

Japan International Cooperation Agency (JICA)
Ministry of Environment of the Government of Morocco


The Study on the National Guidelines for
Solid Waste Management for
the Kingdom of Morocco

Final Report

Book 5

Summary

August 1997

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PREFACE

In response to the request from the Government of the Kingdom of Morocco, the Government of Japan decided to conduct the Study on the National Guideline for Solid Waste Management for the Kingdom of Morocco and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA has sent to Morocco a study team headed by Mr. Masato Ohno, Director of Environmental Department, EX Corporation., Ltd., three times between January 1996 to May 1997.

The team held discussions with the officials concerned of the Government of Morocco and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Morocco for their close cooperation extended to the team.

August 1997



Kimio Fujita
President
Japan International Cooperation Agency



July 1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita,

Letter of Transmittal

I am honored to hereby submit to you the Final Report of "the Study on the National Guidelines for Solid Waste Management for the Kingdom of Morocco." This report consists of "Guidelines for Solid Waste Management at the National and Local Levels (consisting of *Guidelines for National Level Policies and Actions for Solid Waste Management*; and *Guidelines for Improvement of Solid Waste Management for Urban Communes and Communities*)," "National Action Programs for Solid Waste Management," and "Solid Waste Management Plans for Safi and El Jadida."

"Guidelines for National Level Policies and Actions for Solid Waste Management" aims at establishing national SWM administration. It presented national strategies for development of SWM and addressed various aspects of SWM; namely, a legal framework of SWM administration, institutional arrangements for the administration, human resource development, legal standards for treatment and disposal, and improved administrative systems for management of infectious and hazardous wastes.

"Guidelines for Improvement of Solid Waste Management for Urban Communes and Communities" assists local governments to improve municipal SWM by providing directional assistance in the aspects of software such as institutions, management and financial management; and of hardware such as collection and treatment technologies.

In order to implement the national strategies and guidelines, "National Action Programs for Solid Waste Management" was presented, proposing national policies for the next five years. These action programs were formulated based on numbers of discussions held with the Moroccan counterparts.

"Solid Waste Management Plans for Safi and El Jadida" explains a demonstration plan implemented for increasing a citizens' environmental awareness in Safi while it provides the city with improvement plans for collection services and construction plans for model sanitary landfilling sites. Another construction plans were prepared for El Jadida to introduce an advanced type of sanitary landfilling sites.

The government of Morocco showed a strong intention to immediately formulate a SWM law. In order to add meanings to the law, the body planned construction of model (controlled) landfilling sites in Safi and El Jadida, and intends to implement action programs. The Moroccan government is strongly expected to achieve successful implementation of action programs.

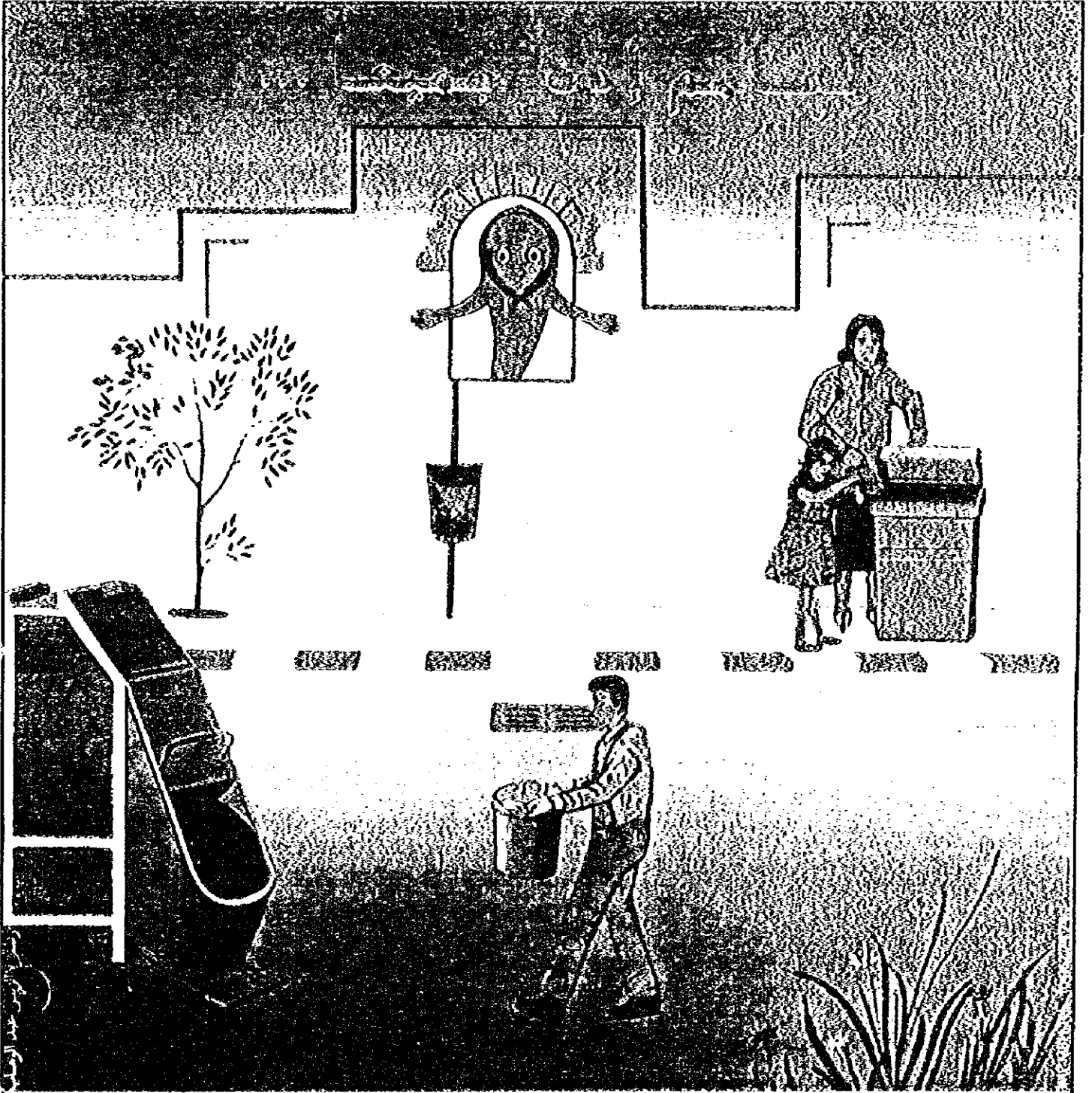
The Study Team sincerely hopes that this report will be a help for improvement and development of SWM in Morocco.

The JICA Study Team would like to express its sincerest gratitude to officials of JICA, the Ministry of Foreign Affairs and the Ministry of Public Health as well as all the Steering Committee chaired by Dr. Masaru Tanaka of the National Institute of Welfare for their cooperation and understanding throughout the period of this study. The Study Team has been most grateful of advises and cooperation devoted by officials from various authorities including the Ministry of Environment, the governors and other officials of Safi and El Jadida, the Embassy of Japan in Morocco, JICA Morocco Office, and would like to deliver its best appreciation to all those concerned.

Respectfully,

A handwritten signature in black ink, appearing to read 'M. Ohno', with a long horizontal flourish extending to the right.

Masato Ohno
Team Leader
The Study on Solid Waste Management
for the Kingdom of Morocco

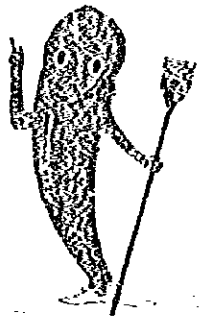


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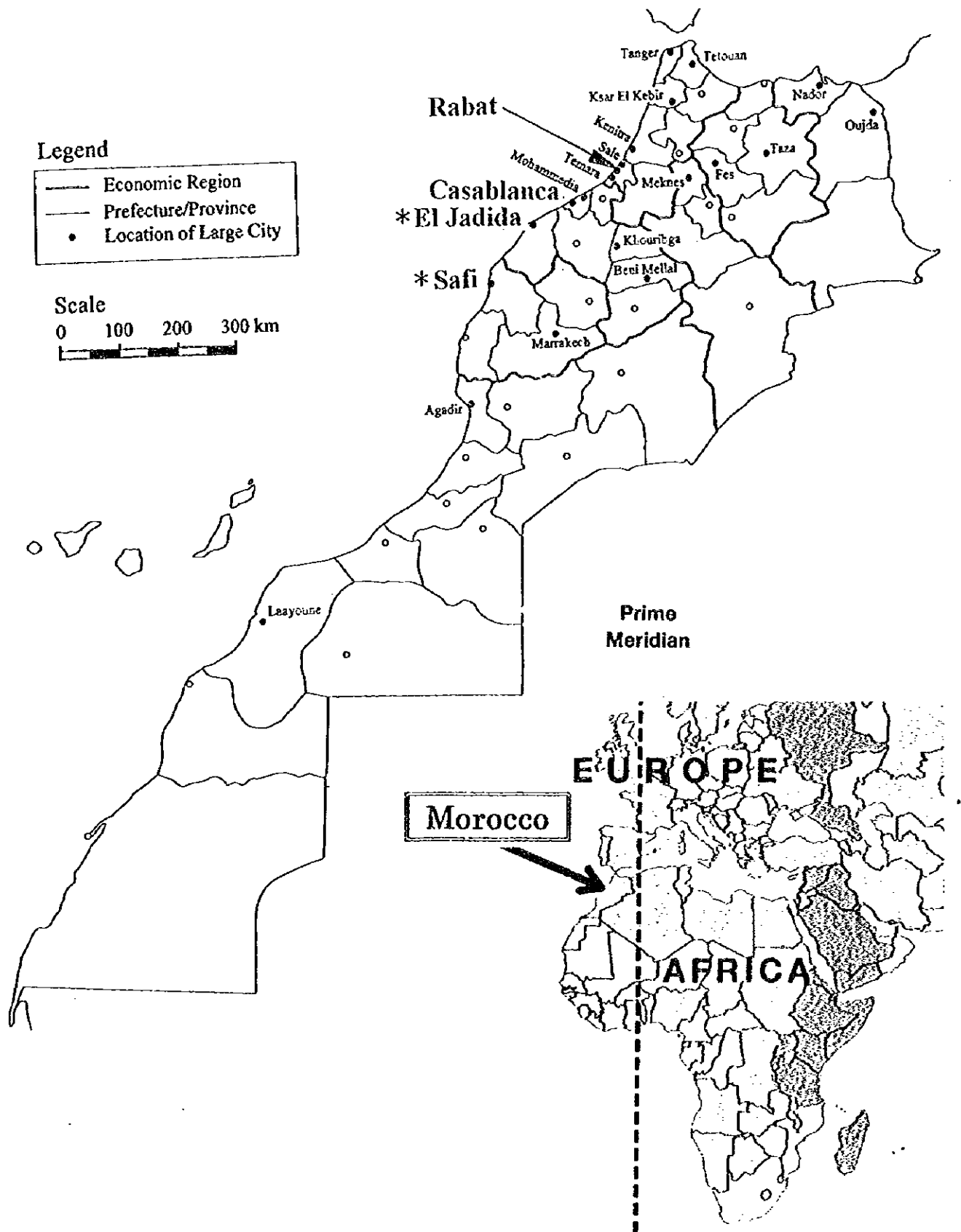
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وزارة الداخلية - وزارة البيئة
الوكالة اليابانية للتعاون الدولي





Location Map of Morocco



* Safi and El Jadida were selected for the second year study of this project.

Exchange Rate (as of July 1997)

1 Dirham = 0.115 US dollars = 13 yen

Abbreviation List

BMH	Municipal Health Service
CNE	National Council for Environment (Conseil National de l'Environnement)
CRE	Regional Council for Environment (Conseil Régional de l'Environnement)
DAHIR	Law, Decree, or other legal document signed by the King
DH	Dirham
EU	European Union, E.E.C
FEC	Fond D'Equipeement Communal Communal Fund for Equipment
GDLC	General Department of the Local Government, MoI
HCS	Haul Container System
MoA	Ministry of Agriculture
MoC&I	Ministry of Commerce and Industry
MoE	Ministry of Environment
MoEM	Ministry of Energy and Mines
MoH	Ministry of Health
MoI	Ministry of Interior
MoPW	Ministry of Public Works
NP	National Promotion
ONEP	National Office for Drinking Water
SWM	Solid Waste Management
USE	Under Secretariat for Environment, MoI
Veh.	Vehicle

Final Report

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Current Book and Part are marked with “*”.

- Book 1** **Guidelines for National Level Policies and Actions for Solid Waste Management**
- Part 1 National Strategy
 - Part 2 Laws, Institutions, and Finance
 - Part 3 Industrial and Hazardous Waste
 - Part 4 Infectious Waste
- Book 2** **Guidelines for Improvement of Solid Waste Management for Urban Communes and Communities**
- Part 1 Management and Institutions
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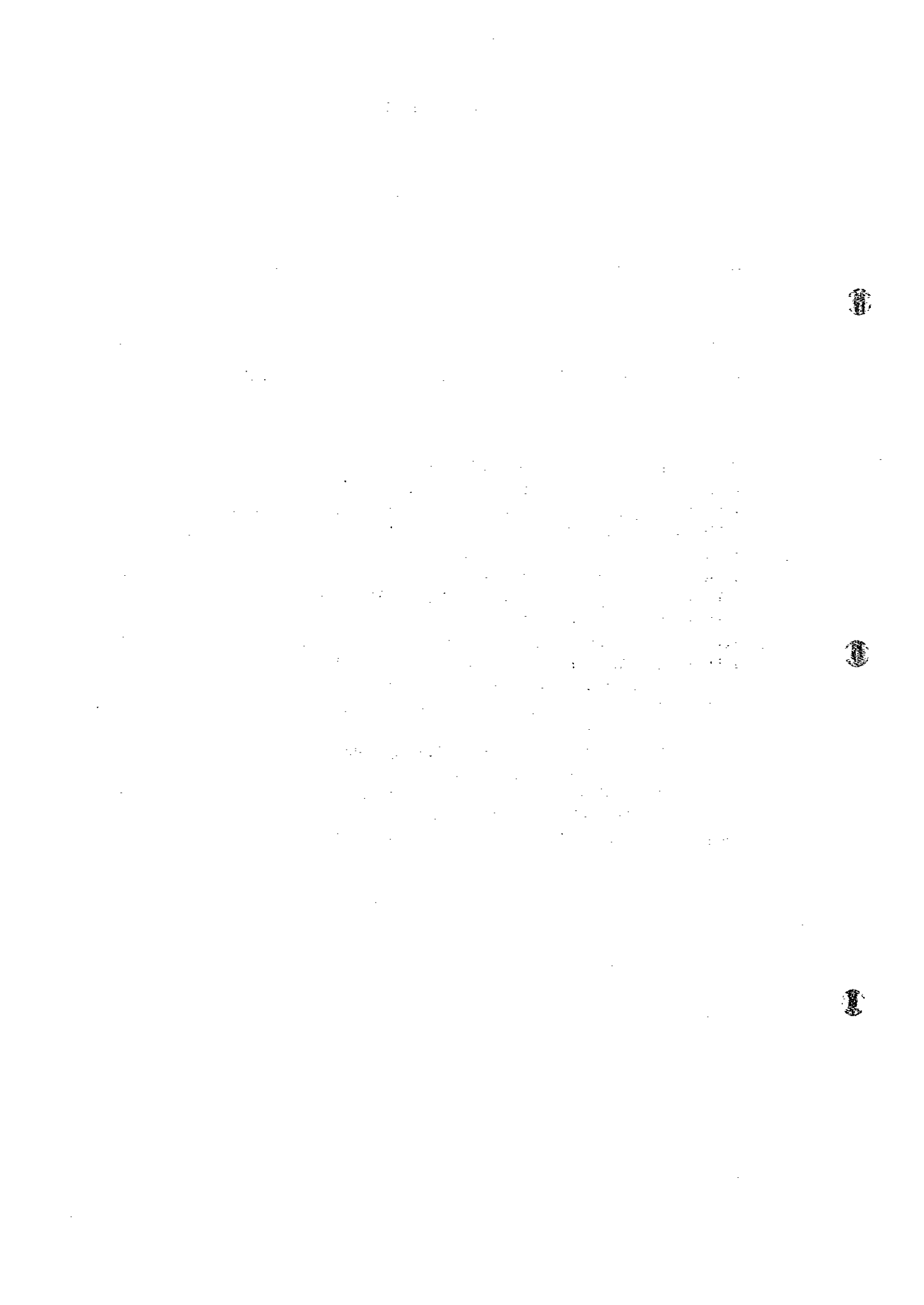
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THE STUDY ON THE NATIONAL GUIDELINES FOR SOLID WASTE MANAGEMENT FOR THE KINGDOM OF MOROCCO

INTRODUCTION

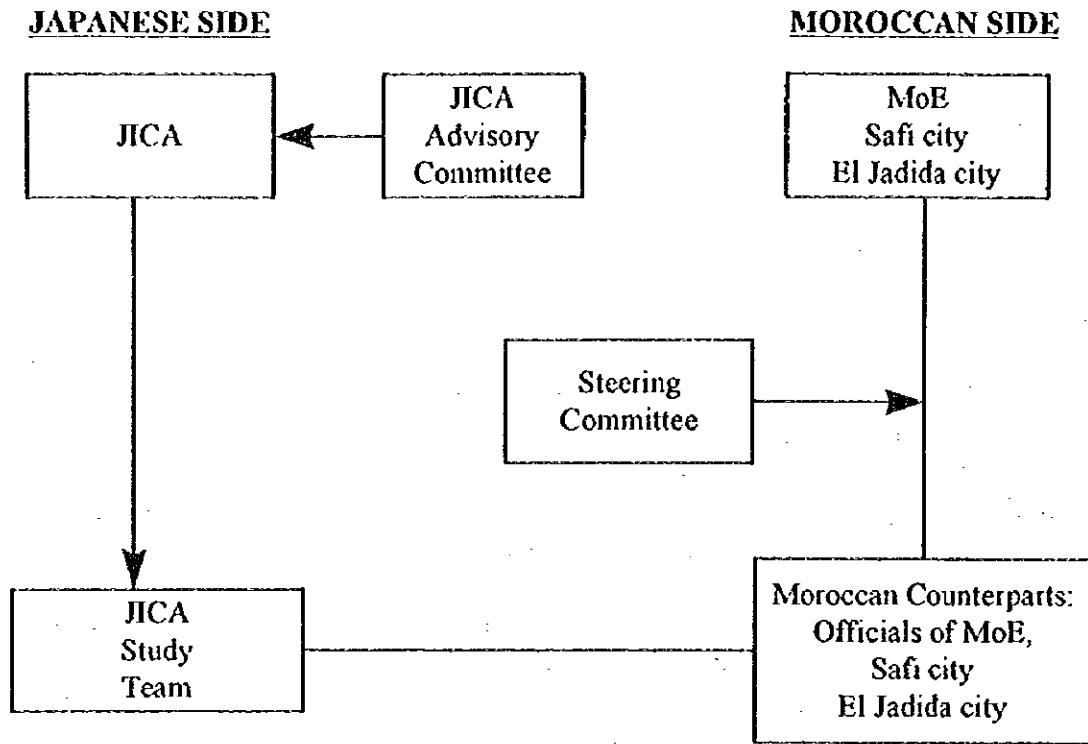
1. Objectives of the Study

The objective of the Study is to strengthen the capacity of solid waste management at both national and local levels. This study has been executed by Japan International Cooperation Agency (JICA) based on the request from the Government of Morocco. JICA commissioned the study to a joint venture comprising EX Corporation and Yachiyo Engineering Co., Ltd. The joint venture has organized a study team comprising of 11 specialists. The Study has been conducted jointly by Japanese consultants and their and Moroccan counterparts.

The study period was about 18 months from January 1996 and July 1997. The Study is divided into two phases, the first phase being from the beginning upto September 1996, and the second phase being from October 1996 till the end. The objective of the first phase study is to formulate the guidelines and action plan for solid waste management at both national and local levels. The objective of the second phase is to apply the guidelines formulated, and check applicability. Two cities, i.e. Safi and El Jadida were selected for the second phase. The Study team in collaboration with the counterparts in Safi city have formulated a plan for improvement of solid waste management. In addition, we have implemented a public education campaign (demonstration project) aiming at strengthening citizens' understanding and cooperation concerning city cleansing. We have also formulated a plan for improvement of disposal of solid waste for El Jadida. It is expected that the plans will serve as a model for other local authorities in Morocco.

2. Study Organization

The study organization is shown in the figure below. This study has been conducted jointly by the Study Team led by Mr. Ohno and the Moroccan counterparts, i.e. officials of Ministry of Environment, Safi city and El Jadida city. A key counterpart agency on the Moroccan side is the Ministry of Environment. For the smooth execution of the study, the Moroccan side has formed a steering committee comprising of representatives of Ministry of Environment, Ministry of Interior, Ministry of Health, Ministry of Public Works, and Ministry of Commerce and Industry. Mrs. Layachi, Director, Department of Observation, Study and Coordination, Ministry of Environment has served as chairman of the steering committee. On the Japanese side, an advisory committee was formed for the study. Dr. Masaru Tanaka, Director, Department of Waste Management Engineering, the National Institute of Health served as chairman of the Advisory Committee.



MoE: Ministry of Environment

3. Reports

This study has produced the following reports:

1. Inception report
2. Progress report (1)
3. Interim report
4. Progress report (2)
5. Draft final report
6. Final report

The final report consists of the following Books:

- Book 1** Guidelines for National Level Policies and Actions for Solid Waste Management
Part 1 National Strategy
Part 2 Laws, Institutions, and Finance
Part 3 Industrial and Hazardous Waste
Part 4 Infectious Waste
- Book 2** Guidelines for Improvement of Solid Waste Management for Urban Communes and Communities
Part 1 Management and Institutions
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- Book 3** National Action Programs for Solid Waste Management
- Book 4** Solid Waste Management Plans for Safi and El Jadida
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Current Conditions of Solid Waste Management in Morocco
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All the Books except for Book 8 have been prepared in English and French.

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**A GUIDELINES FOR SOLID WASTE
MANAGEMENT AT NATIONAL AND LOCAL
LEVEL**



A. GUIDELINES FOR SOLID WASTE MANAGEMENT AT THE NATIONAL AND LOCAL LEVELS

I. OUTLINE OF MOROCCO AND CURRENT CONDITIONS OF SOLID WASTE MANAGEMENT

1. Outline of Morocco

Morocco is a kingdom located in the north western part of Africa. Its population is about 26 million (1994). GNP per capita in 1994 is 1,265 U.S. dollars. Natural and socio economic conditions of Morocco are outlined below.

1.1 Natural Conditions

1) Topography

Morocco is one of the Magreb countries (Morocco, Tunisia and Algeria). Of the three countries, Morocco is located in the most western part. Morocco faces Algeria on Morocco's south eastern border. To the south of Morocco is Mauritania. To the north of the country is the Mediterranean Sea. The Atlantic Ocean is to the north west. Spain is 14 km away from Morocco across the straits of Gibraltar.

Morocco has an area of 710,850 km², of which 250,000 km² is the west Sahara. The Atlas mountain chain runs from the western part of Morocco to the east. On the northern part are the Rif mountains. Mountain areas of Morocco have unstable geological characteristics, and occasionally experience earthquakes.

2) Climate

Climate varies in different regions of Morocco. The Northern part of Morocco down to Casablanca has a Mediterranean climate, while inland, it has a continental climate. The Atlas mountain has a mountain climate. To the south of the Atlas Mountains there is desert. Regions facing the Mediterranean Sea have an annual rainfall of about 750 mm, the largest in Morocco. The Western Sahara region has the least rainfall averaging about 100 mm per year. Rainfall in Safi and El Jadida, which were studied in the second phase, is about 300 mm per year.

3) Natural Resources

Water Resources

Total rainfall in Morocco is about 150 billion m³/year, of which 30 billion m³/year is surface or groundwater available for human use. Average rainfall available is 800 m³ per person. According to international standards, Morocco is categorized as a country of water shortage risk.

Mineral Resources

Morocco is the largest phosphate producing country. Estimated reserves of phosphate are 58 billion ton. About one half of excavated phosphate is exported, the remaining half being processed in Morocco. OCP, a Moroccan semi-governmental company, manages all the process of phosphate production including mining, production and sales. There are OCP factories in the suburbs of Safi and El Jadida.

1.2 Socio-Economic Conditions

1) Population

Morocco's population was about 26 million in 1994, of which 51 % lived in urban communes, and the remaining 49 % in rural communes. The share of the urban population has been increasing. The rate of population increase during the period 1992 to 1996 was 3.64 % in urban communes, and 0.67 % in rural communes. The national average was 2.06 %.

2) Illiteracy

Rates of illiteracy is 37 % of population in urban communes, and 72 % in rural communes, the national average being 55 %. These rates are high compared to those of other countries of similar economic level. In 1991, school attendance rates for those between 7 and 13 years is 81 % in urban communes, and 41 % in rural communes. National average rate of high school attendance (7th - 12th grades) is 37 %. Only 5 % of Moroccans go to universities.

3) Local Government System

The territory of Morocco is divided into 248 urban communes and 1,297 rural communes. Of the 248 urban communes, 57 have been organized into 14 urban communities (cities). The biggest urban community is Casablanca comprising of 20 urban communes. It has population of 2.67 million. The two urban communities, Casablanca and Rabat were established in the mid 1970's. The other urban communities were established in 1992.

Presidents of communes are elected by citizens. Presidents of urban communities are selected by and among presidents of member communes.

Morocco has dual local government systems. One is the system (where presidents and councilors are elected by people) explained above. The other is the local government system directly under control of the Moroccan government. In the latter system, there are 22 prefectures and 43 provinces. There are urban and rural communes in each prefecture or province. The only difference between prefectures and provinces is that the former are more urban than the latter.

Each prefecture or province is divided into smaller units called "districts" and "circles" respectively, which are further sub-divided into smaller units called "arrondissements"

and "caidates" respectively.

Wilayas are formed in politically important cities. There are 9 Wilayas including Rabat and Casablanca. Heads of prefectures, provinces and Wilayas are nominated by the King of Morocco. All these organizations are administratively under the control of the Ministry of Interior.

Morocco is divided into 7 economic regions. They are not administrative units.

4) Economy

During the past decade, Morocco has implemented an effective adjustment program, involving stringent fiscal and monetary policies, tax reform and tight wage and salary policies. Fairly stable real exchange rates have been achieved and inflation is now under control, after large increases in the urban consumer price index in the early 1980's. Overall performance of the Moroccan economy has been good in recent years: per capita income has grown at an average rate of about 4 percent since the mid 1980's. Estimated GNP in 1994 at current prices was DH 286,030 million, which corresponds to about DH 10,757 (or about 1,265 US dollars) per capita.

Moroccan economic performance depends heavily on agricultural production, which in turn largely depends on rainfall. In 1994, 40 % of the Moroccan population was engaged in agriculture. Agriculture accounts for only 20 % of GNP though. Agricultural export earnings account for 30 % of the total export earnings.

In 1994, the manufacturing industry accounted for 17 % of GNP. Major sectors include food processing, textiles, car assembly, chemicals and fertilizers.

The mining industry contributes 5 % of GNP. Phosphate is a major mineral resource. Due to the drop in the world price of phosphate, the share of phosphate exports relative to total exports decreased from 32 % in 1982 to 8 % in 1991.

The trade balance has been good in recent years and foreign reserves have increased. EU countries are most important for Moroccan exports. EU purchases 90 % of Moroccan exports of textiles and clothes, and 80 % of its exports of agricultural goods. Morocco will face increased competition for its main exports (textile, clothing and agriculture) to the EU countries in future.

5) Public Expenditures

Government expenditures account for about 30 % of Moroccan GDP. In recent years, government deficits have been growing. Components of expenditures have also changed considerably. Education and defense are the two major items of expenditures.

Transferring the burden of certain national programs to local governments has also taken place, but this has clearly not addressed the substantive issue of deficit reduction. Expenditure of local governments is about 10 % of that of the central government, i.e. 3 % of the GDP.

6) Urban Environmental Sanitation

Household sewage is a major pollutant of water in urban areas. In recent years, water pollution due to industrial effluent in some rivers including The Sebou river has become a major environmental problem. Sea pollution near industrial cities such as Casablanca and Rabat is also a cause of concern.

The proportion of people with access to piped water or well water in their homes is 74 % in urban areas, and 14 % in rural areas. 14 % of the urban population use piped water placed in public places. 94 % of the urban population has toilet facility in their homes, 34 % in rural areas. The proportion of those who have bath or shower facility in their homes is 22 % in urban areas and 5 % in rural areas.

2. The Current State of Solid Waste Management in Morocco

2.1 Legislative and Administrative Systems for Solid Waste Management

There is no legislation specifically regulating solid waste in Morocco. According to the Decentralization Law of 1972, responsibility for solid waste management rests in the hands of local governments. This responsibility, however, is not clearly defined and, moreover, the scope of the responsibility is not yet determined. Even the definition of what constitutes solid waste is not yet determined. The current situation is that municipal wastes are collected and disposed of by local governments and special process wastes generated from industrial activity are disposed of by the generator of that waste.

There are number of ways to regulate solid waste management. One way is to to regulate construction works when an application for their construction is submitted ; however, it is practically difficult to regulate final disposal sites. The Law on Water of 1996 demonstrated a means of regulating construction of disposal sites from the viewpoint of water resources. The law, however, only applied to water pollution and is not sufficient to regulate solid waste disposal sites.

National government institutions for SWM are now being prepared. The Ministry of Interior is authorized to regulate SWM at the local government level since the ministry is responsible for supervising local governments. The Ministry of Environment and the Ministry of Public Works are also authorized to regulate environmental control at disposal sites, while the Ministry of Public Health is authorized to regulate public sanitation.

Authority to regulate industrial wastes is shared by the MoIC and MoE through regulation of industrial activity and disposal of the wastes respectively. The scope of such authority is not clearly addressed.

It is considered that the MoH, which is the regulatory agency for hospitals, is the appropriate authority for regulating infectious wastes. The agencies mentioned above also have some responsibility for management of such wastes.

The roles of the national and local governments concerning administrative control over SWM are not defined. Transfer of authority to other agencies from the national or local governments is also not addressed clearly. Regulatory systems are not established either at the national or local levels.

The current state of Morocco's national legislation on SWM can be summarized as follows.

- There is no specific legislation to define responsibility for SWM. Regulations for final disposal are not sufficient.
- Administrative power over local governments and industrial waste generators is not clearly defined. An administrative system for SWM does not yet exist.

2.2 Municipal SWM at Present

There are 248 urban communes and 1,297 rural communes in Morocco, the urban population accounting for 51 % of the country's total.

Urban communes supply cleansing service to the residents. Although data on waste collection service in all the urban communes are poor, a survey conducted in about 20 communes confirmed that 70 % to 90 % of the population receives collection service. The survey concluded that collection service in urban communes is conducted relatively well despite insufficient budgets, equipment, and human resources. Waste collected is either dumped or landfilled; however, most of the waste is not treated sufficiently from the viewpoints of sanitation or environment.

Important SWM problems in Morocco include the following.

1. Service coverage is not 100 %.
2. Landfilling is not operated in a sanitary manner.

The factors that cause the above two problems are as follows.

1. Budgets are inadequate.
2. Human resources are required
3. Collection services are inefficient.
4. Management is poor.

2.3 Treatment of Industrial and Hazardous Waste at Present

1) Industrial Waste

The amount of industrial and hazardous waste generated in Morocco is not large since the industry sector itself is not large. Pollutants, however, are discharged without being properly treated into rivers and the sea. Some waste, which would be classified as hazardous waste in developed countries, is disposed of without being made harmless and stable.

Business establishments manage the treatment of waste they generate. The government does not know how industrial hazardous waste is treated and there are no governmental or local governmental regulations over industrial waste management.

2) Hospital Waste

Infectious waste is not properly separated from other waste in hospitals. Moreover, the waste is disposed of at municipal disposal sites without being made harmless.

2.4 National Goals for the Future

1) Future Waste in Morocco

The amount of waste in Morocco will inevitably increase due to economic and population growth. Assuming a 3 % annual increase in the amount of municipal waste, which is an average of 75 % of the 4 % economic growth rate, the following table 2.4-1 can be obtained. The amount of industrial waste is assumed to increase at yearly rate of 4 %, which is the same as the economic growth rate, until the year 2000. It will increase at a yearly rate of 2 % after 2000 due to enforcement of new pollution legislation.

The amount of municipal waste will increase from 5,600,000 tons in 1996 to 1.14 times that quantity by the year 2000, 1.56 times by 2010, and eventually double by 2020. The amount will grow more rapidly in urban areas, and means that threats to urban sanitation will be more pressing. Simply assuming that all waste will be collected, the necessary number of concerned staff and vehicles will be twice as many.

This estimation of the per capita amount of municipal waste is as low as 880 g/capita. An average of 660 g/capita was estimated for 1995. Based on this estimation, waste quality will be largely changed, and packages, containers, papers and plastics will be seen more often in the waste.

In this context, the change in waste quality means that the amount of recyclable waste will increase and the content will not be suitable for composting.

A large increase in the amount of industrial waste is predicted. Presently, industrial waste accounts for only 16 % of total municipal waste, but it will represent about 90 % by 2020. When legal regulations are enforced, industrial waste to be subject to special regulations will inevitably increase. It is estimated that hazardous or dangerous waste will account for 10 % of industrial waste

**Table 2.4-1 Growth in Population and Waste Generation in Morocco
1995 - 2020**

	Population Unit:1,000	Municipal Waste (,000t/year)			Industrial Waste (,000t/year)
		Total	Urban	Rural	
1995	26,074	5,660	3,800	1,860	930
2000	28,341	6,560	4,450	2,110	1,130
2050	30,484	7,600	5,220	2,380	2,820
2010	32,628	8,810	6,120	2,960	7,010
2020	36,914	11,850	8,400	3,450	10,2380

An increase in waste generation will require additional waste disposal facilities. This means that many disposal sites need to be constructed. It also means that the environmental burden and threats to local residents will be greater unless construction is implemented properly.

2) Issues of SWM in Morocco

In order to develop Morocco's SWM, the following issues should be taken care of.

- Legal and administrative systems concerning SWM should be developed.
- Open dumping should be replaced with controlled disposal.
- Regulations for special waste should be strengthened and treatment facilities should be developed.
- Human resources in the field of SWM should be developed.
- Public awareness in SWM should be increased.

In the long run, it will be necessary to introduce sophisticated treatment methods and to develop treatment technology. Additionally, a social system conducive to recycling of package waste should be formed. Taking these issues into consideration, it will be the first step in a long run effort to develop social infrastructure related to SWM.

II GUIDELINES FOR NATIONAL POLICIES AND ACTIONS FOR SOLID WASTE MANAGEMENT

The Guidelines for National Policies and Actions for Solid Waste Management consists of four parts.

- Part 1 National Strategy for Solid Waste Management
- Part 2 Laws, Institutions, and Finance
- Part 3 Industrial and Hazardous Waste
- Part 4 Infectious Waste

1. National Strategy for Solid Waste Management

1.1 Introduction

Part 1 of the Guidelines presents SWM policies that the Moroccan government should employ to improve SWM. The table of contents of this part is listed below.

- Chapter 1 Introduction
- Chapter 2 Solid Waste Management Principles
 - 2.1 Fundamental Principles of SWM
 - 2.2 The Objectives of SWM
- Chapter 3 Responsibility For SWM And Government Roles
 - 3.1 Responsibility of SWM Staff
 - 3.2 Governmental Roles
- Chapter 4 SWM Issues And Goals
 - 4.1 SWM at Present
 - 4.2 National Goals for the Future
- Chapter 5 Strategy For Development Of Municipal SWM
 - 5.1 Staged Goals for Municipal SWM
 - 5.2 Administrative Measures to improve Municipal SWM
 - 5.3 Governmental Policies for Expansion of Collection Service Coverage and Improvement of Service Quality in Local Governments
 - 5.4 Governmental Policies to Promote Sanitary Disposal with Environmental Considerations
 - 5.5 Governmental Policies to Strengthen Financial Management and to Attract Investment Funds
- Chapter 6 Strategy For Proper Management Of Industrial And Special Waste
 - 6.1 SWM Goals of Business Establishments
 - 6.2 National Policies for Developing Industrial and Special Waste Management
 - 6.3 Establishment of Laws, Enforcement, and Administration concerning Industrial and Special Waste
 - 6.4 Introducing Proper Management of Industrial and Hazardous Waste
 - 6.5 Promotion of Proper Infectious Waste Management

Chapter 7 Effects Generated By Implementing The SWM National Strategies

7.1 Cost

7.2 Benefits and Effects

The National Strategy for SWM described in detail goals for SWM, which are based on fundamental principles, and also explained policies that the government should employ in order to successfully achieve these goals.

The National Strategy for SWM presented a program of actions for the government to handle the many problems it faces. Lacking social infrastructure such as laws, institutions, and human resources, and with insufficient waste collection service and waste treatment facilities, it is essential to develop a set of priorities. The National Strategy introduced the following principles, taking priority distribution of resources into consideration.

- There must be a prevention of risks to public health caused by deterioration of the living environment and the natural environment. The National Strategy strongly recommends the government to immediately eliminate these risks even though there is no established legislation for solid waste.
- The government should, with high priority, establish social rules for SWM. Morocco is experiencing economic development and urbanization and currently is at an appropriate stage to start establishing legislation for SWM.
- The government should promote pilot cases, in which the social rules for SWM are followed. It should also develop human resources for SWM, increase public awareness on waste issues, and disseminate relevant technology through the pilot cases.

1.2 Fundamental Principles of SWM

The National Strategy introduced three fundamental principles of SWM.

- SWM should help to provide a sanitary living environment to the public.
- SWM should prevent environmental pollution, and protect the environment.
- SWM should help in attaining sustainable development

The National Strategy also addressed fundamental principles for municipal, industrial, and infectious waste management.

1.3 Responsibility for SWM and Governmental Roles

In Morocco local governments are responsible for municipal SWM based on its decentralization law. Responsibilities for industrial and special waste management belong to those who generate it. It is an important role of the national government to

help the responsible bodies conduct proper SWM of their wastes, i.e. local governments and businesses.

a. Local governments

The national government is responsible for preparing the legal framework ruling national SWM by local governments. It also has the responsibility for instructing local governments and for assisting and regulating aspects that local governments cannot handle alone.

b. Businesses

The national government is responsible for setting up and enforcing legislation to control management of industrial and hazardous wastes that are generated by businesses. It also has responsibilities for the following duties.

- Drafting national policies for industrial and hazardous SWM
- Regulating and providing instructions on SWM by businesses
- Providing technical advice to businesses
- Introducing economic incentives for investment in SWM by businesses
- Developing human resources for regulating SWM

1.4 SWM Issues and Goals at the National Level

The current situation and issues involved in SWM in Morocco are explained in section I-2. This section will introduce SWM goals at the national level, taking into consideration the National Strategy for Environmental Protection and Sustainable Development. These goals are as follows.

- Collection service rate for municipal waste should be 100% in all Urban Communes and center areas of Rural Communes by 2010.
- Controlled disposal sites should start their operation by 2010.
- Collection service in Rural Communes should be improved.
- All industrial and special wastes should be disposed of at controlled disposal sites.
- The government should establish targets for the introduction of treatment facilities for special waste

1.5 Strategy for Improving Municipal SWM

Listed below are three staged goals for improvement of municipal SWM.

- Stage 1:** Provision of expanded collection service
- Stage 2:** Sanitary waste disposal with environmental considerations
- Stage 3:** Minimized generation of waste and dissemination of a recycling system

Following are measures to achieve the staged goals.

1. Legislation for municipal SWM and institutions for governmental regulation

- a. Development of legislation to regulate municipal SWM
- b. Strengthening of institutions for regulation of SWM by local governments
- c. Provision of training courses
- d. Formulation of a national council for solid waste

2. Development of municipal SWM

- a. Dissemination of planning techniques for improved SWM
- b. Formulation of priority projects and their dissemination
- c. Strengthening financial management abilities of local governments, and assistance in securing investment funds
- d. Human resource development
- e. Establishment of R&D institutions for treatment technology and recycling systems
- f. Production of a white paper on solid waste

3. Expansion of collection service areas by local governments, and improvement of service quality

- a. Investigation of causes of inadequate service and instructions on means of improving service
- b. Instruction on improvement of management ability of local governments for providing better quality collection service
- c. Promoting contracting out of the service to private service providers

4. Promotion of development of environmentally-considered sanitary disposal sites

- a. Instruction on development of disposal sites based on facility standards, and implementation of pilot projects
- b. Improvement of site operation management that will resolve identified problems
- c. Encouraging privatization of disposal site operations

5. Improvement of municipal financial management

- a. Strengthening SWM cost management
- b. Development of accounting system for SWM

1.6 Strategy for Proper Management of Industrial and Special Wastes

As a strategy for proper management of industrial and special wastes, one principle and

three goals are presented as follows.

- Principle:** Establishment of proper SWM by waste generating businesses
- Goal 1:** Establishment of a management system for proper treatment of solid waste by waste generating business
- Goal 2:** Conducting proper treatment for all the special waste generated (hazardous industrial and infectious wastes)
- Goal 3:** Introduction of clean technology

Basic policies to achieve the three goals are as follows.

The government should conduct the following activities to regulate and instruct waste generating businesses to properly implement industrial and special waste management.

1. Development of legislation regulating industrial and special wastes, and its enforcement system
2. Information management on industrial and special wastes, and preparation of guidelines for SWM
3. Training administrators with expertise on industrial and special wastes

Along with these tasks, the government should conduct the following strategic activities to promote proper SWM.

- Identifying special waste that has negative influence on the environment, and regulating the treatment of such waste intensively.
- Imposing intensive regulation on businesses generating special waste, and instructing them to introduce facilities for proper intermediate treatment and final disposal
- Selecting some businesses that adhere to the above instructions as role models, and encouraging other businesses to follow suit
- Examining treatment and disposal methods with businesses, and enhancing an environment equipment industry in Morocco
- Creating the economic circumstances that encourage businesses to invest in environmental protection

Following the above strategic policies, the following measures should be made.

1. Administrative Measures for Industrial and Special waste

- a. Establishment of Administrative Systems for Industrial and Special Waste**
- 1) Developing legislation regulating industrial and special waste
 - 2) Establishing an administrative system for permission, approval, instruction, and regulation for special waste management
 - 3) Enforcing governmental regulation of hospitals
 - 4) Developing an inventory system of special (hazardous) waste, and preparation of technical guidelines for management of such waste

- 5) Establishing institutions for regulation of transboundary movements of hazardous waste
- b. Forming a national committee for preparing legislation on special waste and disposal standards
- c. Encouraging the development of experts in special waste management
- d. Providing training courses to develop human resources for SWM
- e. Enforcing R&D on special waste management and clean technology
- f. Considering the use of economic incentives

2. Promoting Proper Management of Industrial and Hazardous wastes

a. Instructions on SWM for businesses

- 1) Increasing awareness of top managers of business establishments on waste issues
- 2) Development of SWM institutions in factories that need SWM most urgently, and instruction on environmental auditing
- 3) Provision of information on guidelines for proper treatment methods
- 4) Strengthening systems for reporting on and permission for installation of treatment facilities
- 5) Offering lectures for developing specified SWM managers and engineers in business establishments
- 6) Promoting development of private treatment facilities for industrial and hazardous waste

b. Identification of Factories to be Subject to Intensive Regulation on Hazardous Waste, and Instructions to those Factories

- 1) Identification of waste and factories of high SWM priority
- 2) Research on present situation of waste and factories of high SWM priority
- 3) Technical instruction on management of waste of high SWM priority

c. Preparation of Guidelines for Special Waste Management and Instructions for Development of Treatment Facilities

- 1) Preparation of guidelines for setting targets for special waste treatment
- 2) Preparation of national plans for developing special waste treatment facilities
- 3) Instructions for promoting development of special waste treatment facilities based on the national plans

d. Promotion of Proper Management of Infectious Waste

- 1) Instructions for improving infectious waste management at hospitals

- 2) Research on development of facilities for infectious waste treatment, and promoting installation of such facilities

1.7 Effects of National Strategy for SWM

1) Costs of Improving SWM

Operation of treatment facilities can begin around the year 2000. Based on the assumption that wastes generated during 2000 and 2010 are disposed of at controlled landfills, it is roughly estimated that investment and operation costs will account for a total of 28 billion DH. This is small in relation to Morocco's GNP, costing about 100 DH/year/person.

This cost can be regarded as inevitable if sanitary living and sustainable economic development is to be achieved. The cost is not expensive when compared to disposal costs in European countries. The government should regard this cost as necessary if it intends to introduce free trade with EU and to join in international trade under WTO rules.

Table 1.7-1 Estimated Investment and Operation Costs for SWM (2000 to 2020)

	Municipal Waste	Industrial Waste	Total
Accumulated amount of waste during 2000 and 2010	83,980,000 t/year	36,407,000 t/year	120,387,000 t/year
Investment cost	6.7 billion DH	7.3 billion DH	14.0 billion DH
Operation cost	6.7 billion DH	7.3 billion DH	12.0 billion DH
Total	12.4 billion DH	14.6 billion DH	28.0 billion DH

Note: Figures are roughly estimated.

Note 2: Investment and operation costs for municipal SWM are assumed to be 80 DH/person

Note 3: Investment and operation costs per ton of industrial waste management are assumed to be twice as high as those for municipal SWM.

2) Benefits and Effects

Benefits and effects obtained from introducing controlled landfills would be as follows.

- Moroccan citizens would enjoy healthy, sanitary, and comfortable living.
- Water quality at sources can be improved. Conservation of water resources can be achieved. Reductions in the cost of purifying waste can be brought about.
- Maritime resources in the ocean can be conserved.
- A "clean and beautiful" Morocco can encourage tourism.
- Domestic consultants and facility construction businesses can be developed, which will be able to explore business opportunities in other African countries.
- By meeting trading conditions at the international level, business opportunities will become easier to access.

- By aiming at environmental protection, wasted resources will be decreased and the competitive power of companies can be enhanced.

It is rather difficult to present benefits in monetary terms and to compare them to disposal costs, especially in the field of solid waste. Taking many benefits into account, it is, however, expected that the benefits will be larger than the costs.

The Moroccan government should learn from the experience of European countries, the United States, and Japan in the field of SWM. These countries are now suffering the consequences of their past improper SWM. These countries have to pay more expensive costs for restoring the environment than if they had conducted proper SWM at the beginning. Morocco should not follow the same path.

In these countries, waste disposal costs have increased at high rates due to the fact that these countries have taken preventive measures against environmental pollution. In Japan per capita cost for municipal waste management is about 1,500 DH. Although it cannot be denied that these countries can afford this expense, this fact should not be stressed excessively. It is an important fact that these countries have achieved greater economic efficiency while they took care of the SWM costs. By achieving more efficiency use of resources, companies that have respected environmental protection have gained competitive power.

Morocco should learn that, in fact, these countries have strengthened their economies by taking initiatives in the field of environmental conservation. Instead of neglecting SWM, it is better for Morocco to tackle the problem now so that the country's economy will enjoy sustainable development.

2. Guidelines for Strengthening Laws, institutions, and Finance

2.1 Introduction

This chapter addresses the following aspects.

1. Laws and their contents
2. Institutions required to establish national administration of solid waste
3. Policies required to improve SWM

The Guidelines for strengthening laws, institutions, and finance have been prepared for the readership of national government officials. These Guidelines have also been prepared to initiate discussion of national SWM policies.

- Chapter 1 Laws and Regulations
- Chapter 2 Institutional Framework
- Chapter 3 Financial and Economic Aspects
- Chapter 4 Information System
- Chapter 5 Technical Standards
- Chapter 6 Human Resource Development and R&D
- Chapter 7 National Support

2.2 Laws and Regulations

The Guidelines for Strengthening Laws, Institutions, and Finance proposed some important basic legal concepts to help formulate legislation for solid waste, referring to relevant legislation in Europe (mainly France, Germany, the UK, and EC). Basic concepts for national legislation were proposed in accordance with Basel Convention since Morocco has ratified the Convention.

1) Concepts of Solid Waste Legislation

The following are concepts of solid waste legislation.

1. General provisions

- Objectives of law on waste treatment
- Terminology

2. Principles and Obligations of SWM

- Principles of SWM
- Waste reduction at its source, recovery and reuse of waste
- Obligations concerning SWM

3. Treatment System

- Treatment methods
- Classified facilities
- Administrative involvement in special waste management
- Criteria for selecting treatment facilities for special waste
- Utilization of agricultural lands
- Treatment standards and technical standards for treatment facilities
- Contracting out waste treatment

4 Responsibility of Factories that Generate Waste

- Responsibility for SWM in manufacturing processes
- Responsibility for SWM in physical distribution processes
- Waste recovery

5 Waste Commission and Regional Regulatory Agency

- National Commission of Waste
- Regional Regulatory Agency

6 Regulatory Activities for SWM

7 Installation and Operation of Waste Treatment Facilities

- Authorization for waste treatment facilities
- Supervision of operation
- The status of existing facilities
- The obligation of declaration
- Authorization for collection and transport

8 Operators of Waste Treatment Facilities

- Obligation and Qualifications of of Waste Treatment Facility Operators
- Roles of SWM managers in business establishments
- Operation records and reports

9 Packaging Waste

10 SWM Plan

11 Illegal Dumping, Management of Post-closure Landfill Sites, and Public Funds

The main report also covered the authority of local governments to collect fees, authorization of private service providers, and penalties, the details of which are not presented here.

One purpose of a law on waste is to clarify the definition of solid waste and the responsibility for waste treatment. This section mainly discussed municipal waste, identification of special waste, and responsibility of waste generators as well as local government responsibility for SWM.

This section stressed the importance of two legal definitions concerning waste treatment, treatment standards, and administrative powers to strictly apply the standards. Obligations of managers in charge of waste treatment are addressed, and those of manufacturers, whose responsibility has been getting stricter, are also presented.

This section also stressed that it is desirable to set up a national waste committee. Also stressed was the importance of a regulatory agency, which will authorize installation of waste treatment facilities and regulate their operation.

2) Laws and Regulations controlling Import and Export of Hazardous Waste related to Basel Convention

Morocco has ratified the Basel Convention and needs to develop national legislation related to the Convention. Items of the legislation are listed below.

- Objectives
- Definitions
- Permission to export
- Permission to import
- Transfer manifest
- Arrangement orders
- Report, auditing, inspection, and complaint
- Penalties
- Focal point

Items listed above are related to domestic procedures. Morocco needs to define these items. Other procedures are defined in detail by the Convention, and Morocco has to respect the defined procedures.

The Basel Convention imposes strict responsibility on a country (a Party) to respect certain principles. According to the Convention, an exporter cannot permit waste export to Morocco since that country is not yet equipped with necessary national legislation or systems for management, regulation and treatment of special waste.

2.3 Institutional Framework

1) Arrangement of Roles and Powers among Authorities

Morocco has not yet created institutions for national policies and actions for SWM. The main report addressed the scope of the responsibility of authorities for SWM. The absence of the necessary institutional structure has prevented cooperation of SWM officials and hampered development of SWM.

Details were presented on the roles of the national government. Distribution of roles and powers among the MoE vis-à-vis other authorities were described since the MoE has the widest range of responsibilities.

2) Development of Institutions for Waste Administration

National policies and actions for SWM were recommended in the main report, and the following items were proposed for better administration of waste:

1. Setting up a national committee to examine draft legislation
2. Strengthening instructions and regulations of SWM by local governments
3. Introducing regional regulatory agencies for environment
4. Strengthening channels for instructions and regulations for hospital waste

5. Strengthening instructions on recycling and clean technology
6. Establishment of a national laboratory for waste and environment
7. Providing better training courses
8. Setting up a national waste council

3) Organization related to Waste Administration

The following sections are necessary for organizing waste administration.

1. the MoI's internal section for instruction and regulation relating to local governments
2. the MoE's internal section for the control of environmental pollution, solid waste, and soil pollution
3. the MoH's internal section for instruction and regulation of hospital waste
4. the MoIC's internal section for instruction concerning recycling and clean technology

2.4 Financial and Economic Policies

Details on financial and economic policies are not in the scope of national waste administration; however, the main report presented some guidelines for these essential policies for improving SWM.

1) Financial Policy

The main report explained Morocco's financial system. The report also presented outlines concerning the value added tax (VAT); collection by the government and distribution to local governments. Some explanation was given concerning a loan system of investment funds for a local government through the governmental financial agency, FEC.

The main report estimated the current costs of SWM and presented a projection of increasing SWM costs in Morocco. As long as local governments simply maintain the same level of SWM services, no large increase in SWM costs will take place. However, new investment will be necessary for development of disposal facilities. It will be necessary to internalize such increases in financial policy, which will require improvement of financial management at the local government level.

Morocco's financial system is not mature enough to manage demands for investment funds for adequate treatment facilities. Credible financial management of a local government is a must for receiving loans for investment. The government, currently facing financial shortage, must properly manage distribution of available funds.

It is necessary for local governments to have financial support from the national government. Lump sum grants, with local decisions about their allocation including for SWM, is consistent with the on-going progress of decentralization.

2) Economic Policy

The government takes a role of developing policies for environmental economy. Such policies may include distribution of subsidies, introduction of product charges, deposit-refund systems, environmental taxes, and other charges. It is not preferable to distribute explicit subsidies for SWM to both local governments and businesses. Such subsidies prevent the recipients from being financially independent and are practically difficult to maintain in an equitable and efficient manner.

Volume reduction and recycling of waste can be effectively achieved by introducing environmental taxes of various forms. When imposing the taxes, it is indispensable to establish a fair system for measuring the amount of waste generated, treated, and disposed. Procedures for imposing taxes should be clearly defined and presented to the public. Disposal fees for industrial waste dischargers are relatively easy to introduce and are actually used in European countries

2.5 Information System

1) Information System for Municipal Waste

The main report addressed information management for municipal and industrial wastes, which are necessary for national SWM. Items referred to in the report are evaluations of current municipal SWM and risks to public health and environment; formulation of national policies for municipal SWM, and useful information for advice to local governments.

Development of an information system was introduced as a effective way to improve SWM. Formulation and utilization of databases was introduced as well.

2) Information System for Industrial and Hazardous Wastes

Information on the source of waste generation is an essential element for control and regulation of industrial waste management. Management of this information is called "inventory" and is proposed in the main report.

The main report presented items necessary for control and regulation of industrial waste and its treatment facilities. It also refers to necessary information to check proper implementation of SWM.

Reporting of inventory was explained as a necessary method to obtain the above mentioned information. Also addressed were the kind of information system the government should build up and how to use obtained inventory information.

2.6 Technical Standards

This section gives more details on SWM standards introduced in section 2.2 "Laws and Regulations." From a legal point of view, SWM standards are disposal standards,

technical standards for treatment facilities, and operation standards.

Disposal standards are the most important and show criteria for legal disposal activities. The standards mentioned here were presented as regulation of waste treatment in accordance with properties of wastes. The standards regulate treatment of waste acid, waste alkali, waste oil, and infectious waste. Disposal standards in Japan were taken as an example. Standards for landfilling, which serves as safety criteria for hazardous contents of waste, were also referred to.

Facility standards assist in legal authorization of treatment facilities. A model of the standards was proposed using Japanese standards as an example. Operation standards are not included in European legislation; however, it is suggested that Moroccan legislation also addresses operation standards to assure proper operation of treatment and disposal facilities.

2.7 Human Resource Development and R&D

Human resource development and R&D are very important aspects for development of SWM in Morocco. The main report described directional guidance for these topics as shown below.

1. Need for Human Resource Development and R&D

- a. Institutional arrangements for SWM and necessary human resources
- b. To increase awareness of top managers on SWM issues
- c. To develop leading experts and researchers in the field of SWM and necessary institutional arrangement for R&D
- d. The governmental roles

2. Strategies for Human Resource Development and R&D

- a. Basic policies
- b. Strategic human resource development and R&D

3. Producing SWM Experts and Administrators

- a. Producing at least 20 to 30 experts in the field of SWM
- b. Providing opportunities to produce such experts by the government

4. SWM Training Courses

- a. Offering training courses for municipal, industrial, and infectious wastes
- b. Offering training courses for municipal waste
- c. Offering training courses for industrial, hazardous, and infectious wastes

5. Enhancing R&D

- a. Significance of R&D
- b. Various themes of R&D

6. Establishment of Institutions for Human Resource Development and R&D

- a. Institutional arrangements for training by the government
- b. Institutional arrangements for R&D by the government

Training courses for SWM, which are indispensable in Morocco, were explained in detail. It is emphasized that training courses should be offered especially to top managers of local governments and businesses. Great importance is attached to on-the-job training, and it is observed that participants in training courses should learn practical know-how.

Training courses should be offered both for local governments and for businesses. The former should be offered by the MoI's existing training institutions, and some courses on environment and industrial and hazardous waste should be provided by the MoE.

2.8 National Support

The national government should help in providing environmental education, promoting private service providers, and opening access to information on SWM. Details of such support were given in the main report.

The government should help by producing educational materials and support to local governments and NGOs by launching nation-wide campaigns on SWM issues.

In order to encourage local governments to use private service providers, the government should provide necessary information and advice, sample contract formats, and seminars. Legislation on long-term contracting was explained as a necessary support to promote local governments to use the private sector.

The main report explained that the government was expected to offer support such as development of an information management system; processing of obtained information; location of a public relations center to provide information; and consulting services to local governments using the information system.

3. Guidelines for Industrial and Hazardous Waste Management

3.1 Introduction

This part is closely related to the guidelines for strengthening laws, institutions, and finance. It explains topics that were not fully explained in the guidelines; namely, national administration for industrial and hazardous waste management. Detailed information to establish a system for administration of industrial and hazardous wastes were presented.

The Guidelines for industrial and hazardous waste management consist of nine chapters.

- Chapter1. Introduction
- Chapter2. Sources of Industrial Waste and Existing Industrial Waste Management
- Chapter3. Principles and Legal Framework
- Chapter4. Administrative System and Institutions for Industrial Waste
- Chapter5. Institutions for SWM in Business Establishments
- Chapter6. Disposal and Treatment Methods for Industrial Waste
- Chapter7. Waste Prevention and Recycling
- Chapter8. Developing Private Service Providers
- Chapter9. Promoting Investment in Environmental Control

3.2 Sources of Industrial Waste and Existing Industrial Waste Management

Manufacturing industry in Morocco accounts for only 19% of the country's GDP. Food, chemical, and metal industries take relatively large shares of GDP. Heavy industry is not so dominant in the country although Morocco has one of the largest factories producing phosphate fertilizer. The mechanical industry is relatively small but has been growing recently. The main report addressed characteristics of industrial waste in light of the types of manufacturing industries in Morocco and described current industrial waste management based on a survey carried out by the MoE and JICA Study Team.

Characteristics of industrial waste management in Morocco are as follows.

1. There is no regulation of emission gas and waste water. Wastes that are defined as pollutants in developed countries are discharged in the environment.
2. Most industrial waste is disposed of within factory sites.
3. There are almost no private SWM service providers.

3.3 Principles and Legal Framework

1) Principles

The main report explained principles of industrial waste management such as the priority of reducing pollutant loads with clean technology and process improvement,

promotion of recycling, neutralization of waste generated, and proper disposal of the neutralized waste.

2) Legal Framework

The main report outlined a legal framework for industrial waste management, including definitions of industrial and hazardous (special) wastes, treatment standards, facility standards, institutional arrangements and responsibility for treatment, standards for collection and transport, standards for contracting out, qualification of treatment service providers, etc.

Definitions of industrial and, especially, hazardous (special) wastes were introduced as standard and sample definitions. It is observed that such definitions should be based on those of the Basel Convention. It is, however, practical to define specifications for facilities that generate hazardous waste since Morocco has a limited ability to regulate definitions of hazardous waste. Some examples from Japan were presented to explain treatment and landfilling standards, institutions for treatment, and use of private contractors.

3.4 Administrative System and Institutions for Industrial Waste

Measures to control disposal of industrial waste by business were addressed as shown below.

1. Points and methods of regulation
2. Legal and regulatory measures (reporting, approval, and permission)
3. Inventory system

In addition to the above measures, information requirements for businesses were explained in detail in the main report. It was noted in the report that institutions for administration are necessary, and specifically the following institutional developments were proposed.

1. Preparation of policies and drafting laws
2. Direct instruction to and regulation of factories
3. Institutions for information management concerning hazardous waste
4. Institutions for analysis of hazardous waste based on specific criteria
5. Institutions for providing information
6. Institutions for offering training courses

3.5 SWM within Business Establishments

It was underlined in the main report that factors necessary for SWM within businesses were a good understanding on the part of top managers concerning SWM and establishment of shared responsibilities for SWM. Details were given on internal SWM rules of businesses as well as establishment of shared responsibilities for SWM based on those rules.

3.6 Methods for Treatment and Disposal of Industrial Waste

General information was presented concerning technical aspects of treatment and disposal of industrial waste. Treatment standards and disposal methods used in Japan were explained in the main report.

3.7 Waste Prevention and Recycling

Waste prevention methods, as listed below, were explained in the main report.

- 1. Elimination of source of waste**
 - a. Processes that do not generate waste (clean production)
 - b. Shift to use of non-hazardous materials

- 2. Remodeling nature of products**
 - a. Production of recyclable products
 - b. Extending durability of products

The main report presented some examples of eliminating generation sources by introducing clean production of caustic soda, phosphoric acid, and electric plating factories.

Some aspects of recycling were also explained in the main report.

3.8 Promoting Private SWM Service Providers

Due to the fact that industrial SWM solely by industries is not economically efficient, the main report explained effectiveness of the use of private SWM service providers, which is a worldwide trend, and also measures to promote the private sector.

3.9 Encouraging Investment in Environmental Control

There are two types of methods; namely direct and indirect ones, to encourage investment in environmental control (installation of treatment facilities by businesses, etc.). Indirect methods were represented by an environmental tax. Both methods were explained, accompanied by discussions currently heard worldwide. It was stressed in the main report that indirect methods require less administrative costs than direct ones in developing countries. Effectiveness of the methods were also discussed

Economic incentives for encouraging investment in environmental control were also mentioned. These included direct financial support, including favorable depreciation periods for capital investment.

4. Guidelines for Infectious Waste Management

4.1 Introduction

This part discussed necessary administrative arrangements to assure proper infectious waste management; waste management by medical institutions; and development of treatment facilities. The main report presented comprehensive guidelines for infectious waste management.

The main report contains six chapters.

Chapter1. Introduction

Chapter2. Past Efforts and Current Issues concerning Hospital Waste

Chapter3. Basics of Infectious Waste Treatment

Chapter4. Governmental Roles and Arrangements for Infectious Waste

Chapter5. How to Implement Infectious Waste Management

Chapter6. How Should the Government Develop Treatment Facilities for Infectious Waste?

4.2 Past Efforts and Current Issues concerning Hospital Waste

Responsibility for regulating infectious waste generated in hospitals belongs to MoH. The ministry has prepared with a help of the WHO experts fundamental policies and actions for infectious waste management, and has created a committee within the ministry to implement the policies and actions.

The stated policies of the ministry were well prepared, compared to those of other countries. However, they have not yet been implemented. The ministry has analyzed factors preventing their implementation. The analysis concluded that there are failures in a social system in which hospitals were not required to take responsibility for infectious waste.

4.3 Basics of Infectious Waste Management

For the readership of officials who are not familiar with infectious waste, the main report presented basic knowledge of infectious waste such as definitions, risks, and treatment.

Principles of infectious waste management prepared by the MoH were explained in the main report, and are a fundamental part of the Guidelines for Infectious Waste Management.

4.4 Governmental Roles and Development of Regulatory Institutions

1) Governmental Roles and Regulatory Institutions

The report explained actions for establishing a national administration for infectious waste. Legal factors to be included in the SWM law were also presented.

The main report introduced the following roles that the government should take.

1. Developing SWM laws
2. Formulating arrangements for regulation and monitoring
3. Formulating a national policy for infectious waste management
4. Preparing technical standards for collection, storage, and treatment
5. Providing updated technological information
6. Discussing policy for development of treatment facilities (including economic aspects)
7. Understanding the present status of nationwide infectious waste management
8. Offering training for staff in infectious waste management
9. Building cooperative relationships with foreign institutions

Items to be developed for legislation of infectious waste are as follows

1. Definition of infectious waste
2. Responsibility for hospital waste treatment
3. Obligatory treatment of hospital waste
4. Methods of hospital waste treatment
5. Administrative system for treatment in hospitals
6. Installation and operation of treatment facilities
7. Permission, reporting, and recording of waste management
8. Licensing the treatment services
9. Regulations and evaluations
10. Administrative powers and regulatory arrangements
11. Penalties

2) Institutions

The importance of institutional arrangements at the national level was stressed, and elements of institutions to be established were listed in the main report. Regional regulatory agencies were observed to be necessary to regulate local hospitals. The agencies should ensure the following measures are in place:

- Regulation and monitoring of hospital waste management as a part of hospital management
- Regulation of environmental aspects of planning, licensing, and operation of waste treatment facilities in hospitals
- Regulation of environmental aspects of planning, licensing, and operation of waste treatment facilities outside hospitals

Regional regulatory agencies are communes, provinces, Wilayas, regional public health centers, or a new agency can be created.

3) Administrative Activities

National administration should include the following activities.

1. Preparation of guidelines for medical waste management
2. Instructions on establishment of infectious waste management by medical institutions
3. Strengthening training for hospital employees
4. Auditing collection, disposal, treatment of hospital waste **inside and outside** hospitals
5. Discussions on promoting treatment facilities, and establishing national policies for developing such facilities
6. Detailed instructions on proper hospital waste management conducted by local governments
7. Preparation of guidelines for hospital waste management at medical institutions
8. Instructions on establishment of a management system for hospital and infectious waste in medical institutions
9. Providing training for employees of medical institutions
10. Auditing of hospital waste treatment
11. Examination of need for treatment facilities, and promotion of private service providers
12. Strengthening control of hospital waste at local government disposal sites

4.5 Methods of Infectious Waste Management

Basics of infectious waste management to be conducted by medical institutions were presented in the main report. They were prepared to serve as guidelines for promoting SWM institutions in medical institutions. Necessary factors for conducting SWM in medical institutions were explained, which will help people involved understand SWM.

The main report specified various activities of infectious waste management in medical institutions. It also addressed the need to establish responsibility for infectious waste management; internal rules for defining the responsibility; and education of hospital employees.

Basic explanations on technical and operational aspects were given on containers of infectious waste, collection and transport, storage, packaging, treatment methods, operation of treatment facilities, and contracting out of treatment services.

4.6 Development of Treatment Facilities for Infectious Waste

The government should instruct local and hospital authorities and the private sector on development of treatment facilities for infectious waste. The government should

conduct the following activities.

1. Preparation of instructional guidelines for development of infectious waste treatment facilities
2. Instructions to local governments on preparation of a regional development plan for treatment facilities
3. Identifying central hospitals in each region, and instruction for installation of small incinerators
4. Promoting private SWM service providers for infectious waste

It is difficult for private SWM service providers to maintain their businesses with the current amount of waste generated. In major centers such as Casablanca and Rabat, installation of treatment facilities can be promoted when exclusive concessions are feasible. In this context, however, the strength of private service providers for municipal waste should be observed. In regional areas, the use of such providers seems to be difficult. Large public hospitals should be able to incinerate their infectious waste by themselves, and wastes generated from other hospitals should be treated in the incinerators of the public hospitals.

The government should prepare policies promoting development of treatment facilities. It should also prepare such policies for each region and instruct local governments on infectious waste management.

III. GUIDELINES FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT FOR URBAN COMMUNES AND COMMUNITIES

These guidelines consists of the following two parts:

- Part 1. Management and institutions
- Part 2. Technical guidelines

Contents of each part are as follows:

Part 1. Management and Institutions

Introduction

- Chapter 1 Improvement in SWM and role of senior local government administrators
- Chapter 2 Formulation of a SWM improvement plan
- Chapter 3 Management information and indicators
- Chapter 4 Organizational reforms
- Chapter 5 Privatization
- Chapter 6 Finance
- Chapter 7 Municipal regulation
- Chapter 8 Public education

Part 2. Technical Guidelines

Introduction

- Part A Collection and transport
- Part B Disposal

Part 1 should be read by senior local government administrators (presidents, vice presidents and secretaries general) and municipal engineers. Part 2 should be read by municipal engineers and managers of SWM departments.

In Morocco, a commune is the basic unit of local government, and responsible for cleansing. There are 1,297 rural communes and 248 urban communes, of which 57 urban communes have formed 14 urban communities. Populations of urban communes range from 10,000 to 200,000.

1. Institutions and Management

1.1 Improvement in SWM and role of senior local government administrators

The demand for SWM services has been increasing not only quantitatively but also qualitatively. SWM involves various aspects including technical, institutional, financial, legal, and citizens' participation. Improvement in SWM services requires examination of all these aspects. Therefore, improvement of SWM is not a matter to be dealt with only by SWM staff themselves. For effective improvement of SWM, it is necessary for senior local government administrators and municipal engineers to become involved in the planning process.

In Morocco, improvement in SWM means the following:

1. expansion in coverage of waste collection service
2. improvement in quality of waste collection service (in terms of regularity and frequency)
3. reduction in illegal dumping
4. increase in efficiency of waste collection and transport
5. upgrading waste disposal standards (introduction of controlled landfill)

Senior local government administrators should be able to evaluate the degree of improvement by using indicators explained in Section 1.3.

1.2 Formulation of a SWM Improvement Plan

Urbanization has been recently enhanced at an increasing speed in Morocco, and waste collection service for urban population has not been offered sufficiently. Some problems emerged in a environment where disposal sites were constructed excessively close to residential areas. It is necessary to invent solutions for problems such as improvement collection service and disposal sites, and prevention of illegal dumping.

SWM services will not be effectively improved without careful planning, because SWM is not as straightforward as it may first appear. Formulation of an improvement plan consists of the following activities:

1. diagnosis and evaluation of the existing SWM services
2. setting improvement targets
3. examination of means to achieve targets
4. estimation of costs required to achieve targets
5. examination of funds available
6. re-examination of appropriateness of targets in relation to funds available (and re-examination of availability of funds)

Of the above activities, Item 6 is of particular importance. This cannot be done within the SWM sector alone because it requires consideration of priorities relative to the needs of other sectors. Senior administrators' involvement is this necessary.

The municipal engineer should formulate the SWM plan. The president should assign a municipal engineer to this task. The municipal engineer should organize a team to carry out the task. The municipal engineer should consider use of consultants if available.

1.3 Management Information and Indicators

Detailed knowledge of costs and output produced is a basic requirement for management of any kind of business. In the case of a water company, it has to know the cost of water production and the amount of water produced and sold. Without such information, managers cannot manage their businesses effectively.

In the case of SWM, managers should also know the cost of SWM services, and the output (amount of waste collected). Knowing the amount of waste collected is necessary to know amount of uncollected waste, which poses environmental, aesthetic, and health risks.

The most important indicator used to measure the efficiency of waste collection service is the unit cost of waste collection service (DH/ton), which requires information on the cost spent over a certain period (one year for example) and the amount of waste collected during the same period.

It is not necessary for Moroccan local governments to have an independent and separate accounting system for each type of public service. However, it would be very useful and advisable for local governments to have an accounting system which allows them to estimate the approximate cost of different types of service. Feasibility of using a contractor cannot be evaluated without comparing the unit cost of the commune and prices offered by contractors.

The waste collection amount can be estimated by using a truck scale. Communes which do not have a truck scale should rent a truck scale owned by port authority or an enterprise for a week or so. Regular measurement (once a year at least) is advisable.

Many Moroccan communes overestimate waste collection amount and underestimate costs spent. Consequently, communes tend to underestimate unit costs of waste collection, and judge that use of a contractor is more costly than the commune's service.

Senior administrators of local governments should understand the importance of knowing the unit cost of waste collection service.

1.4 Institutions and Organization

The first part of this section in the main report explains a method of analysis of organization. The latter part of this section proposes appropriate organizational arrangements for SWM.

A SWM organization should be analyzed with the following procedure:

1. list the functions required for efficient and effective SWM
2. analyze the gap between the functions currently performed and those to be performed
3. analyze things required to strengthen the functions
4. prepare a plan for organizational reform

A weakness of SWM service in Moroccan communes is that SWM managers do not have adequate capacity for diagnosis, planning, information management, coordination and training. Strengthening of their capacity in these areas is important for improvement in SWM service.

Appropriate organizations for SWM differ by size of commune. Communes with populations over 10,000 should have a specialized SWM organization. The head of SWM organization (department) should have qualifications similar to the municipal engineer.

Communes with populations over 100,000 should establish a SWM department which has its own workshop for collection trucks. In case of communes with population less than 100,000, a workshop may be more economically managed by a workshop department which has responsibility for maintaining all vehicles of commune.

Communes with populations less than 10,000 may not need to create an independent SWM department. However, there should be a person responsible for SWM alone, and responsibilities of such a person should be clearly specified.

Urban communities should establish an independent SWM section because of the increasing needs to introduce a controlled landfills which require engineering expertise.

1.5 Privatization

Privatization of SWM and other public services provided by local governments is a worldwide trend. Privatization brings about two types of benefits: one is that private funds can be mobilized, the second is that the efficiency of SWM services will increase, which then brings about a reduction in service costs.

In Morocco, there is almost no case of privatization of SWM services. Two urban communes in Casablanca, i.e. Ain Sebaa and Hay Hassani, have been preparing contracts with waste collection companies. Experience of these two communes deserves close watching.

The most important information in making a judgment about the potential use of contractors is the cost of SWM and in particular the unit cost of collection (DH/ton). It is absolutely necessary for communes to know accurately the unit cost of their own service and compare this with the price offered by interested firms. To know unit costs accurately, communes should know the waste collection amount and costs accurately.

One obstacle to privatization of waste collection service is opposition by collection workers. It seems that the contract prepared by contractors and the communes (Ain Sebaa and Hay Hassani) includes a condition concerning transfer of the communes' workers to contractors.

Privatization takes various forms. Contracting out (use of contractors) is a popular form for waste collection and street sweeping services. BOO (Build, operate and own) or BOT (Build, operate, and transfer) as well as concessions are generally applied to waste treatment and disposal which require a large initial investment.

Important factors for successful privatization include appropriate contract conditions, and monitoring and supervision of contractors' performance. In preparing contract conditions, the following aspects should be carefully studied:

- definition of service (level, contents, methods)
- contract period
- penalties
- conditions for termination of contract

1.6 Finance

Major issues related to financial aspects of SWM at the local government level are the following:

1. affordability of SWM expenditures
2. financing SWM costs
3. improvement of accounting practices

1.6.1 Affordability of Proposed SWM Improvement Plan for Safi City

A case study was made for Safi. The study team examined affordability for implementation of the proposed SWM improvement plan. The conclusion was that the proposed plan is affordable to the city on certain conditions and assumptions described below:

1. Targets were set as follows: a) waste collection service coverage will gradually increase from the current 75 % (on waste quantity base) to 100 % by 2010, b) the sanitary landfill will be introduced by 2000.
2. Waste collection efficiency in term of unit cost will improve, i.e. the unit cost will decrease from the current DH 300/year to DH 250/year by 2000.
3. Safi city's revenue will grow at 4 %/year, which is same as the economic growth of Morocco during 1995 - 2005 forecasted by IMF.

Under these assumptions and conditions, ratios of future SWM expenditures needed to implement the plan relative to estimated revenues will not increase.

Conclusion:

Local governments of Morocco should improve waste collection and disposal services. Future costs will inevitably increase. To avoid a real financial burden due to the improvement in service level, local governments should 1) improve waste collection efficiency by about 20 % in terms of unit cost, and 2) arrange so that revenues will grow at same rate as economic growth.

1.6.2 Financing SWM Costs

Waste collection and street sweeping are not capital intensive services though some equipment such as trucks and containers are needed. Construction of a sanitary landfill, which should be gradually introduced by the Moroccan cities, requires large initial investment funds. The central government should take necessary measures so that loans are available from FEC to local governments for this purpose.

1.6.3 Improvement of Financial Control

1) Accounting System Reform

Moroccan local governments should be able to estimate public service costs by type of service although independent and separate accounting systems for each type of service may not be necessary at present. The following costs should be distinguished:

- waste collection cost / disposal cost
- investment cost / operation and maintenance costs
- household waste management cost / industrial waste management costs

Ability to distinguish the above costs is pre-requisite for introducing a SWM fee system in future.

2) Cost Recovery and Introduction of Economic Incentives

In many countries, introduction of economic incentives is regarded as powerful tools for environmental protection. Introduction of a SWM fee system is useful not only as means to obtain necessary funds but also as means of reducing waste generation. At present, Moroccan local governments already collect a "cleansing tax," and therefore, it may be difficult to introduce SWM fees. However, when the local governments introduce sanitary landfill, they should consider the possibility of charging tipping fees on waste generators who bring waste to municipal disposal sites.

Other options include the introduction of environmental taxes and deposit-refund systems for food and liquid containers. The Ministry of Environment should take the initiative in studying possible introduction of these options.

1.7 Municipal Regulations concerning SWM

There are not many Moroccan local governments which have regulations (by-laws)

concerning cleansing or SWM. It is advisable that the Moroccan governments should have such regulations because of increasing needs for upgrading SWM services. Municipal regulations on SWM should include the following topics:

1. purpose of regulation
2. definition of solid waste
3. responsibilities of citizens, local governments and enterprises regarding solid waste management
4. fees
5. penalties

In defining solid waste (Item 2 above), types of waste to be collected by communes and those to be collected by generators should be clearly defined. With respect to Item 3 above, citizens' responsibilities should include avoidance of illegal dumping and littering, and observance of waste discharge in a manner specified by communes in terms of types of waste containers, timing and place of waste discharge. Municipal regulations should define types of enterprises who should have full responsibility for waste management, and types of waste subject to control. Stipulations concerning fees (Item 4 above) should cover such aspects as level of fees, frequency of revision of fees, and fee collection methods.

1.8 Public Education

The most significant difference between SWM service and other public services such as power or water supply is that the efficiency of SWM services depends very much on the degree of cooperation of service recipients (citizens). Public education is necessary to strengthen citizens' cooperation. Messages to be sent to citizens include the following:

1. maintain city's cleanliness by refraining from littering or illegal dumping
2. observe waste storage and discharge manner specified by commune (to improve collection efficiency and city's cleanliness)
3. participate in recycling
4. understand the importance of environmental protection and act accordingly

Public education should be addressed to all citizens including school children, teachers, employees of local governments, and city councilors. For wider and deeper contacts with various groups, the campaign organizers should include representatives of different organizations such as local delegations of Ministry of Health, Ministry of Education, Ministry of Youth and Sports, and NGOs.

Public education activities may include video movies, posters, leaflets, notebooks, poster design contests, radio and television, voluntary cleanliness activities, cleanliness contests and visits to SWM facilities.

2. Technical Guidelines

2.1 Municipal Waste Collection and Transport -

1) Waste Collection and Transport Improvement Plan

a. General

The importance of this activity within the context of SWM cannot be ignored because of the high costs it involves. In Morocco it is estimated that roughly 80 - 90% of total SWM costs are spent in collection and transport.

The need to improve collection and transport through planning is confirmed based on surveys of existing conditions of urban communes in general, and specifically in Safi city. These surveys identified the following issues;

- Collection service coverage rates in terms of population served are low, at approximately 60 - 70%
- Trucks and manpower operation efficiencies are low because of unsuitable collection systems employed and lack of cooperation on the part of residents
- Cost accounting and evaluation of the work is not sufficient
- Operation and equipment procurement planning is not sufficient
- Recycling is not recognized at the official level as an integral activity of SWM

b. Collection and Transport Improvement Plan Components and Phasing

To improve collection and transport of solid waste it is necessary to prepare a long-term plan to serve as the framework for operation over a 10 - 20 year period, a mid term plan focusing on a number of projects required in the near future (the next 5 - 10 years) and an annual operation plan.

Book 2-Part 2 shows the guidelines for preparing the collection and improvement plan and Book 4-Part 1 describes the improvement plan for the three urban communes of Safi, which may be used as reference for other urban communes.

2) Data Collection, Diagnosis and Improvement Targets

a. General

A good understanding of existing service conditions in the urban commune will provide the basis for formulating a responsive plan, setting required priorities and allocating available funds. The diagnosis and analysis will yield the following results;

1. Identify issues and problems in waste collection and transport
2. Set realistic objectives and targets for the service
3. Form a data collection and analysis system to continuously monitor operation

This chapter discusses the data that need to be collected, in terms of priority and feasibility (based on experience gained in Safi city) and defines potential issues.

b. Data Collection

(1) Waste Amount Generated and Collected

Knowing the present amount of waste generated in the urban commune it is possible to evaluate collection service in terms of sufficiency and efficiency. The unit waste generation amount for Safi city was 0.49 kg/cap/d based on the survey conducted there. Methods for forecasting waste amount to prepare future plans are also discussed.

In the absence of a truck scale at the disposal facility communes should rent truck scale and measure the waste collected continuously for one week.

(2) Operation Records

Records of daily operation describing manpower and equipment utilization, service areas and frequencies, residents complaints and illegal dumping sites should be maintained on a continuous and accurate basis.

c. Diagnosis

Accurate diagnosis will lead to identification of issues and locations where improvements are required. Minimum desirable diagnostic items and potential issues are shown in the following table.

Diagnosis	Potential Issues
(1) Collection service coverage	
Collected waste amount divided by generated waste amounts	<ul style="list-style-type: none"> • a rate of <100% indicates insufficient service • realistic target to attain 100% by a given year
(2) Truck operation efficiency	
Number of trips by each truck per day and waste amount hauled in each trip	<ul style="list-style-type: none"> • Less than 2 trips/day on average may indicate a problem • Excessive time spent on collection route due to unsuitable collection system and/or crew inefficiency • Insufficient use of available truck capacity • Collection route should be expanded to serve more households
(3) Workers efficiency	
Waste amount collected per SWM worker per day	<ul style="list-style-type: none"> • Too large collection crews per truck • Unsuitable collection system • Lack of cooperation between crew members
(4) Operation costs	
Total cost of operating one truck divided by the waste amount collected by that truck	<ul style="list-style-type: none"> • Unsuitable collection system • High costs of maintenance and consumable materials

The above analysis should be as detailed as possible, in order to identify problem areas of the commune, and the specific trucks and crews that need improvement.

d. Improvement Targets

The improvement plan to be prepared should have general objectives based on identified issues which are translated into targets whenever possible. These targets should be set in light of the specific conditions of each commune. For example, providing complete service coverage to all residents of the commune is an improvement objective shared by all communes. However, one commune may set a target to achieve 100% coverage earlier than another commune.

Each commune should tailor its improvement plan to meet its determined objectives within the targets set out over a certain time period. For example, within 2 years a collection coverage rate of 80% may be targeted, 95% after 5 years, and 100% within 10 years.

3) Technical Systems For Collection and Transport

A. Elements Of The Collection and Transport Plan

The elements of the collection and transport activities that should be considered in the improvement plan are depicted in the following figure.

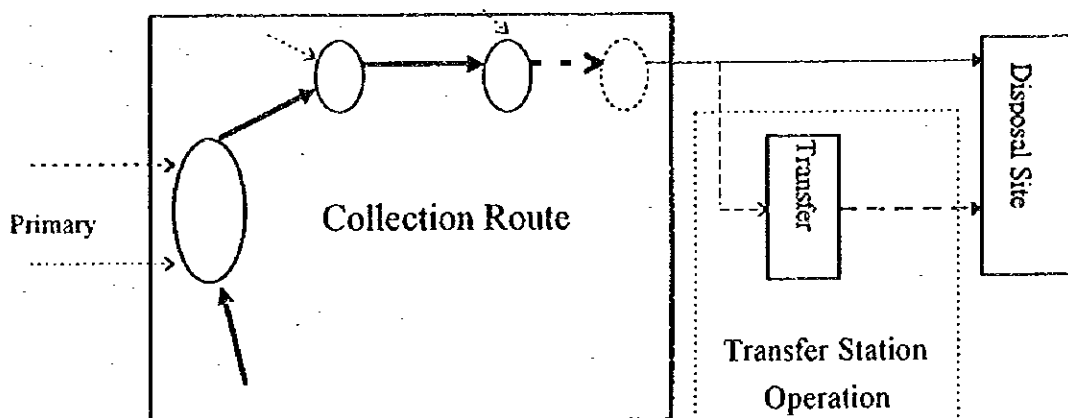


Figure 2.1-1 Collection and Transport

The dominant collection system in Moroccan communes in the served areas can presently be described as collecting the waste from residents' front doors using mainly dump trucks with some pick-ups on a daily basis (excluding Sundays). This system provides a high quality service for residents served but is time consuming, equipment and cost-inefficient, and makes it difficult for communes to expand service to other areas.

The guidelines recommend that communes gradually expand collection service throughout the commune by increasing the number of trips each truck makes a day. This can be done by reducing the time the truck spends on the collection trip through concentrating the waste at a fewer number of collection points and using more suitable equipment. The main recommendations are explained in the following section.

b. Suitable Collection System

(1) Discharge of the waste

There are three ways of concentrating waste at fewer stops along the collection route:

- (i) requesting residents to bring down the waste every 2 - 3 days
- (ii) requesting residents to bring their waste to collection stations within 50 to 100 meters walking distances from their homes
- (iii) a combination of the above

Obviously these discharge methods require the strong cooperation of residents and the commitment on the part of the communes to offer regular service in order to remove the concentrated wastes. It is recommended to proceed with item (ii) collection stations, for the present, due to the difficulty in implementing 2-3 days/week collection, item (i).

Collection stations should be equipped with communal containers of sizes 1 or 2 m³ when possible. The time at which open stations without communal containers can be used should be made clear to residents and respected by communes, in order to avoid problems from waste being left for a long time at these places (loss of individual containers, scavenging, ripping of bags by animals, etc.)

Primary collection service, where waste is brought to collection stations by hand carts or similar means should only be introduced for residents living further than 100 meters from the points. However this means of collection is important for areas such as the Medina where truck access is difficult.

(2) Collection and Transport

An analysis of truck types was made based on the operational performance of each and the operating costs involved. Costs took into consideration salaries, fuel and oils, maintenance, depreciation of equipment, indirect costs and primary collection costs. The results showed the following;

- (i) at one way distances of less than 10 kilometers to the disposal site the most cost efficient trucks are small compactors (8m³) operated without containers, followed by multi-loader trucks operated with 6m³ containers and medium sized compactors (12m³) with containers
- (ii) dump trucks, which are widely used (4 and 6m³) are not cost efficient

At present disposal sites are generally close to urban communes, but distances will gradually increase in the future as standards for selecting sites become stricter. It is therefore recommended that communes gradually adopt compactor trucks of 12m³ with communal containers of 1 to 2 m³. Multi-loaders should be used for large waste generators and densely populated areas.

Use of dump trucks and pick-ups should be restricted to areas where large size truck access is difficult. Other factors such as land use and population densities should be also considered as discussed in the main report.

Introduction of transfer stations becomes economically necessary in communes where distances to disposal sites exceed 20 kilometers on average. The necessary economic analysis and review of transfer station facilities are discussed in the main report.

c. Monitoring of Operations

Each commune should implement daily operations based on an operation plan prepared for each cleansing section of the commune. A commune should be divided into a number of cleansing sections each having around 10,000 population, or based on other factors such as local administrative units, etc.

Operations should be monitored on a daily basis by maintaining truck records. These records should show driver name, trip numbers, weight hauled (either measured by truck scale or estimated based on trip number), maintenance and repairs, working hours, crew number, collection section and route name served, and other relevant data.

On a periodic basis, a time and motion survey in which the operation of the collection trucks is observed and recorded in terms of time spent, distances covered, number of households served, etc. should be implemented.

Through analysis of monitoring results, operations should be modified as necessary.

4) RECYCLING

a. General

Actors involved in recycling are the public sector, private companies and residents. Public activity is limited to recycling of organic waste into compost at a compost plant in Rabat, working well under their capacities and producing low quality compost.

Recycling at present is carried out mainly by private companies on an unofficial basis. Recyclable items are separated from waste after it is discharged by residents, at discharge points by street scavengers, along collection routes by collection workers, and at disposal sites by scavengers. Some processing is carried out in the communes, and items are mainly sent to larger cities as Casablanca, Marrakech and Rabat.

Residents' participation is negligible. No source separation is reported. Some pilot projects have been implemented where residents separate the recyclable items for collection by specific trucks, but there is no ongoing system.

Judging from the study in Safi city, it is estimated that 3 - 5 % of generated municipal waste is recyclable materials such as paper and metals, of which roughly a half may be extracted at sources, one quarter may be extracted at disposal site, and the remaining one quarter may stay at disposal site.

b. Participation by Urban Communes and Residents

Urban communes should recognize that recycling activity is an integral part of SWM.

More efforts should be made to introduce recycling through source separation, i.e. separation of recyclable items from the waste stream by residents and collection separately by communes. Means for implementing pilot projects are discussed in the main report.

2.2 Municipal Waste Treatment and Disposal

1) Plan For Waste Final Disposal

Open dumping has become a major urban public nuisance in Moroccan cities. With expansion of city urbanization, open dumping creates water pollution, soil contamination, and offensive odor, etc., and also creates natural and social environmental problems such as waste scattering, breeding of harmful insects, and waste out-flow. In order to overcome these issues and minimize the environmental impacts, it is necessary to formulate a proper final disposal plan and introduce "controlled disposal sites".

A final disposal plan should be formulated in order to establish a proper waste handling/haulage system at the disposal site, up to the target year. For the formulation of a final disposal plan, it is necessary to set up a comprehensive and concrete implementation plan taking into consideration four stages; i.e. Planning, Design, Operation and Control; and Ultimate Land-use.

2) Selection of New Disposal Sites

Basically, final disposal sites should be located in places which do not adversely effect the living environment of surrounding inhabitants, do not contaminate public water bodies for drinking water, and do not interfere with existing with or future land-use planning areas. Items shown in Table 2.1 should be considered during the site selection process and synthetic evaluation should be carried out in order to select the proper location of a final disposal site.

Table 2.2-1 Evaluation Items for Disposal Site Selection

No	Evaluation Items for Site Selection	
	Main Items	Sub Items
I	Availability of Land	Land ownership / Land-use restriction / Administrative boundary / Land capacity
II	Acceptability to Neighboring Citizens	Proximity to nearest residential area / Achievement of consensus / Proximity to strategic public facilities
III	Environmental Impacts to Surroundings	Proximity to public water supply sources / Risk of dust, noise and odor hazard / Groundwater level / Permeability of base soil / Impacts on ecological system / Impacts on man-made assets of historical and religious value / Impacts on natural landscapes / Impacts on down-stream of prevailing wind / Impacts on disaster prevention measures
IV	Economic Factors	Land acquisition price, Compensation requirements, Distance from waste generation areas, Topographic conditions, Accessibility site, Availability of covering material, Availability of public utilities

The following conditions, as the minimum requirements for the siting of final disposal sites, should be taken into account in their selection:

- Distance from nearest residential area should be more than 200m.
- Wells for drinking water should not exist less than 1.0km downstream. (However, if proper leachate treatment is installed at the site, this requirement may not be necessary.)
- Large scale intake facilities from rivers and deep wells for drinking water should not exist within 1.0km radius.
- Natural conservation areas, habitats of precious fauna and flora should be protected, etc. should be avoided.
- Land-use planning areas for strategic public facilities should be avoided.
- Distance from international airport should be more than 3.0km.

3) Waste Disposal Systems

a. Environmental Counter-measures and levels of Waste Disposal

Disposal systems for final disposal sites in Morocco should be established as "Controlled landfill". Meanwhile, taking into consideration the environmental impacts to the surroundings and its counter-measures, four levels of disposal systems for controlled landfill, shown in Table 2.2, should be established.

Table 2.2-2 Environmental Counter-measures in Each Level

No	Environmental Impacts	Counter-measures	Controlled Landfill			
			Level-1	Level-2	Level-3	Level-4
1	Waste scattering	Enclosed fence	xx	xxx	xxx	xxx
2	Odor, Harmful insects, Self-burning, Scattering	Covering soil	xx	xxx	xxx	xxx
3	Waste out-flow	Embankment		xx	xxx	xxx
4	Ground-water and runoff contamination	Liner, Leachate collection facility, Leachate re-circulation/ treatment system		x	xx	xxx
5	Inflammation or explosion, Destruction of ecological system	Gas removal/treatment facilities			xx	xxx

Note ;

x : Minimum equipped/operated

xx : Fair

xxx : Fully equipped/operated

b. Target for Level of Waste Disposal

As a basic requirement to improve the poor sanitary conditions of existing dumping sites, the target disposal system should be as the Controlled landfill Level-1 or Level-2 (depending on the budgetary resources of the local government concerned).

The level of newly planned disposal sites should be determined taking into account the following three conditions, and be decided by synthetic evaluations/considerations. Taking into consideration the environmental impacts created at disposal sites and counter-measures described in Table 2.2, Controlled landfill: Level-3 is generally recommended to be the target for newly planned disposal sites in Morocco. Basic criteria for choice include:

- Scale (area and/or capacity) of the disposal site
- Rainfall amount and its intensity
- Financial capability of local government

Recently, the Ministry of Environment prepared the "Disposal Site Facility and Operation Standard" based on the concept of Controlled landfill: Level-3. In the standards, controlled landfill site is divided into two types; one is "Basic Standard Type" and the other is "Advanced Standard Type".

4) Operation and Control Plan

a. Landfill Method and Cover Soil

Solid waste must be sufficiently spread and compacted so as to stabilize the landfill area and to prolong the lifetime of the disposal site. Cover soil must be placed systematically and periodically after landfilling of each cell and/or layer of the waste. In order to achieve sufficient spreading and compaction of the waste, a combination of the "cell method" and "push up method" should be adopted. The following items should be taken into account for proper waste spreading and compaction work;

- Waste spreading should not be too thick. Normal thickness of one time spreading is about 30 to 50 cm, taking into consideration the waste thickness which might be effective for compaction work carried out by landfill equipment.
- The landfill layer and/or cell should be made as uniform as possible by the push up method, taking into consideration the waste compaction efficiency. The gradient of the waste slope should be 4:1, in order to maximize the effectiveness of landfill equipment.
- The thickness of each waste layer and/or cell should be less than 3 m, based on waste characteristics and the efficiency of landfill work.

b. Waste Disposal Control (Truck Scale)

Installation of a truck scale is the first and basic requirement for SWM planning. This facility is to ensure that the landfilled waste meets the requirement stipulated. The amount of landfill waste is also measured and recorded. It is essential to introduce the

truck scale at the entrance of controlled landfill site, if its level is higher than Level-2.

5) Ultimate Land-Use and Site Closure

In general, several phenomena have been observed at final disposal site for a long period even after completion of landfill work; i.e. ground subsidence at final disposal sites, production of gas and production of leachate.

These phenomena can be a hindrance to ultimate land-use, so in order to accelerate stabilization of the final disposal site and to perform effective ultimate land-use of the site, the following facilities are recommended to be installed, their necessity depending on the nature of the ultimate land-use.

- Drainage facilities for rainwater
- Gas removal facilities (if required)
- Leachate treatment facilities (if required)

6) Environmental Impact Study for Solid Waste Disposal

Based on the recognition of the importance of environmental issues, Environmental Impact Study should be carried out for disposal site projects. Environmental elements, such as pollution control, and conservation of the natural and social environment, should be considered.

In general, the Environmental Impact Study should be divided into two phases in accordance with the Study objectives, including an Initial Environmental Examination (IEE) applied for the Master Plan Study (selection of new disposal site is included here) and Environmental Impact Assessment (EIA) applied for the Feasibility Study (the location of the new disposal site must be confirmed before starting the EIA).

In the IEE process, negative environmental aspects/impacts in the Master Plan Study area should be identified based on the existing information and data, and a reconnaissance site visit, by using the screening and scoping method. The IEE process should be carried out in a short period at low cost. The objective of the IEE is to evaluate whether an EIA is necessary or not for and, if necessary, to define the contents/items which have potential negative environmental impacts and which should be examined in the next stage of the EIA process.

In the EIA process, negative environmental impacts defined by the IEE should be surveyed, forecast and evaluated more detail, and specifically, take into consideration three stages; i.e. Construction stage, Landfill operation stage and After site closure, and environmental counter-measures should be considered.

7) Cost Estimation

Project costs for the construction and operation of controlled landfill sites (Level-2 and Level-3) have been estimated based on city size (population parameters were used) and the required site area (The sites are assumed to be used for ten years) The following unit costs (DH/ton), i.e. the costs of disposing/handling one ton of waste, for each type of controlled landfill, have been estimated as follows;

- Controlled Landfill (Level-2) : 40 - 60 DH/ton
- Controlled Landfill (Level-3) : 60 - 100 DH/ton

Meanwhile, the following costs have considered when its calculation, i.e. construction equipment procurement, operation and maintenance and land acquisition cost

8) Intermediate Treatment Plan

The main purposes of intermediate treatment systems are the following;

- Reduction of solid waste volume : In order to expand the life time of disposal sites, the volume reduction method of solid waste should be taken into consideration.
- Resource recovery/Recycling : There are two methods for resource recovery from solid waste, one is the extraction of economically re-usable materials from solid waste, and the other is the extraction of energy from solid waste.
- Prevention of environmental pollution : In order to prevent the surrounding environment from being polluted by disposal sites, proper treatment systems should be considered. This should be mainly adopted for toxic waste, such as specific industrial and hospital waste.

As for the treatment of the municipal waste, the feasibility of introducing incineration and composting in Morocco has been verified as follows.

Incineration is not considered to be feasible in Morocco, at present; because it is not difficult for Moroccan cities to acquire land for waste disposal; the lower calorific value of Moroccan waste is too low and moisture content is high; investment and operation of incinerators is about ten times as high as for controlled landfill (unit cost is 900DH/ton for incineration and 60~100DH/ton for controlled landfill).

As for composting, with regard to waste reduction and recycling, it is a very useful method for waste treatment. Also, waste in Morocco is suitable for composting because of its high content of putrescible matter. However, two major conditions affecting the feasibility of composting, should be carefully considered. First, in general. And also in Morocco, composting is not feasible from the point of cost recovery, and second, control of compost plant operation is difficult.