in Morocco

Vehicle Type	Capacity	Price (Dirham)		Annual Production
		Super structure	All vehicle	
1. Flat bed truck	4 - 6 m ³	55,000		40 (1 co.)
	10 m ³	110,000		50 (1 co.)
	4 - 12 ton		300 - 550,000	60 (1 co.)
	12 - 19 ton		600 - 900,000	60 (1 co.)
2. Dumper	2 m ³	30,000	360 - 550,000	100 (2 co.)
	7 m ³	90,000	650 - 950,000	90 (2 co.)
3. Compactor	8 - 12 m ³	300 - 350,000	750 - 850,000	170 (4 co.)
	16 m ³	330 - 380,000	820 - 1,200,000	90 (3 co.)
4. Multiloader	5 - 6 m ³	175 - 210,000		60 (2 co.)
	8 ton		650,000	60 (1 co.)
	12 - 19 ton		700 - 1,100,000	40 (1 co.)
5. Armroll	16 m ³	325 - 365,000		30 (2 co.)
	3 ton		650,000	60 (1 co.)
	12 - 19 ton		800 - 1,000,000	40 (1 co.)
6. Tractor	38 ton		850,000	40 (1 co.)
7. Containers	plastic 330 lit		1,350	300 (1 co.)
	metal 1100 lit		5 - 6,900	1,300 (2 co.)

From the figures in the table it is clear that the production of only these four companies can meet over 1/3rd the demand in waste collection and haulage, estimated to be 15,600 tons daily.

Table 7.3-2 shows the overall production in trucks for February 1996.

Table 7.3-2 Total Production of Trucks

Truck type	February 1996 production (unit)	estimated annual production (unit)	estimated annual capacity (ton)
3.5 to 7.9 ton	100	960	5,000
8 to 13 ton	272	2,610	26,100
Total	372	3,570	31,100

note: includes trucks which may be used for waste collection and haulage only, Ministry of Industry

From the above two tables it is reasonable to assume that the local production can meet the waste haulage demand. However the small portion of local component indicates a strong reliance on foreign components which may effect vehicle prices and production scheduling.

Heavy equipment used at the disposal sites, such as bulldozers, excavators, etc. are not produced nor assembled in Morocco. These equipment are imported, and the shares of the major manufacturers in the Moroccan market are Caterpillar at 60% and Komatsu at 15%.

Metal and plastic containers are manufactured in Morocco as shown in Table 7.3-1. Plastic bags are manufactured and sold in Morocco in various sizes. Thirty bags of about 40 liters cost 12 Dirham. Foreign made bags are also sold, but at more expensive prices. Information on annual production is pending.

The Study Team is still researching potential for local manufacture of other facilities and equipment used in SWM such as liner for sanitary landfill sites, etc.

7.4. SWM and Sanitary Engineering Consultants in Morocco

Many studies have been performed in Morocco in the last 10 years in the environmental sector. Consequently many engineering consultants specialised in this field have worked in this country. Some of them have already established offices in Casablanca or Rabat.

We have so far no information to enable us to evaluate capacity of the below-listed engineering firms. In Morocco, environment related business market has not grown yet. It seems however that there are many engineering firms related to water supply.

There would be a high potential that the market for environment related business including solid waste sector would possibly grow fast in Morocco provided that the relevant laws are established and other business conditions are satisfied.

There is an association for engineering consultants named A.M.C.I "Association Marocaine Du Conseil Et De L'Ingenierie, but there is not yet a specific branch association for environment.

Table 7.4-1 Consulting Firms Operating in the Field of Environment in Morocco

Engineering Consultant	Field of Activity	Address and Phone
BCEOM	<ul style="list-style-type: none"> - Industrial environment - Air pollution - Water pollution - Technical assistance for solid waste disposal - Environmental audits 	10 Place des Alaouites Rabat Tel 70 91 38 70 65 25
C.I.D.	<ul style="list-style-type: none"> - Impact study - Study for water treatment plant for industrial used water 	Charia Maa al Ainine, Hay Riad Rabat- instituts, Secteur 22 BP 1340 RP Tel 71 10 90 to 92 71 10 94 to 98
EWI-Morocco	<ul style="list-style-type: none"> - Environment technology - Impact study - Waste disposal 	13, rue Demnate Rabat Tel 73 37 85 70 15 79/70 16 30
Gester-Morocco SA	<ul style="list-style-type: none"> - Noise study - Study on air pollution - Study on water pollution - Study on soil pollution 	22, Zankat Saria Ben Zounaim Quartier le Palmier Casablanca Tel / fax 98 84 43
MEDITERRE	<ul style="list-style-type: none"> - Industrial waste storage and treatment - Rehabilitation of sites - Environmental audits 	100, BD Abdelmoumen 20 100 Casablanca Tel 98 18 82 fax 98 18 83
NEDECO	<ul style="list-style-type: none"> - Environmental protection - Treatment of flying hashes - Impact study 	9, Zankat Tamsloht BP 1321 Rabat Tel/fax 70 58 74
Omnium technologique	<ul style="list-style-type: none"> - Measures and control on -- Water network - Environmental enquiry 	425, av. Hassan II app. 1, Rabat Tel 72 35 20/fax 72 35 91
SAFEGE/LYSA	<ul style="list-style-type: none"> - Water resources and distribution study - Sewage - Solid waste management study and technical assistance 	20, BD Rachidi Casablanca Tel 22 41 07 fax 29 31 52 in Rabat Tel 71 14 95/fax 71 14 95
SIGMA-TECH	<ul style="list-style-type: none"> - Elaboration of environment monography - Impact study - Energy and chemical works 	5, rue Midelt Rabat Tel 76 89 61/62/63 fax 76 89 64
PHOENIX	<ul style="list-style-type: none"> - Urban and industrial environmental audit - Impact study prevention of industrial pollution - Waste management 	56, avenue Allal Ben Abdelah n°6 10 000 Rabat Tel/fax 73 39 89
URBA/PLAN	<ul style="list-style-type: none"> - Industrial environment audit - Environmental evaluation on air, water, soil, noise, waste, and hazardous waste - Waste management 	14, rue oued ziz, Agdal Rabat Tel 77 21 34

Chapter 8 Issues



CHAPTER 8. PROBLEMS AND ISSUES ON MOROCCO'S INDUSTRIAL WASTE TREATMENT

After understanding and analyzing the current SWM (see section 4, 5, 6, and 7.), some problems and issues have emerged in Morocco's SWM. SWM in Morocco is apparently not adequate when referred to the SWM principles (see section 3.1.). This part present problems and issues identified by the Study Team in, SWM's various aspects such as institution, law, collection, and disposal.

8.1 General Problems of Morocco's SWM

1) Morocco's SWM Principles and Objectives

The major problem of Morocco's SWM is that there is no consensus to the SWM principles among citizens and SWM staff. Creating the consensus is a first step for achieving successful SWM.

Since the principles are not understood clearly in Morocco among SWM staff, goals and objectives of SWM are not recognized by them. It can not be overemphasized that the consensus to the principles and the goals is necessary for accomplishing advanced SWM.

2) Sanitation

Although municipal waste collection has generally been done successfully, the service became unable to catch up with the recent rapid urbanization. This problem has resulted in insufficient collection service in suburbs and illegal dumping in vacant lots.

Disposal sites are not sanitary. Most of the sites are operated without control, and some of them are located near residential areas.

Infectious hospital waste is mixed with household waste when they are treated and disposed of. Appropriate management of infectious waste is urgently needed.

3) The Environment

Not enough attention has been given to the environment so as to Morocco's waste treatment. Hazardous substances may be disposed of at municipal disposal sites since industrial waste is mixed in the municipal waste. It is a serious problem that industrial waste sludge is discharged into rivers and sewage without control, and is polluting rivers and sea areas.

Landfilling sites are not operated environmentally sound in Morocco. Although recent construction plans are designed with environmental consideration, procedures and standards have not been established yet.

4) Recycling

Recycling has been done in Morocco but the recycled amount has been very small. Collection system that citizens can participate in recycling activities should be established.

5) Institution

A SWM administrative system at the central government level has not established yet since there are no laws concerning waste. It is essential to make a clear demarcation of ministries' and agencies' roles; to create related laws; and to set up regulations and standards.

The most serious constraint weakness at the same time at the local level is the acute shortage of qualified SWM experts including engineers, planners, and technicians of municipal SWM is that there are no able human resources and engineers with a SWM background.

8.2 Issues concerning Municipal Waste Management

8.2.1 Goals of SWM

Moroccan SWM lacks explicit goals. Lacking such goals is one of the most fundamental causes for the inadequate SWM. Also, SWM staff do not seem to be in a good understanding of the SWM goals and objectives of their tasks.

Collection service is not provided in some parts of urban area although general collection service coverage is rather high in urban areas. Coordination of city planning and collection service is essential because it is difficult to provide collection service for uncontrolled urbanization. It is necessary for municipalities to specify a service area, and to present the level of the service to citizens.

8.2.2 Institution

1) Legal Aspects

a. National Level

The decentralization law does not clearly define the Commune's responsibility for municipal SWM, while it is generally understood so.

The following legal aspects should be considered to achieve the favorable environment and sanitation, and to prevent the environmental pollution. Municipalities should improve their SWM service instead of justifying the current SWM level.

- (1) Clear definition of SWM objectives
- (2) Definition of the scope of Communal power to achieve the objectives
 - Rights to refuse service provision

- Power to permit establishments to use the service
- Power to apprehend illegal dumping and impose fine on violators
- Power to collect waste tax
- Power to authorize the service provision by private contractors
- Power to instruct waste generators
- (3) Definition of Communal obligations
 - Informing citizens of the service provision
 - Compliance with technical standards of treatment and disposal
 - Creating rules of SWM operation
 - Preparing plans concerning SWM
 - Obligation to make SWM achievements public
 - Obligation to report to the central government concerning SWM
- (4) Definition of the central government's responsibility and power
 - Obligation to provide technical standards at the national level
 - Technical instruction to local governments
 - Power to supervise Communal SWM
 - Obligation of technical and financial assistance

b. Local Government Level

Local governments should define their roles concerning SWM, obligations concerning sanitation and waste discharge by citizens and establishments. They are also to set up norms concerning SWM service and to make the norms public.

2) Organization and Administration

a. National Level

The central government is expected to offer guideline for municipalities to upgrade SWM. First of all, coordination among ministries and agencies should be made. Second, administrative line concerning SWM should be established. Third, a management unit to administer national SWM should be created.

The unit will be responsible for building up a data base on local government's SWM. It is also responsible for the following tasks; offering local governments a guidance concerning the objectives and operation of SWM; facility development; and preparing and implementing action programs to arrange and to upgrade SWM. Additionally, institutional arrangements should be made for offering technical instructions about a disposal site.

Establishing an institution for human resource development is strongly recommended. Human resources in SWM are lacking seriously. It is necessary for the central government to lead the country's human resources development since this is needed not only for SWM but also the other environmental sector.

b. Local Government Level

(1) Management System

Management system is needed for the following tasks; setting operational goals; evaluating the operational achievement; arranging institutions; assigning human resources; managing staff; preparing investment plans; creating improvement plans; and doing public relations.

Local governments should introduce a management system for improving the service quality. The following items should be taken in the system for achieving the goals.

- A guideline for evaluating goals and performance of SWM should be established.
- Training, employment, and work assignment should be arranged.
- Medium and long term plans should be prepared.
- Arrangements for encouraging citizens' cooperation should be made.

(2) Institution

Hierarchy of a local government's SWM section is very simple, and is easy to operate. The SWM is operated relatively well under the current conditions.

Pursuing adequate SWM will face a problem with the scope of the responsibility of a chief engineer of a local government, engineers of SWM section, and technicians. The scope is too broad for them, and they can not handle all the problems that arise in SWM.

The current SWM institution of a local government is not functioning as efficiently as a specialized SWM service contractors do. Functions such as service provision, financial management, maintenance, and human resources management are currently scattered in many different departments of a commune. It is difficult to conduct a proper SWM while the functions are fragmented in this way.

Arranging the institution of a local government's SWM is related not only to SWM but also to other public service fields. From this point of view, an institution that can carry out effective public work services should be arranged.

(3) Human Resources at the Local Government Level

There are no solid waste experts, and this is keeping the local government's SWM from its development. Offering SWM skills to managers or higher rankers is more important than doing so to specialized engineers. This is because managers need skills to control their able engineers. Such human resources development should be encouraged by the central government.

3) Financial Policy

a. National Level

At the national level the Ministry of Interior is supervising financial policies of local governments. VAT is redistributed to local governments to strengthen their financial ability, which is favorable for improving SWM finance.

The central government is expected to take a leading role to do the following tasks in order for increasing the financial management ability of local governments.

- Instruction on financial management to figure out costs by types of services.
- Normalization of costs for waste management
- Offering advise on reducing the costs to a target level
- Subsidy arrangements for priority investment of local governments
- Preparing a standard set to judge the degree of priority (This is especially to judge the priority of investments linked to an environmental policy.)
- Presenting a method to evaluate investment costs for construction SWM facilities
- Technical assistance for local governments to utilize FEC
- Increase of FEC funds

b. Local Government Level

Local governments faces the following financial problems.

- Local governments of a small budget cannot afford sufficient equipment and human resources. (There is a large variation in budget size among local governments.)
- Local governments do not have financial resources available for SWM because of the demand for various services resulting from urbanization.
- Local governments do not have financial resources available for investing in construction of proper treatment facilities.
- Debt service ratio of local governments has been increasing.

Local governments face the following problem with financial management.

- Financial management ability of local governments is low.
- Expenditures are not recorded according to types of service.
- Accounting system that can present the cost of each service is not developed.
- Local governments have no experience of arranging a long term financial policy for investment, and tend to make short-sighted investment.
- Local governments cannot afford SWM equipment since they attach a higher priority to urgent projects that will yield quick return.

Since these problems are seen in various fields of local government activity, the solutions of these problems employed in SWM should be adopted to the project with which the central government improves the financial management ability of local governments.

4) Using Private Contractors

It is globally proved that private contractors can provide better SWM service less costly than public sector can do. Although using private contractors has become a worldwide trend in SWM, a doubt about them is still upheld in Morocco. The misunderstanding should be cleared away by experimental use of a private contractors.

Urban Community of Ain Bahaa in Casablanca is going to use a private contractor for waste collection, and this should be supported by the central government. This is still an experimental case in Morocco, and it should be noticed that legal conditions concerning SWM service by private contractors check the original.

The central government should support the use of private contractors by providing the following items to local governments.

- Standard terms of reference for private contractors
- Sample contract
- Guideline for evaluating proposals from private contractors

5) Citizens' Awareness to Waste Problems

It is said that Moroccans discharge waste before or after the designated time and commit illegal dumping since they are not much aware of waste issues. Moroccans, however, seem to be maintaining a social etiquette when discharging waste, according to the Study. It can be assumed that they will be able to improve the manner.

Environmental awareness of Moroccans does not seem to be fully grown since there seems to be no active citizens' movements blaming dumping sites that is polluting the neighboring area.

In order to increase environmental awareness of citizens, it is necessary to do regular collection and to inform people of discharging rules. It is also important to offer citizens basic information on environmental conservation and to educate school children on environmental issues.

8.2.3 Technical Aspects

1) Waste Quantity Management

Measuring and recording the waste quantity precisely is a basic SWM activity. In order to achieve successful SWM by local governments, it is necessary to measure the waste quality in each process of generation, collection, and disposal. The following tasks should be done.

- Setting the truck scale
- Measurement of waste quality service at disposal sites
- Preparing statistic data on waste quantity

2) Management of Waste Discharge

Each local government is recommended to implement the following tasks for waste discharge.

- Establishing rules of waste discharge
- Deciding the standard size of a waste container
- Setting procedures of sorting recyclable materials at generation sources
- Arranging routes of returning recyclable materials back into production process

3) Collection and Haulage

Waste collection has been done fairly well regardless of insufficient equipment. The following are problems with waste collection.

- Some municipalities have not achieved satisfactory service coverage.
- The service is not done very efficiently.
- Operation is not managed based on data.
- Few collection equipment is used properly.
- Collection trucks are used for other purposes. (This intensive use of trucks is rational under the current financial constraint of commune, but this may lead to a decrease in operational efficiency of collection service.)
- Collection crews pick up recyclable materials during the operation, which prevents efficient operation.
- Collection quantity of each area is not well taken into consideration when deciding on the wise assignment of collection trucks.
- Preventive maintenance of collection trucks is not periodically done.
- Collection trucks are not washed everyday.
- Work schedule is not prepared.
- Operational disciplines are not clearly defined.
- The number of workers are larger in the communes' workshop relative to that of private workshop.
- Collection trucks are forced to use unpaved roads especially outside town area.
- Safety in collection work is not considered enough.
- Small size trucks of 1m² capacity load are hauling waste to disposal sites without transferring.
- Collection trucks often spill collected waste during its haulage.

The following is required to improve waste collection service.

- Expanding collection coverage
- Providing regular quality service
- Improving collection service efficiency

In order to achieve the goals above, the central government is recommended to offer the following assistance to the service providers.

- Dissemination of collection planning skills (including macro-route and balancing)
- Standardization of collection equipment
- Presenting optimal use of equipment
- Diffusion of methods of evaluating productivity and efficiency of collection work (Operation Management System)
- Standardizing collection and haulage
- Upgrading maintenance work (including periodical preventive maintenance, and increasing the efficiency)
- Setting a standard set of a transferring station
- Setting a safety standard of collection work

4) Street Sweeping

Streets of central downtown in Moroccan cities is relatively cleaned up compared to the ones in the surrounding areas although there are not many street sweepers employed. This is because street sweeping is done, and pedestrians do not litter. Some people even clean up the area around their houses. In suburbs, however, unattended waste in vacant lots and street is seen often.

Problems with street sweeping can be listed as follows.

- The number of dust bins located in downtown is less than enough.
- There are no rational operation plans for street sweeping. (There is no standards of the work amount to be done.)
- Equipment not suitable for removing collected waste are used.

There are some recommendations to be adopted. It is necessary to increase citizen's awareness not to throw away the trash in the street. Street sweeping should be done more efficiently and more productively. In order for these improvement, an ability to create operation plans and to conduct the management should be developed. Also, institutional arrangement should be made to handle the problems listed before. Mechanical sweepers should be used for main roads.

The central government is recommended to offer the following assistance.

- Dissemination of planning skills of street sweeping
- Standardization the operation street sweeping
- Standardization of equipment for street sweeping

5) Intermediate Treatment

Many municipalities have attempted composting for an intermediate treatment but few made it successful. Generally, in Morocco there have been no arrangements for the successful composting.

- Cause of failure attempts has not been examined carefully.
- Such attempts have not been recognized as lessons for avoiding another failure.

Although intermediate treatment of municipal waste is not feasible in Morocco at present, it is a better idea to accumulate the know-how of evaluating plans and technologies for intermediate treatment. The following items should be taken into consideration.

- Improvement of skills to introduce and operate composting plants
- Diffusion of the methodology of evaluation and planning concerning introduction of intermediate facilities

6) Final Disposal

Final disposals in Morocco are not controlled at all, and the situation of them is generally described as follows.

- Open dumping is done and no cover soil is applied.
- Access roads are not developed.
- Fences around the site is not placed enough.
- Location of the site is not desirable.
- There is the lack of heavy equipment in the sites.
- Operation of disposal is not done based on a proper plan.
- Operation management is not conducted.
- Waste monitoring at the gate of disposal site is not implemented enough.
- Almost no truck scale is prepared almost at all.
- Plastic bags are left scattered around disposal sites
- Some portion of waste are discarded before taken to the disposal sites.

Construction of new disposal sites is an issue in many municipalities, but large municipalities have a difficulty with securing land. To eliminate the difficulty, it is necessary to prepare the procedure rules for the construction and to establish facility standards. In order to improve the level of the construction and site management, the central government should offer the following assistance.

- Establishing facility standards
- Establishing operation standards
- Standardizing the site selecting method
- Conducting the environmental impact assessment when locating a disposal site
- Advancing the skills for planning a final disposal
- Developing the ability of engineers and technicians of final disposals
- Establishing a method to close a disposal and standards to manage the postclosure sites
- Standardizing the skills to rehabilitate the existing disposal sites
- Securing the domestic supply routes of equipment, etc. for disposal sites
- Monitoring the disposal sites

7) Environmental Impact Assessment

There is no systematic environmental impact assessment conducted for disposal site. Only few reports have been made concerning underground water pollution caused by

disposal sites. Due to the untreated lechate from the site, there may be negative impacts on the environment.

The following problems have been pointed out concerning pollution at disposal site.

- Bad smells around the site have been reported in many occasions.
- Smokes from burning waste have been reported.
- Cattle (sheep and pigs) eat waste that may contain hospital waste at dumping sites. This may bring secondary negative effects to human health although it has not been confirmed.

8) Recycling

Recyclable materials in municipal waste are recovered fairly well. They are collected by collection crews during collection and by scavengers at disposal sites.

The amount of recyclable materials collected will decrease in the following cases; prohibiting collection crews to pick up the material (This is necessary to improve collection efficiency.); or starting sanitary landfilling at final disposal sites.

A collection system of recyclable materials, especially at the generating sources, should be considered.

8.3 Issues of Industrial Waste Treatment

8.3.1 Goals in Treating Waste

There are no national goals for the treatment of industrial waste. Hazardous waste does not is not managed properly. Establishments generating industrial waste are not paying enough attention to environmental pollution resulting from disposing waste. Also, they do not pay up for the cost restoring the sound environment.

8.3.2 Institution

1) Law

There are no laws ruling specifically the treatment of industrial waste. Morocco has signed the Bazel Convention recently, MoE has a plan to draft a relevant domestic law.

Waste disposal will be subject to the Law on Water in areas where this law is applied. In accordance with the law, it will be necessary to set standards for the level of treatment and facilities for disposal of industrial waste. It is also necessary to take into consideration that large amounts of sludge will be generated through the industrial effluent, once regulations are set for treatment of industrial effluent.

The following arrangements in legal aspects should be made for preventing industrial waste's impact on the environment.

- Making clear definitions for industrial and hazardous waste
- Specifying the responsibilities for the treatment of industrial waste and hazardous waste
- Setting a standard for the treatment of industrial waste and hazardous waste
- Setting a standard for treatment facilities of industrial waste and hazardous waste
- Forming a system for authorizing a treatment of industrial waste and hazardous waste
- Establishing a system in which enterprises are required to report on generation and treatment of industrial waste and hazardous waste
- Making it obligatory for enterprise to have a staff in charge of the management of industrial waste and hazardous waste
- Imposing penalties on violators of the law
- Defining administrative power for supervision and for requiring reports

2) **Solid Waste Management and Organization within Enterprises**

Industrial SWM at the enterprises level is not matured. Within the enterprises, are no sections foamed specially for environmental protection. This is due to the absence of environmental regulations for business activities. (Since there are no laws requiring environmental consideration, establishments find no needs for creating such institutions or sections.

Even though Moroccan joint ventures with companies of EC are more environmentally conscious than domestic companies, the joint ventures, which is limited to the handling of waste within their industrial sites.

Engineers of establishments have some understanding about necessity for environmental consideration, but they have neither objectives of nor roles of maintaining the sound environment.

Establishments do not have any engineers with an expertise on the environment and industrial waste.

High rankers of establishments started to pay due consideration to the environment. Opinions are exchanged in the labor union meetings of the establishments. Also, discussions over activities for the sound environment have been made there. There are, however, no institutional arrangements with which the establishments can conduct SWM.

The private sector is not prepared for industrial SWM.

3) **Industrial Waste Administration at National and Local Government's Level**

a. **National Level**

From the environmental conservation point of view, it is very important to establish a national level system to administer industrial and hazardous waste. The central

government has not decided the ministry or agency that supervises industrial waste. Due to this, SWM of establishments is not supervised by the central government.

Recommendations on industrial and hospital waste are as follows.

- Identifying the generation source of hazardous waste
- Establishing an inventory of generation source of industrial waste
- Offering a technical guidance to arrange hazardous waste management
- Training engineers specialized in industrial SWM of industrial waste
- Establishing a national system for monitoring and supervision of industrial

SWM

From an institutional points of view, the central government is largely expected to guide the industry in industrial SWM since it is difficult for local governments to perform this duty. A reason behind this is that industrial SWM requires more complex and specialized knowledge.

(2) Local Government Level

Local governments accept every kind of industrial waste at their disposal sites. It seems difficult to conduct industrial SWM in view of the lack of human resources.

8.3.3 Technical Aspects

a. Generation and Storage of Waste

Types of industrial waste are numerous unlike the one of municipal waste. Different types of industrial waste require different types of treatment.

The following problems can be pointed out with administrative management.

- Establishments are not managing industrial waste generation satisfactorily.
- Waste quantity is not recorded.
- Industrial waste is not sorted for necessary treatment of different level. (Municipal and industrial waste are separated from each other in some cases; however, hazardous industrial waste is not separated from non-hazardous industrial waste.)
- Liquid waste is not treated, and is discharged into sewage, rivers, and sea areas.
- Proper facility is not located to store industrial waste.

b. Collection and Haulage

Establishments are generally implementing the collection and haulage of their industrial waste on their own. They, however, do not have information on the destination of the collected waste in many cases.

The following problems can be pointed out concerning collection and haulage

- Hazardous waste are not separated from non hazardous one in the haulage.
- License system of haulers (contractors) of industrial waste does not exist.
- Data management is not done for haulage of industrial waste.
- Truck drivers who haul industrial waste are not informed of the type of waste.
- Private haulers of industrial waste are not developed.

c. Treatment and Disposal

Industrial waste is disposed of at different types of places such as municipal disposal sites; into public sewage and rivers; and areas inside or outside of generator's own site. Organic waste water of high density and dangerous industrial waste are not treated to be harmless when they are discharged or taken to disposal sites. (To list some of them, waste acid, waste alkali, waste oil, waste solution, and waste containing heavy metals.) There are some cases that industrial waste is disposed of at municipal disposal sites, but no waste monitoring is done for it.

Waste seems to be treated at factory site in many cases, but such activity is not studied enough. It is necessary to construct a study on due consideration given to underground water and soil pollution.

At present, it is considered that the following waste can be mainly listed as hazardous waste.

- Waste acid used for pickling and plating, waste alkali, and old waste water (chromium and zinc)
- Mercury mud from producing sodium hydroxide
- Waste water containing chromium from bark tannery process
- Waste pigment containing lead and its packaging from coating production process
- liquid waste from photo developing process
- PCB solution from producing condensers of home electric appliance, and transformers of electric business
- Waste solution from elaborated machinery industry
- Waste water containing battery lead from car garage
- Condensed waste water from grease, oil, and sugar production process

Once Law on Water is enacted, factories will have to have treatment facilities. Large amounts of sludge will be generated from the facilities as a result of treatment of effluent. Treatment and disposal of the sludge will be a serious problem in the future.

4) Environmental Aspects

Quantitative data is lacking on environmental impact caused by disposal of industrial waste. Water pollution, however, is reported on Sebou River and coastal area along Casablanca.

Problems can be pointed out such as damage to river water intake; increased cost for water purification; degradation of tourism resources in coastal areas; accumulation of hazardous substances in marine lives.

Underground water pollution may be caused by leachate from disposal sites.

8.3.4 Issues to be Considered

The following issues are identified concerning industrial waste management.

1) Institutional Issues

National Level

- Gathering information on generation sources of industrial waste
- Preparing laws concerning management of industrial and hazardous waste
- Establishing administrative system to monitor, supervise, and instruct on industrial and hazardous waste
- Setting an administrative unit concerning industrial and hazardous waste
- Developing human resources for monitoring and supervising industrial and hazardous waste
- Providing technical assistance for developing facilities
- Providing financial assistance for developing facilities

Enterprise Level

- Forming a section or designating a person responsible for managing of industrial and hazardous waste
- Preparing norms of operation for the management of industrial and hazardous waste.
- Conducting environmental auditing

2) Technical Issues

National Level

- Preparing a technical guideline (standard)
- Developing treatment facilities and containers for collection and storage
- Strengthening domestic manufacturers of treatment facilities and containers for collection and storage
- Training and developing engineers and technicians

Enterprise Level

- Encouraging industry to prepare SWM manuals
- Developing necessary treatment facilities

8.4 Problems of Hospital Waste Treatment

8.4.1 Goals in Hospital Waste Treatment

Concerning hospital waste, legal responsibility of its treatment is not clearly diffident. Both hospitals and an administrative body do not recognize their social responsibilities for hospital waste.

8.4.2 Institution

1) Law

There are no legal framework concerning the scope of the responsibility for hospital waste management

Infectious waste is not separated from and other waste. Also, there are no standards legally defined for the treatment of those waste. High rankers in charge of hospital management are not in a position responsible for hospital waste.

2) Institution and Management

a. Hospital Waste Management System and Organization

(1) Waste Management Organization in Hospital

Management Responsibility

In a large hospital, a section for general affairs is in charge of cleaning. This section is responsible for day to day cleaning of hospital, but it does not "manage" the hospital waste.

Persons in charge of a hospital building where infectious waste is generated, understand the danger of it, and the waste is separated there. Arrangements are not made for keeping the waste separated until disposal.

Human Resources

There are almost no experts of hospital waste disposal in the hospital. People in medical field also do not have any systematic expertise on hospital waste. Individual doctors, however, are very able in Morocco, and hospital waste management in the future seems to improve.

(2) Disposal outside Hospital

Local Government (Communes and Urban Communes)

Local governments are currently conducting waste disposal and even collection of hospital waste within their administering areas. The waste is taken to their disposal sites

without any regulations; however, management of the site is not done at all since there is no organizational arrangements for the management.

Private Sector

There are no market demands for treatment of hospital waste by private sector since hospitals will not be benefited from doing so.

b. Central Government's Arrangement for Hospital Waste Treatment

At the central government level, administrative responsibility concerning hospital waste has not been clearly defined by law. For the time being, it can be recognized that Ministry of Interior, which is responsible for supervising hospitals, remains with the responsibility for administrative supervision over hospital waste. The ministry recognizes the importance of hospital waste issues, so it has a section and a section leader responsible for hospital waste management. The ministry, however, is not authorized to require hospitals to apply the measures that the section has prepared.

c. Management and Administrative Supervision

(1) SWM inside Hospital

Hospitals have no proper in-house norms set for their SWM. No management activities is done for performance monitoring, data management, and human resources development. There is no management system for SWM inside hospital.

(2) Administration and Supervision

Although administrative instruction has not been done, basic guideline has been prepared through the assistance of WHO. An issue is how to implement the guideline in hospitals.

There are no clear rules for supervision to check if SWM is properly done by hospitals.

8.4.3 Technical Aspects of Hospital Waste Treatment

1) Generation and Storage of Hospital Waste

a. Generation and Separation of Hospital Waste

Hospital waste is separated only when a person in charge of each hospital building recognize the necessity for the separation. This is because there are no clear definitions of waste sorting. Waste separated are mainly visceral organs from surgical operation, and waste from facilities analyzing pathogens. Persons in charge of these generation sources are recognizing how dangerous the hospital waste is.

They, however, are not informed of how the waste is treated. Once such dangerous waste is taken out of the facilities by cleaning staff, it can be mixed into other waste.

b. Storage of Hospital Waste

Proper storage of hospital waste does not seem to be prepared in hospital buildings. It is containers, which Communes have offered, that is used for storing waste collected during cleaning. While it is not sanitary around the containers, scavengers can easily reach them.

2) Collection

a. Collection at General Hospital

The following problems can be listed based on the Study concerning collection in general hospitals.

- Sorted collection is not done enough.
- Used injection needles may not be put in a container.
- No labels are attached to waste for notifying the danger.
- Collection crews are not informed of how to handle the waste.

b. Haulage of Hospital Waste outside Hospital

Communes are hauling hospital waste from hospitals to disposal sites. They, however, do not give any instruction for sorting the waste. It is a problem that no consideration is paid to sanitation during collection work.

1) Treatment and Disposal

a. Incineration

A proper credit should be given to a hospital in Rabat for incinerating its waste. The following problems, however, should be pointed out.

- The incinerator is not located in a desirable place, and is close to residential area. (Smoke stack are too low.)
- The incineration facility does not have equipment for combustion gas treatment.
- Waste is not combusted completely due to sufficient operation.
- Operators of the facility do not seem to be trained enough.
- Record of operation is not kept.

b. Disposal of Hospital Waste

Municipal disposal sites accept waste containing hospital waste. No particular consideration is given to it there.

4) Environmental Aspects

The following environmental impact (to air, water, ecosystem) should be taken into consideration concerning treatment of hospital waste.

- Disperation of pathogens into the air environment caused by incomplete incineration treatment
- Exposure of pathogens to human health and animals
- Underground water contamination caused by pathogens

8.4.4 Issues

The following issues can be listed for establishing hospital SWM at the national and hospital levels.

1) Institutional Aspects

National Level

- Preparing laws concerning management of hospital waste
- Establishing administrative system to supervise and instruct on treatment of hospital waste
- Developing human resources for treatment of hospital waste
- Setting an organization responsible for hospital waste
- Offering technical assistance for developing facilities
- Providing financial assistance for developing facilities

Hospital Level

- Clarifying legal responsibility of hospitals for management of hospital waste
- Establishing a section responsible for hospital SWM
- Preparing norms of operation for treatment of hospital waste.
- Training hospital staff responsible for management and treatment of hospital waste

b. Technical Issues

National Level

- Preparing a technical guideline (standard)
- Developing treatment facilities and containers for collection and storage (Research and development in coordination with the private sector)
- Training and developing engineers and technicians

Hospital Level

- Creating SWM manuals for hospital waste
- Developing necessary treatment facilities





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