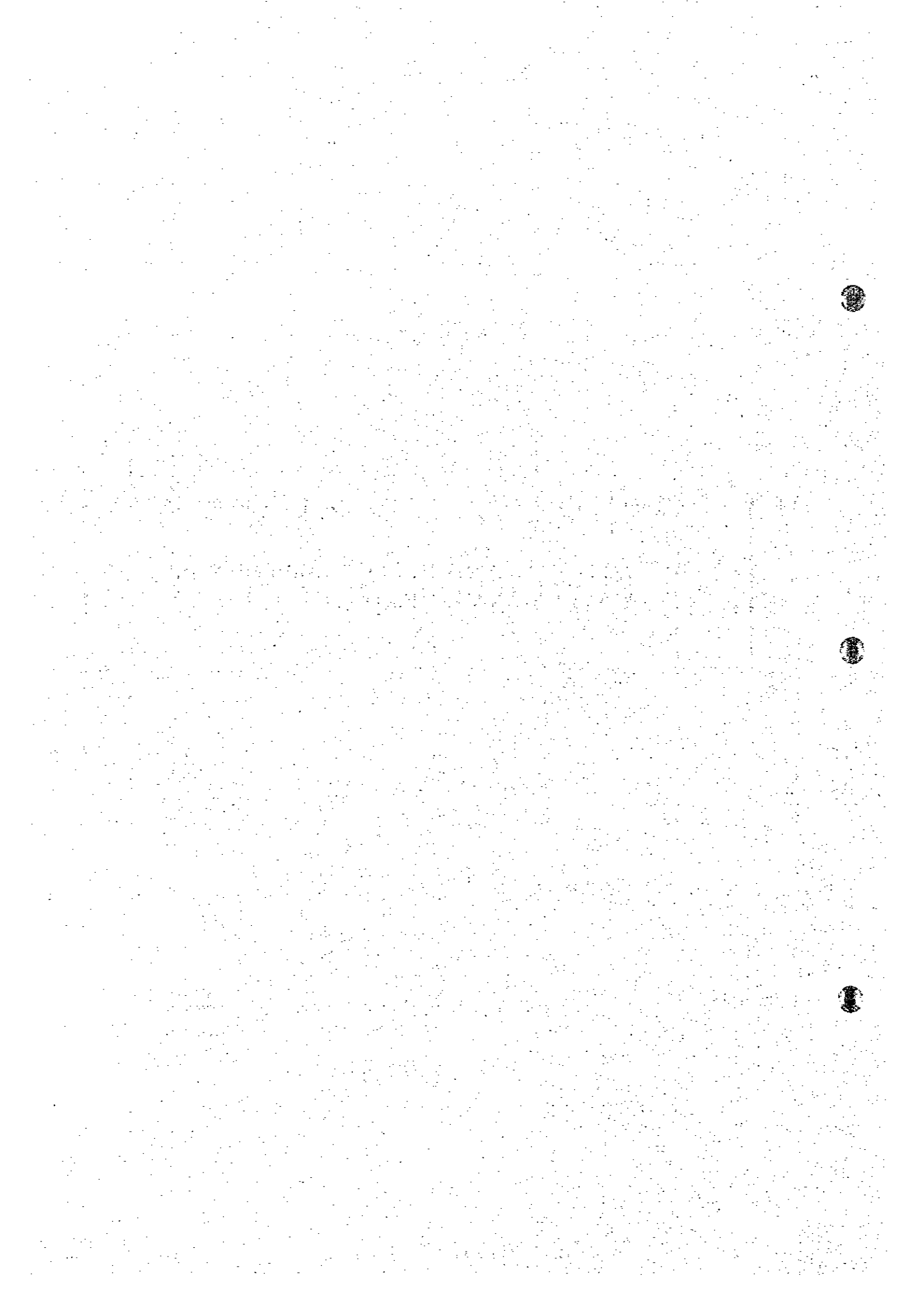


**B NATIONAL ACTION PROGRAM FOR SOLID  
WASTE MANAGEMENT**



## **B. NATIONAL ACTION PROGRAMS FOR SOLID WASTE MANAGEMENT**

### **INTRODUCTION**

The Ministry of Environment and the JICA Study Team have conducted joint research to prepare SWM policies at the national level including administrative guidelines, and guidelines for improvement of SWM at the local government level. The national strategy for SWM in Book 1-Part 2 defined the role of the national government and then introduced national policies and actions for development of municipal SWM and improvement of proper municipal waste treatment. The framework and content of the actions that the government should take are presented in Book 1.

The next step to be taken is to implement the policies and ideas presented in the reports. Since they are to involve long-term strategy, there are many tasks to be carried out. It is unrealistic to try to implement them in a short period taking into consideration the country's limited resources and its other priorities. Actions, therefore, should be made according to phased plans. This report proposes a five-year national action program from 1997 to 2001.

This report was prepared for discussion by the parties involved. Proposals in this report should be discussed by MoE officials as well as among concerned authorities. It is recommended that the National Committee for Environment should support the proposals.

Action programs are addressed in the following four chapters.

Chapter 1 addresses the objectives of preparing action programs. Chapter 2 sets out the objectives of action programs. As the main chapter of this report, Chapter 3 presents the overall action programs. Chapter 4 refers to related actions and management of the action programs.

## **1. Objectives of Preparing Action Programs**

There should be more discussion of means to address solid waste issues in Morocco, and efforts to actually implement problem-solving ideas must be initiated. Ideas are no use if they are not put into effect. It is, however, difficult to prioritize such efforts since there are so many tasks to deal with. As a matter of fact, it is impossible to start handling the tasks all at the same time. Since the government must achieve a consensus among concerned officials as well as citizens, and in view of resource limitations, actions should be made according to plans according to a long term strategy.

The coming five years from 1997 to 2001 are very important years to create a base for SWM in Morocco. The future of Morocco's SWM may be determined by action programs and their implementation in the coming five years.

## **2. Objectives of Action Programs**

### **2.1 Principles for Preparing Action Programs**

There are four principles for preparing action programs.

The first principle is that action programs should support public welfare and sustainable development.

The second principle is that actions based on the programs should remove obstacles to the success of future measures.

The third principle is that action programs should be practical.

The fourth principle is that action programs should provide SWM workers with adequate motivation.

### **2.2 Goals**

All persons in Morocco have the right to enjoy sanitary and healthy living, but they also have an obligation to support conservation measures in Morocco and behave in a safe and sanitary manner.

Goals for SWM should be established as follows based on the above rights and obligations.

1. All persons should be able to enjoy sanitary and healthy living.
2. All persons should prevent environmental pollution.
3. Essential environmental assets should be conserved for future generations.
4. The national economy should achieve sustainable development
5. A beautiful environment that attracts foreign tourists should be maintained.

Business opportunities should be expanded, and employment and national income

should be increased.

### **2.3 General Objectives**

Formulation of a sound base for SWM is scheduled over the next five years. This base is comprised of the establishment of legal and administrative systems, human resource development, and demonstration activities. Details are as follows.

1. Establishing a legal and administrative system for SWM
2. Establishing a body of leading experts who will develop the guiding principles and practice for SWM
3. Producing pilot cases that will facilitate further development

### **2.4 Targets**

The following targets should be achieved by 2001.

#### **1) Actions for Establishing Legal, Institutional, and Administrative Systems**

One of the highest priorities is attached to development of a legal framework. This should be achieved before any of the other targets. An administrative system should be developed as human resources are developed.

1. Specific targets are to draft laws and disposal standards, to set up a section for implementation, and to prepare the way for future administrative systems and procedures.
2. About five to ten leading experts should be developed in the field of SWM.

#### **2) Improvement of SWM by Local Governments**

Within five years, some pilot projects involving SWM improvement should be carried out and analyzed, and also human resources should be developed. Projects should be developed, placing more importance on results than on actual numbers so that lessons for future actions can be learned. Specific targets are as follows:

1. Developing at least 50 leading experts in municipal SWM
2. Preparing and implementing improvement actions for 20 to 30 municipalities
3. Constructing 3 to 5 controlled disposal sites
4. Promoting several successful cases in which SWM is contracted out to private contractors
5. Restoring existing disposal sites

#### **3) Proper Management of Industrial and Hazardous Wastes**

First of all, SWM by enterprises in Morocco should be improved by developing leading enterprises that have international SWM experience. Special waste should be defined, and treatment facilities developed for properly stabilizing it. Specific measures

should be:

1. Encouraging 20 to 30 business establishments to conduct proper management of industrial and hazardous waste.
2. Developing leading private establishments in management of industrial and hazardous waste
3. Promoting several successful cases of private SWM service providers
4. Facilitating development of treatment facilities for special waste

#### **4) Proper Infectious Waste Management**

In the same way as mentioned in 3), a leading medical institution should be developed in the SWM field to disseminate proper medical waste management nationwide. Infectious waste treatment facilities should be introduced as a matter of urgency. Specific actions should be:

1. encouraging 20 to 30 medical institutions to conduct proper management of infectious waste
2. Promoting several investments in treatment facilities

#### **5) Improving Public Awareness**

Frequent opportunities should be taken to provide information and environmental education and to continuously launch campaigns so that public awareness on solid waste and environmental issues can be strengthened. The specific target is as follows.

- Increasing public awareness for waste and environmental issues

### **3 Action Programs**

#### **3.1 Establishing an Administrative Framework**

Laws and their enforcement system are required to secure proper SWM in Morocco. In order to enforce laws, it is necessary to establish criteria for proper disposal of waste. Therefore, action programs for these tasks include the following.

1. Immediate enactment of laws concerning solid waste
2. Establishing disposal standards
3. Strengthening administrative institutions at the national level

##### **3.1.1 Enactment of Laws Concerning Solid Waste**

The legal system should ideally be in place before implementing action programs; however, in the present case, formulation of the legal system is scheduled for the beginning of the action program.

### **1) Objectives**

Laws to improve SWM, which is currently left unregulated, should be immediately drafted and sent to the parliament.

### **2) Programs**

The government should prepare draft laws by 1998 in cooperation with concerned ministries and agencies, lawyers, and SWM professionals, and introduce them in parliament sessions, with the objective of having them enacted by the year 2000. In parallel with preparation of laws, regulations and orders necessary to execute the legislation should be prepared.

### **3) Institutions for Implementation**

The government should place specialized legal staff in MoE. A working committee for law preparation should be set up, consisting of concerned ministries and agencies and academicians. The secretariat for the committee should be located in the MoE to gather information on SWM legislation in Europe and prepare draft legislation.

#### **3.1.2 Establishment of Disposal Standards**

##### **1) Objectives**

Along with preparation of legislation, disposal standards, which are indispensable for law enforcement, should be developed. The standards should be issued, after undergoing governmental discussion, as governmental orders at the same time as the law is issued. Until then, the standards should be issued as disposal criteria under a governmental circular note as an administrative instruction.

##### **2) Programs**

The following programs should be implemented.

- a. Preparation of disposal standards
- b. Preparation of technical standards for disposal facilities

**Table 3.1-1 Action Programs for Establishing Criteria for Waste Disposal**

	1997	1998	1999	2000	2001
a. Preparation and Enactment of Law	←→				
b. Preparation of Standard Criteria for Disposal					
Preparation of Standard Criteria for Special Waste	←→				
Preparation of Tentative Disposal Standards	←→				
Tentative Standards for Landfilling	←→				
Circulation of and Instructions Regarding Disposal Criteria			←→		
Conversion of Criteria to Standards				←→	
c. Preparation of Technical Standards for Disposal Facilities					
Technical Criteria for Disposal Facilities	←→				
Technical Criteria for Special Waste Treatment Facilities		←→			
Technical Criteria for Infectious Waste Treatment Facilities	←→				
Circulation of and Instructions on Criteria			←→		
Conversion of Criteria to Standards			←→		

Discussion should be started on criteria for waste disposal and standards for landfilling, which define the acceptable final waste in landfilling sites. At the same time, discussion should proceed on technical standards for disposal facilities and intermediate treatment facilities.

These standards can be prepared by 1998 without legal power, and the government should immediately start instructions based on them.

### 3) Institutions for Implementation

The Ministry of Environment should contain staff specialized in examining the standards. It should also establish two working committees in MoE; one for



establishing criteria and technical standards for disposal facilities and the other for technical standards for intermediate treatment facilities for special waste. The government should require concerned ministries and agencies to cooperate with the committees.

### **3.1.3 Strengthening Administrative Institutions at the National Level**

#### **1) Objectives**

Institutions should be established for administration of SWM at the national level.

#### **2) Programs**

The following actions should be taken at an early stage of action programs.

- a. Coordination among ministries and agencies regarding the sharing of roles
- b. Strengthening of National Waste Committee
- c. Establishment of a section in MoE for environmental pollution control

In November, 1996, a small committee located under the National Environment Committee was upgraded to be the National Waste Committee. This committee should be strengthened to deal with various issues relating to solid waste.

Based on the national decentralization policy, the possibility of establishing regional offices of the MoE section for environmental pollution control should be considered.

### **3.2 Development of Municipal Waste Management**

To provide a municipal waste collection service of better quality and to develop controlled disposal sites, the government should undertake the following actions.

1. Improving management abilities of local governments in SWM
2. Introducing weigh-bridges and waste quantity control
3. Implementing pilot projects for controlled disposal sites
4. Promoting improvement of existing disposal sites
5. Promoting privatization of SWM service

#### **3.2.1 Improvement of Management Abilities of Local Governments in SWM**

##### **1) Objectives**

The quality of SWM and productivity of its operation can be improved without increasing costs by improving management abilities of local governments in SWM. Management abilities can be strengthened by introducing management technology that private companies are currently employing.

2) Programs

The following programs should be implemented.

- a. Holding seminars for top managers
- b. Providing training for municipal engineers
- c. Instructions for preparing improvement plans, and their implementation

**Table 3.2-1 Action Programs for Improving Management Abilities in SWM**

	1997	1998	1999	2000	2001
a. Seminar for Top Managers					
Preparation	↔				
Implementation	•	•	•	•	•
b. Training					
Preparation	↔				
Implementation		•	•	•	•
Follow-up Seminar				← - - - - - →	
c. Improvement Plans					
Orientation		←-----→			
Implementation				←-----→	

a. Holding Seminars for Top Managers

(1) Target Participants

Participants in seminars for top managers should be presidents, vice presidents, and secretaries-general of local governments. Seminars should be held for all communes by 2001.

(2) Frequency of Seminars

Seminars for top managers should be held twice a year, nine times by 2001.

(3) Seminar Description

The seminar should be for one day, and subjects to be taught should be SWM basics in morning sessions and case studies in afternoon sessions.

## **b. Providing Training for Municipal Engineers**

### **(1) Target Participants**

Participants in training for municipal engineers will be mainly municipal engineers and chiefs of cleansing sections.

It is proposed that 100 % of municipal engineers should receive training by 2001.

### **(2) Frequency of Seminars**

Training courses should be held once a year; four times by 2001. It will take 10 days to finish the course.

### **(3) Preparation of Training Texts, and Contents**

Training should consist of basic management theory, case studies, practice study, and mock presentations. Six trainers for environment, institutions, management, waste quality and quantity, collection, and disposal will be required. Trainers are responsible for preparing textbooks for the subjects. Practice study includes planning for management and collection. In mock presentation, trainees will make presentation on practice studies.

### **(4) Follow-up Seminars**

Trainers should remain in contact with their trainees. They will be able to gather information on knowledge actually used and outcomes produced after training. Successful outcomes should be explained in succeeding training courses. Experience obtained from the outcomes should be added in training courses

## **c. Preparation of SWM Improvement Plans by Local Governments**

To create model cases, 20 to 30 high priority Urban Communes can be selected, taking into consideration seriousness of waste issues, population, and efforts made for SWM improvement. The government should instruct the selected Urban Communes to prepare SWM improvement plans based on the guidelines for local governments created jointly by the MoE and JICA Study Team. The government should also prepare instructions on implementation of the plans.

Also the government should instruct communes to implement the prepared improvement plans, and awards can be given in cases where excellent improvement is achieved.

### **3) Institutions for Implementation**

The Ministry of Interior should take the initiative in implementing seminars, training courses, and instructions on preparing improvement plans in cooperation with the Ministry of Environment.

The Ministry of Environment should give assistance to local governments to introduce weigh bridges.

### 3.2.2 Introducing Weigh Bridges and Waste Quantity Control

#### 1) Objectives

To evaluate efficiency of Morocco's municipal SWM and to decide how to improve the existing situation, accurate data on waste quantity are necessary. The government should provide instructions on the introduction of truck scales at disposal sites that will help obtain the data.

#### 2) Programs

The following programs can be implemented.

**Table 3.2-2 Action Programs for Introducing Truck Scales**

	1997	1998	1999	2000	2001
Introduction of Truck Scale as Pilot Case	←————→				
Nationwide Introduction of Truck Scale				←————→	

#### a. Selection of Local Governments for Pilot Implementation

In order to introduce waste quantity control, which will improve SWM management, five to ten local governments among Urban Communities or advanced Communes should be selected for pilot implementation.

#### b. Assisting Introduction of Weigh-bridges, and Instructions on Waste Quantity Control

The government should assist introduction of weigh bridges and give local government instructions on waste quality control.

#### c. Evaluation of Introduction of Weigh-bridges, and Presentation

Results of using weigh-bridges should be explained in a presentation, and the government should offer opportunities to share and exchange the data obtained. The results should be included in top manager seminars and training courses.

#### 3) Institutions for Implementation

The Ministry of Environment should assign some staff to prepare a SWM Improvement plan for local governments and to instruct the governments to introduce truck scales.

### 3.2.3 Implementation of Pilot Projects for Controlled Disposal Sites

#### 1) Objectives

Pilot controlled disposal sites should be constructed as model sites. Objectives of pilot projects are to create technical guidelines for construction and operation of the facilities based on experience earned and to instruct local governments in construction of the sites.

#### 2) Programs

The following programs should be implemented.

- a. Construction of three to five model controlled disposal sites
- b. Preparation of technical guidelines for construction and operation of controlled disposal sites
- c. Establishment of controlled disposal sites by other local governments

**Table 3.2-3 Pilot Projects for Controlled Disposal Sites**

	1997	1998	1999	2000	2001
a. Construction of Model Sites					
Study	←→				
Construction		←→			
Operation of Model Sites				←→	
b. Preparation of Technical Guidelines		←→			
c. Instructions to Local Governments				←→	

The government should select locations for pilot project controlled disposal sites by 1997, conduct research, and complete construction by 1999.

The government should use experience with preparation of spec documents and cost estimation to create "Guidelines for Construction and Operation of Controlled Disposal Sites." The guidelines would be for local government use.

Several selected local governments should complete site construction based on the guidelines by 2001.

**3) Institutions for Implementation**

In order to promote pilot projects, MoE should assign promotional staff and set up a steering committee for pilot projects in cooperation with MoIF and MoPW.

**3.2.4 Instructions for Improving Existing Disposal Sites**

**1) Objectives**

After evaluating existing municipal industrial disposal sites, Those which have the most serious adverse environmental impacts on surrounding areas should be improved first.

**2) Programs**

The following programs can be implemented.

- a. Implementation of evaluation studies of existing disposal sites
- b. Instructions for preparation of improvement plans
- c. Instructions for implementation of improvement projects

**Table 3.2-4 Programs for Improving Existing Disposal Sites**

	1997	1998	1999	2000	2001
a. Implementation of evaluation study of existing disposal sites	←————→				
b. Instructions for preparation of improvement plans		←————→			
c. Instructions for implementation of improvement Projects			←————→		

It will be helpful in evaluating existing conditions to study existing conditions of municipal disposal sites nationwide and to conduct field observations at disposal sites used by large cities, or where major problems have emerged. Based on this evaluation, disposal sites that have a negative impact on the surrounding environment and require urgent improvement can be selected for action. Local governments supervising these disposal sites should receive advice on the preparation of improvement plans. The government should offer technical advice to the local governments when they prepare improvement plans.

The government should instruct local governments to secure funds to implement the plans and should also take necessary measures to assist in their implementation.

**3) Implementation Arrangements**

The government should assign experts on SWM disposal in the MoE to promote action programs.

### 3.2.5 Promotion of Privatization

#### 1) Objectives

Privatization is an effective way to improve local government SWM. Its effectiveness needs to be studied and guidelines for privatization should be created to facilitate consideration of this matter by local governments

#### 2) Programs

The following programs should be implemented.

- a. Research on effectiveness of privatizing SWM
- b. Preparation of guidelines for privatization, and dissemination to local governments

**Table 3.2-5 Programs for Promoting Privatization**

	1997	1998	1999	2000	2001
a. Study	←→				
b. Preparation and Dissemination of Guidelines					
Preparation		←→			
Instructions on Dissemination			←→		
Seminar		•	•	•	

Prior cases of privatization in Morocco should be studied. The government should select local governments that intend to privatize SWM service and conduct research on the effectiveness of privatization.

Based on the research results, the government should prepare guidelines for privatization by 1998. They should include methods for evaluating private contractors, privatizing current human resources and assets, contracting, and monitoring.

Seminars should be held based on the guidelines by 2000. The government should give local government instructions on methods of privatization.

#### 3) Institutions for Implementation

A working team should be set up consisting mainly of MoIF in cooperation with MoE to conduct research on and prepare guidelines for privatization.

### 3.3 Promoting Proper Hazardous Waste Management

The government should carry out the following actions in order to achieve proper treatment of toxic and dangerous industrial waste generated by factories.

1. Developing administrative tools for government
2. Improving management abilities of business establishments (factories) in SWM
3. Promoting investment in environmental control in business establishments (factories)
4. Promoting the development of treatment facilities for special waste

#### 3.3.1 Development of Administrative Tools for the Government

##### 1) Objectives

In order to address environmental pollution caused by factories, the government should formulate a database including inventories of hazardous waste and prepare instruction criteria.

##### 2) Programs

The following programs should be implemented.

- a. Formulating a database system for inventories of hazardous waste
- b. Preparation of standards for hazardous waste management, and instructions.

**Table 3.3-1 Action Programs for Controlling Special Waste**

	1997	1998	1999	2000	2001
<b>a. Database System</b>					
Preparation	↔				
Establishment of a Database System		↔			
Information Gathering		↔			
Operation and Updating of Database			↔		
<b>b. Instruction Criteria</b>					
Study	↔				
Preparation		↔			
Orientation			↔		

##### a. Formulating a Database System for Inventories of Hazardous Waste

Based on Chapter 4 of Book 1-Part 2, specification of a database system for inventories of hazardous waste should be considered. The database should be developed by 1998.



At the same time, inventories of hazardous waste need to be collected. The database should be in use by 1999.

**b. Instructions for Hazardous Waste Management**

The government should study research on hazardous waste management technology. Observation should be conducted of domestic inventories of hazardous waste in 1997.

Instruction criteria should be prepared in 1998, and actual instructions based on the criteria should become effective in 1999. These criteria should be integrated with disposal standards.

**3) Institutions for Implementation**

The Ministry of Environment should set up a hazardous waste control team consisting of three to five staff. A working committee should be established consisting of academicians, private consultants, and industrial engineers. Members of the committee should work closely with the team.

The government should make arrangements to obtain technical assistance from foreign professionals.

**3.3.2 Improvement of Management Abilities of Industrial Establishments in SWM**

**1) Objectives**

Top managers of industrial establishments should recognize the need for hazardous waste management. Industrial engineers should be familiar with the basics of SWM. The government should help to develop Morocco's leading industries and engineers in their capacity to undertake SWM.

**2) Programs**

The following programs should be implemented.

- a. Holding seminars for top managers
- b. Preparing and providing training courses

**Table 3.3-2 Action Programs for Improvement of Management Abilities of Industrial Establishments in SWM**

	1997	1998	1999	2000	2001
<b>a. Seminars for Top Managers</b>					
Preparation	↔				
Implementation		•	•	•	•
<b>b. Training Courses</b>					
Preparation	↔				
Implementation of First Training Course			•	•	•

**a. Seminars for Top Managers**

Annual seminars should be held for company executives and top managers on the importance of hazardous waste management. The target number of attendees in the seminar is 500 by 2001. Subjects of the seminar should include on SWM in foreign countries, the benefits that SWM will confer upon companies, and social responsibilities of industry.

The seminar should also cover clean technology, laws concerning trends in waste generation, and case study presentations. Industrial companies should be involved in case study presentation.

Among the participating companies, the government should develop 20 to 30 industrial facilities as model establishments for SWM.

**b. Training Courses**

Training courses should be prepared by 1998 along with a database system and instruction standards. Training courses should start in 1999 and aim for 100 to 200 trainees by 2001.

Among the trainees, 10 to 20 individuals should be developed as SWM leaders in industry.

**3) Institutions for Implementation**

The hazardous waste control team of MoE should handle seminars and training courses. Seminars should be held jointly by MoE and the MoC&I, and training courses by MoE in cooperation with MoC&I.

### **3.3.3 Promotion of Investment in Environmental Control**

#### **1) Objective**

In order to promote investment in environmental control in industry, consideration should be given to economic measures and formulation of regulations.

#### **2) Programs**

Promotion of investment should be preceded by research activities. Consideration should be given to economic incentives such as low interest loans for investment and company tax relief as well as environmental taxes. MoE and MoC&I should examine introduction of such incentives.

Internal rules regarding the level of pollution control in industry should be created, securing fair competition. These rules should be put into effect in 1998 when instruction standards for hazardous waste are scheduled to be ready.

#### **3) Institutional Arrangements for Implementation**

Concerned ministries and agencies should set up an internal committee. The secretariat of this committee should be formed by MoC&I and MoE. Industrial internal rules should be created by MoC&I.

### **3.3.4 Promoting Construction of Special Waste Treatment Facilities**

#### **1) Objectives**

An action program should aim at controlling environmental impacts. Using the database for hazardous waste, facilities can be developed for waste treatment when this is urgent from an environmental viewpoint.

#### **2) Programs**

The following programs should be implemented.

- a. Specifying special waste that requires priority treatment
- b. Preparing a national policy for treatment of the specified special waste
- c. Encouraging factories and private investors to start projects for developing special waste treatment facilities

**Table 3.3-3 Action Programs for Developing Special Waste Treatment Facilities**

	1997	1998	1999	2000	2001
a. Specifying special waste that requires priority treatment		←→			
b. Preparing a national policy for treatment of the specified special waste			←→		
c. Examining projects for developing special waste treatment facilities				←→	
d. Project implementation					←→

In parallel with preparation of a database of hazardous waste (special waste) and instruction standards, the government should specify waste that requires immediate measures to prevent adverse environmental impacts.

In order to instruct business establishments, the government should, in cooperation with waste generating businesses, private service providers and other national authorities, prepare guidelines. Based on these guidelines, the government should propose specific investment by industry in treatment facilities for special waste.

### 3) Institutional Arrangements for Implementation

The Ministry of Environment should set up a team to lead action programs in the field of hazardous (special) waste.

The ministry should form joint project teams with the Ministry of Industry and Commerce.

### 3.4 Establishing Institutions for Infectious Waste Management

Objectives of action programs for establishing institutions for infectious waste management are as follows.

1. Establishment of SWM institutions in hospitals
2. Promotion of infectious waste treatment facilities

#### 3.4.1 Establishment of SWM Institutions in Hospitals

##### 1) Objectives

The government should instruct large hospitals on their responsibility for infectious waste management by preparing and disseminating manuals for internal management. The manuals are for establishing institutions for SWM management and operations in hospitals.

**2) Programs**

The following programs should be implemented.

- a. Preparation of manuals for infectious waste management
- b. Development of model hospitals in infectious waste management

**Table 3.4-1 Action Programs for Establishing Institutions for Infectious Waste Management in Hospitals**

	1997	1998	1999	2000	2001
a. Preparation of Manuals	↔				
b. Development of Model Hospitals		←————→			
c. Seminars for Dissemination		•	•	•	•

The manuals are already in process of preparation by MoH and will be ready in 1997 for practical use. The government should select model hospitals and instruct them to adhere to the manuals by 1998. The results in selected hospitals should be made public, and the manuals should be issued by 1999.

**3) Implementing Institutions**

A Project team of MoH should implement these action programs with the assistance of MoE.

**3.4.2 Development of Infectious Waste Treatment Facilities**

**1) Objectives**

Personnel involved in SWM need to be organized in order to promote infectious waste treatment facilities for private contractors and hospitals.

**2) Programs**

The following programs should be implemented.

- a. Preparation of policies for developing infectious waste treatment facilities
- b. Promotion of privatization of infectious waste management
- c. Organizing medical institutions

**Table 3.4-2 Action Programs for Promoting Development of Infectious Waste Treatment Facilities**

	1997	1998	1999	2000	2001
a. Preparation of Policies	↔				
b. Preparation for Privatization					
Bidding	↔				
Construction		↔			
Operation				↔	
c. Organizing Medical Institutions		↔			

The Ministry of Health should prepare policies for developing infectious waste treatment facilities and promotion of privatization with concerned ministries and agencies, in particular with MoE,

Developing treatment facilities should be completed at latest by 1999, to start their operation in 2000.

It is necessary to organize medical institutions regionally and to set up a liaison association for infectious waste management. The association would be intended to promote privatization and installation of small incinerators for regional use.

### 3) Institutions for Implementation

A hospital waste team of MoH should implement the action programs. The Ministry of Environment would be required to participate in examining technical aspects of incineration facility development.

### 3.5 Increasing Public Awareness

Taking advantage of opportunities created by national holidays and festivities such as Earth Day, public awareness campaigns about waste issues can be launched in cooperation with concerned authorities.

It is necessary to prepare materials for environmental education covering waste issues and to facilitate increased public awareness for this subject in rural areas.

#### 4 Related Actions

##### 4.1 Securing Financial Resources and Building up Cooperative Relationships with Foreign Countries

It is necessary to estimate costs of action programs and secure funds for them. The table below provides a rough estimate of the costs of studies, preparation of guidelines, laws, etc. contained in the national action plan. The total cost is 9.3 million DH; therefore, two million DH is necessary every year. This would account for 10 % of the current budget of the MoE.

Capital investment required for the national action programs is estimated at a minimum to be 200 million DH

**Table 4.1.1 Project Costs for Implementing Action Programs**

	Duration	Study Costs (,000 DH)	Capital Investment (,000 DH)
<b>I. Programs for administrative system</b>			
A. Preparation of SWM law	2 years	200	
B. Establishment of disposal standards	5 years	1,000	
<b>II. Programs for developing municipal SWM</b>			
A. Improvement of SWM management in urban areas	5 years	500	
B. Introduction of truck scales	10 locations		4,000
C. Construction of controlled disposal sites	5 locations		200,000
D. Instructions for improvement of existing disposal sites	5 years	1,000	Varies by projects
E. Promotion of privatization	5 years	200	
<b>III. Programs for special waste control</b>			
A. Development of waste inventory	5 years	2,000	
B. Improvement of SWM abilities in factories	5 years	400	
C. Instructions for investment in environmental control of factories	5 years	200	
D. Promotion of construction of special waste treatment facilities	5 years	1,000	Varies by projects
<b>IV. Infectious waste control</b>	5 years	800	
<b>V. Increasing public awareness</b>	5 years	2,000	
<b>Total</b>		<b>9,300</b>	<b>200,000</b>

Morocco's national budgetary situation is highly constrained. But the above expenditures are necessary to improve SWM programs. Therefore, the MoE should make efforts to secure technical and financial assistance from foreign countries.

It is also difficult for local governments to secure funds for disposal site construction. The financial system for regional public investment as well as financial policies of local governments should be strengthened. The MoE should enhance cooperation with the Ministry of Financial Affairs and FEC. When domestic capital is not available, the MoE should examine ways to obtain foreign soft loans.

#### **4.2 Implementing Institutions**

It is necessary to set up institutions for implementing the action programs. The MoE should employ, at least, the following human resources

Legal expert	2 persons
Civil engineer or environmental engineer	3 persons
Chemist	2 persons
Information engineer	1 person
Public relations expert	1 person

It is also necessary to set up a steering committee for action programs. The Ministry of Environment should be the secretariat of the committee. The secretariat should report on the progress that each section has achieved. The committee should have the power to approve action programs for the next year and be responsible for issuing necessary instructions after discussion.

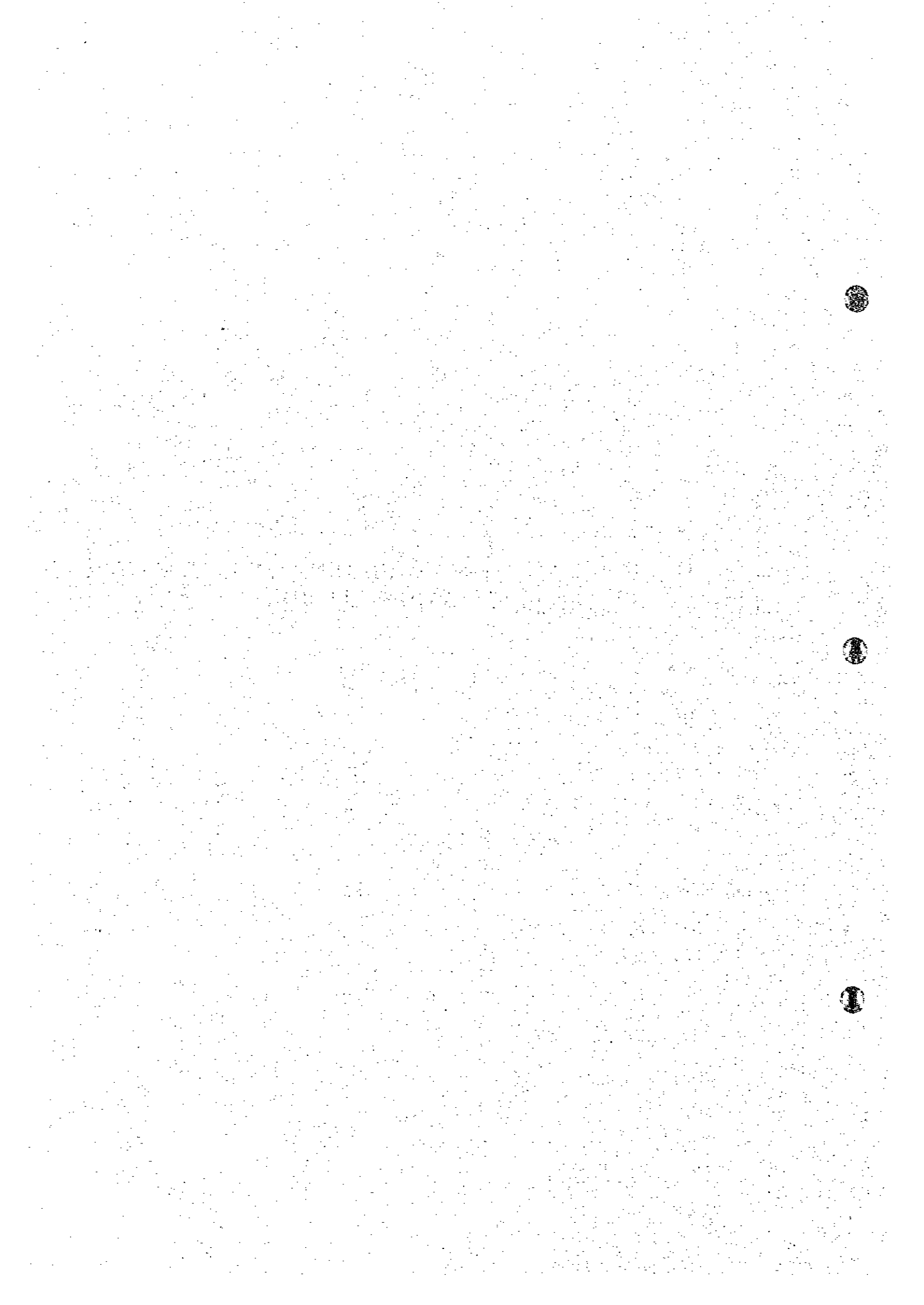
It is necessary that the National Waste Committee, which is under the National Committee for Environment, should be informed of the progress of action programs.

#### **4.3 Updating of Plans**

In 2001 the government should evaluate the results of the action programs and prepare a second phase of National Action Programs for Solid Waste Management



**C    SOLID WASTE MANAGEMENT IMPROVEMENT  
PLAN FOR SAFI AND EL JADIDA**



## **C. SOLID WASTE MANAGEMENT IMPROVEMENT PLAN FOR SAFI AND EL JADIDA**

### **I. SOLID WASTE MANAGEMENT PLAN FOR SAFI**

#### **1. Introduction**

##### **1.1 Outline of Safi City**

Safi city is the seat of the provincial government. The province of Safi is located in the northwestern part of the economic region of Tensift which consists of 8 provinces and prefectures. The province of Safi consists of 7 urban communes and 30 rural communes. The area of the province is 7,285 km<sup>2</sup> (1.0% of the kingdom's territory) and the population was 822,564 (3.2% of the kingdom's population) in 1994.

Facing the Atlantic ocean, the urban area of Safi city (Safi urban community) is formed around the mouth of the Chabah river, approximately 250 km distant from Casablanca. Safi city consists of 3 urban communes; Asfi Biada, Asfi Boudheb, and Asfi Zaouia. The city had a population of 262,276 in 1994, which is estimated at 32% of the total population of the province. Major industries are the phosphoric industry and fishery.

The phosphoric industry, operated by OCP, has significant importance for the city of Safi. Fishing is also a principal industry in Safi city. The haul in 1994 was estimated at 13,983 tons (88.2 million DH), approximately half of the catch being sardines. However, the canning industry declined from the peak it reached under the French protectorate; the number of processing units decreased from 80 in 1950 to 30 in 1975. At present, only 21 of those processing units are actually active, and these operate at about 50% of capacity, due to the irregular supply of raw materials.

As a unique feature, Safi city is well known for its traditional pottery, which is a principal tourism attraction as well as historic sites such as the Portuguese fortress which was restored in 1963.

##### **1.2 Objectives of the Study**

This study for the city of Safi has the following two objectives:

- 1) formulation of SWM improvement plan for Safi
- 2) implementation and evaluation of the public awareness campaign

##### **1.3 Study aspects**

The study covers the following aspects:

- 1) waste generation
- 2) collection and disposal
- 3) public awareness

- 4) management and institutions
- 5) finance

## 2. Waste Generation

### 2.1 Municipal Waste

It is estimated that 139 tons of municipal waste is generated per day on average, of which 100 ton/day is collected by the 3 communes and 4 ton/day by generators of large quantity waste such as the port authority. The current average collection rate in the whole city is 75 % in terms of waste quantity.

- Per capita generation: about 500 gram/capita/day
- Of the 500 gram/capita/day, household waste is 425 gram/capita/day; the remaining 75 gram/capita/day is commercial and industrial waste as well as street waste

Waste composition is as follows:

77 % is kitchen waste, which is very high. Paper 9 %, plastic 6 %. Moisture content is 66 %.

It is projected that the future rate of increase in the generation of waste will be 3.1 %/year

### 2.2 Industrial Waste

It is estimated that 60 tons of solid waste is generated by industrial enterprises in Safi. Of the 60 ton/day of waste, 15 tons/day is non-industrial (municipal) waste, and the remaining 45 ton/day is industrial waste. Of the 45 ton/day of waste, 8 ton/day is recycled. The remaining 37 ton/day of waste comprises 31.7 ton/day of demolition waste, 2.5 ton/day of pottery waste, 1.8 ton/day of expired fish cans and bad meat, and 1.0 ton of hospital waste.

Demolition waste and pottery waste are dumped at depressions in Safi. These types of waste are actually used as filling materials. Some buildings have been built on the former dumping sites. It is not considered that industrial solid waste causes a serious environmental problem in Safi.

## 3. Collection and Transport

### 3.1 Present Collection Rate

It is estimated that the present collection rates (ratios of collected amounts to generated amounts) are as follows:

Boudheb:	90 %	
Zaouia:	77 %	
Biada:	44 %	<u>City average: 75 %</u>

### Opinion of Citizens:

According to the Household Survey conducted in December 1996 by the JICA Study Team, 77 % of the interviewees answered that collection service of the communes is satisfactory.

## 3.2 Collection and Transport Plan

The present collection system can be broadly described as follows;

- (1) Low cost efficiency (all three communes)
- (2) Inefficient operation of equipment (new trucks in Zaouia make only one trip/shift)
- (3) Old age of trucks (Biada trucks average age is 12 years.)

### 1) Target

It is recommended that the rate of waste collection of Safi City should reach to 100 % by 2010.

### 2) Recommended collection system

Gradual shift to a system with compactors (trucks) and communal containers is recommended. In the case of collection by dump trucks, less use of door-to-door collection and more use of open stations is advisable.

### Cost comparison

Purchase costs of compactors (DH 1.1 million) are higher than dump trucks (DH 0.54 million). However, the unit cost of collection with compactors and communal containers is more economical, as shown below:

- Compactor (12 m <sup>3</sup> ) with container:	DH 170/ton	(index: 100)
- Dump truck	DH 361/ton	(index: 210)

The communes should introduce a collection system with compactors and communal containers as the existing dump trucks retire. Judging from the successful introduction of this collection system in Boudheb, it is expected the citizens of the other communes will also accept this system.

Areas that are not accessible by compactors must be served with other systems. A suitable system for such areas is the open station system using dump trucks. In this system, the citizens are asked to bring their waste to an open area (station). Collection trucks collect waste from waste stations.

Use of multi-loaders is another system which requires the citizens' cooperation in taking their waste to communal containers. This system is recommended for large waste generators.

After the year 2000 when the new disposal site opens, no scavenger activity will be

allowed there. Pilot projects introducing source separation (separation of waste at sources) and collection are recommended.

## **4. Disposal**

### **4.1 Recommended Disposal System**

The sanitary landfill is recommended.

- **Incineration** is not suitable for Safi either from a technical or economic viewpoint. The waste of Safi has high water content, and therefore is difficult to incinerate. Incineration costs are very high, the unit cost being 900 DH/ton minimum, while the unit cost of the recommended sanitary landfill is DH 80/ton.

- **Composting** is an environmentally ideal system for recycling of waste. However, it is not feasible from economic point of view. In order for composting to be feasible, there must be constant demand for compost throughout year. Composting projects in Casablanca, Marrakech, Rabat resulted in failure.

From a technical viewpoint, waste in Safi is of a quality suitable for composting. However, it also has the following disadvantages; 1) too high a water content (77%): it should be less than 55 % to avoid generation of bad odor during fermentation process. 2) C/N ratio (from 10 to 14) is lower than the ideal ratio (30 - 35), and paper should be added, for example, to increase the ratio.

### **4.2 Proposed New Sanitary Landfill Project**

The plan for the new sanitary landfill is outlined as follows:

- 1) **Location:** Lahmidate in Rural commune of Khatte Azakane adjacent to the Safi city
- 2) **Area:** 15 ha for Zone 1 (40 ha in total)
- 3) **Waste receiving capacity:** 790,000 ton for Zone 1  
(2,120,000 ton in total)
- 4) **Type of disposal system:** Sanitary landfill (Basic type)
- 5) **Major facilities**
  - a. **Major facilities**
    - Access roads (1050 m)
    - On-site road with dike
    - Operation road
    - Storm waster drainage

b. Environmental protection facilities

- Liner (made of natural clay)
- Leachate collection system
- Gas removal facilities
- Leachate re-circulation facilities
- Buffer trees
- Rain-water channel

c. Other facilities

- Site office
- Truck-scale
- Washing facilities
- Fence and gate
- Lighting facilities
- Water supply

6) Acquisition of land:

A site selection committee was organized consisting of the governor of the province and president of the urban community. The acquisition of the site was discussed and approved by the councilors' meeting of the urban community held in February 1997.

7) Construction schedule:

- Selection of consultants for detailed design: by the end of 1997
- Start of construction: in 1999
- Start of operation of the site: in 2000

8) Duration of operation 11 years till 2011

9) Costs

A) Construction and procurement

- |                              |    |               |
|------------------------------|----|---------------|
| a. Site construction:        | DH | 33.9 millions |
| b. Procurement of equipment: | DH | 8.5 millions  |
| c. Total (a + b):            | DH | 42.4 millions |

B) Land Purchase:

DH 1.5 million

C) Annual Operation and Maintenance

- |                                      |    |                     |
|--------------------------------------|----|---------------------|
| a. Salary of personnel:              | DH | 409 thousand/year   |
| b. Fuels:                            | DH | 281 thousand/year   |
| c. Maintenance of equipment:         | DH | 351 thousand/year   |
| d. Indirect and miscellaneous costs: | DH | 104 thousand/year   |
| e. Total (a + b + c + d):            | DH | 1,145 thousand/year |

- D) Annualized costs including depreciation
- |   |                     |
|---|---------------------|
| a. Annual depreciation of construction:       | DH 2.9 million/year |
| b. Annual depreciation of equipment purchase: | DH 1.2 million/year |
| c. Annual operation & maintenance:            | DH 1.1 million/year |
| d. Total (a + b + c):                         | DH 5.2 million/year |

- E) Unit Disposal Cost
- |                             |             |
|-----------------------------|-------------|
| a. Construction:            | DH 42.9/ton |
| b. Procurement:             | DH 17.3/ton |
| c. Operation & Maintenance: | DH 17.0/ton |
| d. Land purchase:           | DH 1.8/ton  |
| e. Total (a + b + c + d):   | DH 79.0/ton |

10) Expected source of funds for Investment: grant from an International or bi-lateral aid agency

#### 4.3 Proposed Improvement of the Existing Site

Waste which is deposited outside the municipal site will be taken inside the boundary and covered with soil. Required cost is estimated to be DH 4.7 million. The improvement work should be carried out during the first half of 1998.

### 5. Management and Institutions

Major recommendations are:

- 1) Setting up, within each commune, a specific SWM organization which has overall responsibility for SWM
- 2) Provision of incentives for collection workers
- 3) Clearer definition of responsibility of personnel involved in SWM
- 4) Formulation of mid term plans for improvement of SWM
- 5) Establishment of an accounting system whereby SWM costs can be estimated
- 6) Zaouia and Biada should have a municipal regulation similar to that of Boudheb.
- 7) Control of special waste (hazardous waste that needs to be treated)
  - At present, quantity of special waste generated in Safi is not significant.
  - Only special waste which is transported to the municipal waste disposal site seems to be hospital waste generated from Mohammed V Hospital (2 ton/day)
  - Responsibility Issue:
    - a. The Urban Community should set criteria concerning the type of waste to be accepted at the municipal disposal site, and instruct waste generators (factories) to separate special waste from other types of waste before collection.
    - b. The Province, in consultation with the Ministry of Environment, should establish a system whereby it can monitor and supervise generation and



disposal of special waste by requiring waste generators to submit necessary data to the Province.

- c. The communes should not collect special waste defined as such by the urban community.

## 6. Privatization (use of contractors for waste collection)

It is advised that the three communes should consider, as an alternative, use of contractors for waste collection because the efficiency of the waste collection service provided by the communes is not as efficient as expected as shown below:

		<u>Index</u>
- Boudheb	DH 254/ton	(127)
- Zaouia	DH 336/ton	(168)
- Biada	DH 377/ton	(188)
- Average	DH 298/ton	(149)
- A contractor	DH 200/ton	(100) (Ain Sebaa)

Two urban communes in Casablanca, i.e., Hay Hassani and Ain Sebaa are arranging to use contractors for waste collection. The contract price offered by a contractor and accepted by Urban Commune of Ain Sebaa is about 200/ton.

A major problem arising from using contractors is how to treat the existing workers. The experience to be gained in Casablanca will be useful. Both the commune and the contractor agreed that the existing workers and some equipment of the commune will be transferred to the contractor. Section 8.4 of the main report explains practical steps to be taken towards privatization.

## 7. Financial Issues

### 7.1 Affordability

At present, the urban community of Safi is responsible and pays for the costs of disposal. However, it is considered appropriate that in future, each commune will bear the costs of disposal according to quantity of waste brought by themselves to the municipal landfill site. Financial impacts of the proposed project is evaluated with this view in mind.

At present, Safi city as a whole (3 urban communes and urban community of Safi) spends a total of DH 18.9 million for waste collection (DH 13.8 million) for street sweeping (DH 4.5 million) and disposal (DH 0.6 million) respectively. The aggregate SWM cost of DH 18.9 million corresponds to 16.4 % of the city' aggregate revenue.

Implementation of the proposed landfill project will require an increase in annual disposal costs from DH 0.6 million/year to DH 5.2 million/year. The current ratios of disposal costs to the expected revenue (DH 115 million) of the city is 0.5 %.

Assuming the revenue of the city will grow at roughly the same rate as the real economic growth of 4 %, the corresponding ratio throughout the project period will be about 2.8 % on average. The peak ratio will be about 4 % in 1999, and the lowest ratio will be 2.5 % in 2010. The net average increase in the ratios is 2.3 % (2.8 % - 0.5 %).

On the other hand, the current ratio of total cost of collection and street sweeping relative to the expected revenue is about 15.9 % in 1996/97. This ratio will be maintained at about the same level throughout the project period. As a result, the ratio of SWM costs to the city's revenue will increase from the current 16.4 % to a future average of 18.7 % by implementing the proposed landfill project.

If a grant is available for financing the initial investment, the ratio of disposal cost to the city's revenue will increase from the current 0.5 % to the future average of 0.8 %. This increase is considered quite feasible.

## **7.2 Other Financial Issues**

Other financial issues include the following:

- Introduction of user charges (tipping fees on waste brought to the municipal disposal site by waste generators)
- Strengthening of capacity for investment appraisal
- An accounting system which enables the local authorities to estimate costs of different types of service

Implementation of these recommendations requires reform of local government financial operations as a whole. The solid waste sector illustrates the urgency of such reform.

## **8. Public Awareness Campaign**

In parallel with the formulation of a SWM improvement plan in Safi, the JICA Study Team supported the implementation of the public awareness campaign by providing planning inputs and funds.

### **8.1 Objective**

The campaign aims at strengthening the awareness of citizens concerning cleansing of the city and environmental protection. The campaign's target groups are the citizens, school children and local government officials.

## **8.2 Campaign Organizers**

A committee has been set up for the execution of the campaign. Members of the committee include:

1. Province of Safi
2. Urban Community of Safi
3. Urban Commune of Boudheb
4. Urban Commune of Zaouia
5. Urban Commune of Biada
6. Delegation of Minister of National Education
7. Delegation of Minister of Public Health
8. Delegation of Minister of Youth and Sports
9. Delegation of Minister of Cultural Affairs
10. Delegation of Minister of National Mutual Aid
11. Association of Culture and Leisure
12. Association for Environment and Development

## **8.3 Production and Exhibition of Campaign Materials**

The following campaign materials were produced:

1. Two video movies (a 10 minutes movie for the citizens, and a 20 minutes movie for the personnel of the local authorities)
2. Giant posters (2.5 m x 2 m) (10/kind x 3 kinds)
3. Posters (50 cm x 50 cm) (700/kind x 2 kinds)
4. Leaflets (20000)
5. Notebooks (10000)
6. Postcards (50000)

Drawings used for the above materials were prepared through drawing competitions. Both professional artists and school children participated. Prizes were awarded to competitors whose drawing were used.

Giant posters are exhibited at places where many people come. Notebooks which contain information on solid waste are delivered to school children. The video movie (prepared for both informative and instructive purposes) will be shown at various occasions by participating organizations including NGOs. Postcards and leaflets will be delivered to the citizens.

The campaign period will be about 6 months.

It is expected that this campaign, which was designed by the Ministry of Environment will serve as a model for other Moroccan local authorities as well as for other awareness campaigns in Safi.

#### **8.4 Evaluation of the Awareness Campaign**

The final objective of the campaign is to improve the cleanliness of the city by strengthening citizens' awareness and cooperation in urban cleansing.

It would take six months to one year for this type of campaign to have physical results (improvement of the city's cleanliness). Both the Ministry of Environment and the City of Safi should evaluate the effects of the campaign when it is concluded.

The current campaign consists of series of activities such as:

- 1) Development of the concept, objectives, and method of the campaign
- 2) Organizing a campaign execution committee consisting of relevant organizations
- 3) Production of materials (video movies, posters, leaflets and notebooks)
- 4) Delivery of materials to the citizens and showing video movies

So far, the first three activities have been successfully completed. A campaign execution committee comprised of the 12 agencies listed in Section 8.2 has been formed. Ideas have been exchanged among the participating agencies through many discussions.

It is believed that the experience of organizing the inter-agency committee for the campaign has strengthened the city's capacity for implementation of other awareness campaigns.

Design (pictures) contests have been organized to select good pictures for posters, postcards, and leaflets. These contests were open to school children and a group of artists. A ceremony was held to award prizes to the winners. A series of these activities was aimed at not only selecting good pictures but also strengthening awareness of the school children by inviting them to take part in the contests. It is believed that these contests have fulfilled the both these objectives.

The Final Report will show further evaluation of results of the campaign.

## **II. WASTE DISPOSAL PLAN FOR EL JADIDA**

### **1. Introduction**

The city of El Jadida is a fast growing city in Morocco. It is expected that the city will become the second growth center of the nation within the next 10 years. The city is the capital of the Province of El Jadida. The city had a population of about 120,000 in 1994. Economic development projects planned for the near future in the city and its surrounding areas include :

- 1) Development of El Jadida industrial zone. (It is expected that the value of the total production will be doubled within a few years)
- 2) Extension of OCP (semi-governmental phosphate production company) in Jorf Lasfer which is located adjacent to the city of El Jadida
- 3) Doubling of the capacity of the thermal power station in Jorf Lasfer
- 4) Development of industrial part in Jorf Lasfer
- 5) Construction of the Casablanca- El Jadida - Jorf Lasfer motorway

A few kilometers away from the city center is a summer resort called Sidi Bouzid , (a center of the rural commune of My Abdellah adjacent to the city of El Jadida ). The population of Sidi Bouzid with a few hundred inhabitants increases to over 100,000 during 3 months summer time because of holiday makers. Moulay Abdellah, another center of the rural commune of My Abdellah receives over 100,000 visitors during "Moussem of My Abdellah" (a festival) held in August.

Due to the fast development of the city and its surrounding areas, the existing waste disposal site (where open dumping is practiced) is surrounded by residential houses. There is an immediate need to develop a new disposal site for the city and its surrounding development centers.

### **2. Objectives of the Study**

An objective of this study is to prepare a waste disposal plan. Main focus of the plan is a new sanitary landfill. It is expected that the disposal plan for El Jadida will serve as a model for other Moroccan cities. A model disposal site is also planned for the city of Safi. A disposal site planned for Safi is a basic type, while the one planned for El Jadida is an advanced type.

### **3. Areas Covered by the Disposal Plan**

The planned disposal site will accept solid waste generated from the following areas :

- 1) City of El Jadida
- 2) 3 centers (Sidi Bouzid, My Abdellah and Dewarould Ghadbouz) of the rural commune of My Abdellah

The planned disposal site will not receive waste generated from the industrial park, which will be developed in future in Jorf Lasfer. It is recommended that the industrial enterprises in the industrial park should be responsible for management of solid waste generated by themselves.

#### **4. Waste Generation Quantity**

##### **4.1 Current Generation**

Estimated waste generation in the study area in 1996 is 102 ton/day, of which 76 ton/day is generated in the municipality of El Jadida, and the remaining 26 ton/day is in the 3 centers of the rural commune of My Abdellah. Seasonal variations due to visitors are reflected in the estimation. In 1996, per capita generation rates are 608 gram/capita/day in El Jadida, and 3580 gram/capita/day in the rural commune. 83% of the waste of the rural commune is generated by visitors.

##### **4.2 Future Generation**

Waste generation in the study area will increase from 102 ton/day in 1996 to 185 ton/day in 2010, 1.8 times larger. Annual rates of increase will be about 4.1 % in the study area, 4.7 % in the area of the municipality of El Jadida, and 3.2 % in the three centers of My Abdellah.

#### **5. Target Waste Collection**

Estimated waste collection in the study area in 1996 is 87 ton/day, 65 ton/day of which is collected by the city of El Jadida, and the remaining 22 ton/day is collected by the Rural Commune of My Abdellah. Estimated rate of collection relative to generation is 85 % in 1996. It is planned that both the local authorities will increase their collection rates by one percentage point every year, and the rate of collection will reach 100 % in 2010.

#### **6. Plan for New Waste Disposal Site**

##### **6.1 Evaluation of Candidate Sites**

The province of El Jadida identified two candidate sites, i.e. one in Reragui (36 ha) and the other in Bettioua (50ha). Both sites are located in the rural commune of My Abdellah. The two sites are close each other, and 13 to 14 km from the city of El Jadida. Both of them are on privately owned land, now used to grow wheat. It seems that the productivity in both areas is very low.

The JICA Study Team has evaluated these two sites based on the following criteria :

- Availability of land and acceptability to neighboring citizens and relevant authorities
- Environmental impacts
- Economic factors

As a result of evaluation, it has been judged that the site in Bettioua is more advantageous than the other in every aspect. Therefore, the site in Bettioua has been selected.

## **6.2 Location**

The planned disposal site is located at Bettioua in the Rural Commune of My Abdellah. The planned site is 14 km to the south east of the city of El Jadida.

The site is located in a gentle depression, its lowest level being El +28m and surrounding higher level El + 40 m.

## **6.3 Land Acquisition**

The Province of El Jadida has organized a site selection Committee. Members of the committee include the governor of the province and the mayor of the city. The JICA Study Team gave technical advice to the Committee. In December 1996, the Committee decided to acquire the land.

## **6.4 Area and Landfill Capacity**

The planned disposal site has a total area of 50 ha. It will be divided into 3 zones : zones 1, 2 and 3. Area of each zone is as follows :

- Zone 1 : 14 ha (expected period : 2000-2011)
- Zone 2 : 20 ha (expected period : 2012-2025)
- Zone 3 : 16 ha (expected period : 2026-2035 approx.)

The waste receiving capacity of the planned disposal site is approximately 3 million tons in total. Expected useful period is about 30 years.

The planned disposal facilities will be constructed in zone 1.

## **6.5 Disposal Plan for Zone 1**

The planned disposal site is of "advanced type" equipped with leachate control facilities including artificial liner (rubber sheet) as well as leachate treatment facilities including an aeration lagoon.

The disposal plan for zone 1 is outlined as follows :

- Site area : 14 ha (landfill area is 10 ha)
- Landfill capacity : 614,000 ton
- Useful period : 2000-2011 (12years)
- Type of landfill : sanitary landfill
- Standard of landfill : advanced type
- Service area : city of El Jadida and the 3 centers of the rural commune of My Abdellah.
- Type of waste accepted : Municipal waste (waste collected by the municipality and the commune)
- Operation method : cell method with push-up method
- Post landfill use of the land : amusement park or field athletics

## 6.6 Facilities

The planned disposal site will be provided with the following facilities :

### 1) Environmental Protection Facilities

- a. Leachate control facilities
  - Artificial liner (rubber sheet)
  - Leachate collection pipes (perforated pipe)
  - Leachate re-circulation facility (aeration lagoon)
- b. Gas removal facilities (PVC pipes) (for prevention of explosion and fire)
- c. Surrounding fence and tree planting (for prevention of waste scattering and for better landscape)
- d. Monitoring wells (for monitoring water quality)
- e. Cover soil (for prevention of fire, bad odor, waste scattering, breeding of animals and insects and for reducing generation of leachate)
- f. Embankment (for prevention of outflow of waste)

### 2) Roads and Drainage

- a. Roads
  - Access road (1350 m long, 9 m wide)
  - Onsite elevated road (1350 m long, 5 m wide, 3 m high)
  - Operational road (1050 m long, 8 m wide, 1 m high)
- b. Rain water drainage (U-shaped gutter and open cut)



### 3) Other Facilities

- a. Site office
- b. Truck scale (weigh bridge)
- c. Truck washing facility
- d. Lighting facility
- e. Water supply
- f. Gate
- g. Parking

### 4) Equipment for Landfill Operation

- a. 1 bulldozer
- b. 1 excavator
- c. 2 wheel loaders
- d. 1 dump truck
- e. 1 tank truck
- f. 2 Pick up (small truck)

## 6.7 Implementation Schedule

The planned schedule is as follows :

- 1) Detailed design & tendering: mid 1997- early 1999
- 2) Construction and procurement: early 1999 -end 1999
- 3) Operation: 2000-2011

## 6.8 Cost

Estimated costs of construction, procurement and operation and maintenance are as follows :

- 1) Construction and procurement
  - a. Site construction : DH 36.3 millions
  - b. Procurement of equipment : DH 10.5 millions
  - c. Total (a + b) : DH 46.8 millions
- 2) Land Purchase : DH 1.4 million
- 3) Annual Operation and Maintenance
  - a. Salary of personnel : DH 490 thousand/year
  - b. Cover soil : DH 154 thousand/year
  - c. Fuels : DH 343 thousand/year
  - d. Maintenance of equipment : DH 437 thousand/year
  - e. Indirect and miscellaneous costs : DH 142 thousand/year
  - f. Total (a + b + c + d + e) : DH 1566 thousand/year

4) Annualized costs including depreciation

a. Annual depreciation of construction :	DH 3.2 million/year
b. Annual depreciation of equipment purchase :	DH 1.5 million/year
c. Annual operation & maintenance :	DH 1.6 million/year
d. Total (a + b + c) :	DH 6.3 million/year

5) Unit Disposal Cost

a. Construction :	DH 59.2/ton
b. Procurement :	DH 27.3/ton
c. Operation & maintenance :	DH 29.3/ton
d. Land purchase :	DH 2.2/ton
e. Total (a + b + c + d) :	DH 118.0/ton







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