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SOLID WASTE STUDY

For
Sinfra and Tissale

1990

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SOLID WASTE STUDY

for

SINFRA and TIASSALE

VOLUME 1 OF 3

by
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and
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Consultants

ICMA
Washington, DC
USA

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We would also like to extend our appreciation for the support, guidance, and cooperation offered by the REDSO staff, especially Mrs. Carleene Dei and Mr. Scott Johnson.

Special thanks is extended to the officials and citizens of the municipalities of Sinfra and Tiassale, who patiently answered our questions and provided guidance in the preparation of this report.

EXECUTIVE SUMMARY

GENERAL

At the request of REDSO/Ivory Coast, International City Management Association (ICMA) sent Mr. M. M. Bessalel to Abidjan, Ivory Coast. In Abidjan, Mr. Bessalel was joined by Mr. J. Assemian, a local consultant.

PURPOSE OF THE STUDY

The purpose of this study is to develop alternatives and offer recommendations for improving the solid waste management (SWM) systems of Ivorian secondary cities. The initial analysis was performed for two USAID project cities: Sinfra and Tiassale.

PRESENT SITUATION

The collection and treatment of solid waste in secondary cities has been a problem for many years. Typically, garbage lies uncollected in streets and gutters, and, where collected, lies untreated in open fields. This situation has developed as a result of the indiscriminate disposal habits of the population and the inadequate collection/treatment systems currently in place. Making matters worse, these systems have progressively deteriorated for lack of maintenance and repair to collection equipment.

Delays of payments add to the problems of the SWM system. Even when funds are available for necessary maintenance of collection equipment, contractors are reluctant to provide the needed services because of the anticipated payment delay.

PROPOSED ALTERNATIVES

A proper solution must provide adequate collection equipment and appropriate treatment and disposal facilities at the most economical cost. In addition, the SWM system must demand strong community participation.

In addition to the do-nothing alternative, this report considers three alternatives, each with varying investment requirements.

Alternative I. proposes merely the reparation of existing equipment and maintaining SWM as a uniquely municipal function. This solution would require additional surcharges for solid waste collection on electricity bills, presently established at 1. FCFA.

Alternative II. offers a citywide privatization model.

Alternative III. proposes a transitional "pilot" privatization plan for a section of each city, to be followed by citywide privatization.

Alternatives II. and III. would require new user charges.

BASIS FOR SELECTION OF RECOMMENDED SOLUTION

The selection of the recommended solution was based on the findings of the surveys conducted in Sinfra and Tiassale, discussions with municipal officials, as well as visual inspection.

RECOMMENDATIONS

1. SWM training programs should be offered for the officials of the Technical sections of the municipalities. Workshops should include: Solid Waste Collection, Solid Waste Treatment, Recycling and Re-use of Solid Waste, and Sanitary Landfill Management.

2. Community sensitivity training should be offered to acquaint the population with the health and environmental impacts of improper waste disposal habits.

3. Implementation of a "pilot" program to permit a small-scale privatization experiment should precede a citywide program.

   Years 1 and 2 - Pilot Program

   i. purchase a tractor and two containers and repair existing equipment

   ii. collect and treat the solid waste produced by a population of no more than 15,000 using the new equipment

   iii. collect garbage in the remaining portion of the city with the repaired equipment

   iv. assess minimum charges for services

   v. increase electricity surcharges for solid waste management.

   Years 3 - 5 - Privatization of SWM system

   Based on the insights gained during the pilot program, a citywide program should be undertaken. The performance of the private contractor should be monitored by the Technical Departments of the municipalities, assisted by an expert in solid waste management. Necessary components of the new system will be:

   i. purchase a truck

   ii. assess service charges

   iii. eliminate all electricity surcharges, to be replaced by direct payment for collection services.

LIMITATIONS

The adequacy of part #3 of the recommended solution depends on the success of parts #1 and #2. That is, the success of a given system depends not only on the proper selection of equipment, collecting circuits and appropriate treatment and disposal of solid waste, but also on the interaction of community groups and the collection entity.

I. INTRODUCTION

1.1 General

At the request of REDSO/Ivory Coast, International City Management Association (ICMA) sent Mr. M. M. Bessalel, PE, to study the Solid Waste operation of two Ivorian cities. Mr. Bessalel traveled to Abidjan, where he joined Mr. J. Assemian, a local consultant.

1.2 Purpose of the Study

The purpose of this study was to offer a series of recommendations for municipal authorities and community groups in two A.I.D project cities. The recommendations were to include alternatives for improving solid waste collection and treatment services in a cost efficient manner.

In addition, the study was to address relevant environmental considerations of SWM and to quantify the risks to the immediate human and surrounding ecosystems. Among the environmental concerns addressed are: potential contamination of drinking water sources, infectious and parasitic exposure to residents, and potential contamination of waterways.

1.3 Objectives of the Study

The objectives of the study were:

- To conduct an assessment of the SWM delivery service relative to efficiency, cost and environmental soundness;
- To offer recommendations for local governments based on these assessments, aimed at improving the delivery, cost accounting and environmental soundness of these services.

1.4 Scope of Work

The following tasks were carried out by the project team:

1.4.1 Task One -- Assessment

Meetings with central-level authorities in Abidjan. These meetings involved authorities responsible for the oversight of local government operations as well as technicians involved with solid waste management in the relevant ministries and public departments.

Field visits to two A.I.D. project cities. These visits permitted an in-depth assessment of current SWM practices as well as their costs. While on-site, the project team:

a. Assessed the environmental impacts of current SWM practices,

b. Investigated the potential for private sector involvement in the SWM delivery system, and

c. Assessed the plausibility of involving community groups in the SWM delivery system.

1.4.1 Task Two -- Analysis and Recommendations

Based on the information gained from Task One, the project team will offer recommendations for the improvement of the SWM systems of Sinfra and Tiassale. These recommendations and resulting action plan will take into account the technical, cultural, and financial constraints facing these cities. In addition, the environmental soundness of proposed delivery systems will be addressed. Finally, particular emphasis will be given to potential links of the current public system with informal small scale private sector opportunities.

1.5 Cities studied -- Tiassale and Sinfra.

1.6 Content of the Report

- Volume 1

  Chapter 1 - presents the project's scope of work, its methodology, and the various alternative solutions to be considered.

  Chapter 2 - describes the impacts of inadequate waste collection and treatment on the environment.

  Chapter 3 - presents the organizational framework of the municipalities and the recommended solution for the SWM system.

- Volume 2 (Sinfra) and 3 (Tiassale)

  Chapter 1 - presents a background of the city, its economic resources, project-related conditions, and impacts of the current SWM system on human health. In addition, this chapter introduces the basic parameters for developing a viable SWM solution.

  Chapter 2 - describes the impact of the current SWM system on the environment.

  Chapter 3 - discusses three alternative solutions for the SWM system. For each, the proposed equipment investment and operating costs are described. Based on these costs, calculations are made of implied charges to the population for the services of garbage collection and disposal.

  Chapter 4 - presents the conclusions and recommendations of the study.

1.7 Methodology

The analysis and assessment of the present garbage collection arrangements in the communes of Tiassalé and Sinfra included the following:

1.7.1 Technical Analysis

1.7.1.1 Meetings Held With Local Authorities

The team held consultations with:

a. Abidjan

* Direction de l'Assainissement et des Infrastructures

Mr. George KAKADIE, Director
Mr. Jean-Marie SIE KOUADIO, Vice-Director, Solid Waste Management
Mr. Léon KOUA, Service Chief

* Direction Générale des Collectivités Locales

Mr. Edouard MAHIRI, Directeur du Developpement des Collectivités Locales
Mr. Jules N'DRI, Chef du Service de l'Equipement, des Travaux et Contrôles

b. Tiassalé

Mr. GNAHOUA, Secrétaire Générale de la Mairie
Mr. KAMBO, Responsable des Services Techniques
Mr. Kouamé YEBOUE, Responsable des Services Financiers
Mr. René AMICHIA, Maire de la Commune

c. Sinfra

Mr. Paul TOBOE BI CRITIE, Premier Adjoint au Maire
Mr. Kanga ADOU, Responsable des Services Techniques
Mr. Tété LOUBAO, Responsable des Services Financiers
Mr. Adama DIOP, Maire de la Commune

1.7.1.2 Review of Previous Studies

The team reviewed the following reports:

- Sinfra

Niveau de Ressources Municipales - Rapport Provisoire
Niveau de Fourniture des Services - Rapport Provisoire
Niveau d'Activite Commerciale

- Tiassale

Niveau de Ressources Municipales - Rapport Provisoire
Niveau de Fourniture des Services - Rapport Provisoire
Niveau d'Activite de Commerciale

1.7.1.3 Field Visits

During the field visits, the following was performed:

- Identification of municipal capabilities for collection and treatment of solid waste;
- Investigation of the garbage collection and treatment methods;
- Investigation of the impact of inadequate collection on other sectors of the city's infrastructure and on the environment; and
- Identification of residents' disposal methods and willingness to pay for (and participate in) solid waste collection and treatment services.

1.8 ALTERNATIVE SOLUTIONS

A variety of solutions -- ranging from better utilization of existing equipment to the purchase of new equipment -- are possible given the needs of the cities studied.

In addition to the do-nothing alternative, this report considers three alternatives, each with varying investment requirements.

Alternative I. proposes merely the reparation of existing equipment and maintaining SWM as a uniquely municipal function. This solution would require additional surcharges for solid waste collection on electricity bills, presently established at 1. FCFA.

Alternative II. offers a citywide privatization model.

Alternative III. proposes a transitional "pilot" privatization plan for a section of each city, to be followed by citywide privatization.

Alternatives II. and III. would require new user charges.

Three are considered here. Alternative II offers a citywide privatization model. Alternative III proposes a transitional "pilot" privatization plan for a section of each city, to be followed by citywide privatization.

1.9 RECOMMENDED ALTERNATIVE

Given the economic and technical constraints facing the cities of Sinfra and Tiassale, Alternative III is recommended.

1.10 LIMITATIONS

The appropriate functioning of a collection/treatment system will depend not only on the selection of the proper equipment and most advantageous collection circuits, but also on the interaction of community groups and the collection entity. To assure this interaction, complementary programs promoting community participation are needed.

1.11 COMPLEMENTARY PROGRAMS

1.11.1 Sensitivity Training Program

For the reasons indicated above, a community participation and sensitivity training program must be included in the recommended SWM solution.

1.11.2. Solid Waste Management Workshop

A program to enhance the municipalities' technical capabilities is needed. Training[1] should be directed towards the technical and financial services of the municipalities, and include:

a. Basic concepts of the technical aspects of solid waste management

b. Collection of solid waste

c. Re-use of solid waste

d. Landfill management

e. Concepts of solid waste management

f. Concepts of SWM financing

---

1 See Appendix A for more details.

II. IMPACTS ON THE ENVIRONMENT

2.1 IMPACTS OF INADEQUATE WASTE COLLECTION

2.1.1 General

The conditions observed during the field visit to Sinfra were deplorable. Piles of solid waste have accumulated in almost every empty space, in the streets, and at intersections. These accumulations negatively affect other sectors of the city's infrastructure, as well as the health of the population. Furthermore, the evident neglect of the solid waste situation breeds widespread public apathy toward the problem, thereby further compounding it. In Tiassalé, the conditions are not as drastic. Nevertheless, the need for improvement of the collection of solid waste requires immediate attention. Picture I offers evidence of the inadequate waste collection of these two cities.

2.1.2 Impacts on the Cities' Infrastructure

The trash discharged in the streets of Sinfra and Tiassale is carried into the drainage system, clogging pipes and ditches and forcing water to find its way down the streets until it reaches flat areas where it stagnates. In some locations, after a heavy rain, accumulation of mud, sludge, and garbage is not unusual.

2.1.3 Impacts on the health of the Population

2.1.3.1 Garbage Accumulation

In addition to the solid waste indiscriminately discharged, the collected garbage is dumped untreated in open land in areas outside the limits of both cities. During the rainy season, these accumulations become ideal breeding places for disease-producing organisms. During the dry season, the accumulations generate contaminated dust that blows over the city, promoting respiratory diseases.

According to the chief doctors in both cities, the three major sicknesses treated are: malaria, diarrhea and bronchitis.

- Malaria

  Water accumulated in ditches, broken pipes are breeding places for mosquitoes in urban areas. Malaria is transmitted through a bite of an infected (female) anopheles mosquito.

- Enteric Diseases Primary Diarrheas

  Prevalent develop in environment were there is lax of hygiene habits and expose to contaminate sources of food and drink.

- Respiratory Disease

  Generation of harmful smoke from burning garbage and dust during dry seasons are some of the causes of respiratory diseases

Sanitary conditions are contributing factors in the prevalence and severity of all three.

2.1.3.2 Air Pollution

The industrial activities in Sinfra and Tiassalé have little impact on air quality. However, lack of maintenance of the unpaved roads do contribute to the prevalence of airborne dust. In Sinfra this situation is aggravated by the presence of piles of garbage (see Picture 1). Some waste is burned in the open to reduce the volume and control odors (See Picture 2).

Little attention is paid to the fact that open burning decreases air quality. The low temperature and the open burning increase the emission of particles, carbon monoxide, and hydrocarbons. Some of the emissions[2] associated with open burning are:

Particles	8.0 kgr. per ton.
Sulfur oxide	0.5 kgr. per ton.
Carbon monoxide	42.0 kgr. per ton.
Nitrogen oxides	3.0 kgr. per ton.

These emissions are known to contribute to respiratory problems.

2.2 IMPACTS OF IMPROVED COLLECTION AND TREATMENT OF SOLID WASTE

If present conditions are allowed to continue, public health will remain at risk. Iplementation of any of the alternatives described in section 1.7, should improve existing conditions. The impacts of Alternatives I and III are outlined below.

2.2.1 Impacts of Minimum Investment (Alternative I)

Implementation of this alternative should be considered as a temporary solution. The major components of this alternative are:

- Reparation of collecting equipment, and

- Implementation of a community participation and sensitivity training program.

This minimal investment would have a positive impact on a number of crucial problems. Among these are:

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2 Source: Market Survey of Solid Waste Management - Port au Prince. WASH, February 1991

PICTURE 1 - Piles of Garbage

PICTURE 2 - Air Contamination

a. Drainage

The drainage system will function more efficiently as blockages will be reduced. Stagnation and erosion will be reduced.

b. Health

The reduction of uncollected, untreated garbage and the elimination of stagnant water will help to reduce or eliminate the contamination of groundwater and surface water. This will reduce the incidence of malaria, diarrhea, and other water-borne diseases.

c. Quality of Life

The removal of debris from the streets will markedly improve the overall appearance of the city (as well as its health).

2.2.2 Impacts of a Pilot Privatization Program (Alternative III)

This alternative considers the collection and disposal of all solid waste produced in the pilot areas (N'Douci in Tiassalé and Houphouet Bogny in Sinfra). A citywide privatization program would be phased in. This alternative proposes:

- Purchase of new collecting equipment: a tractor and two containers on wheels. See volumes 2 and 3 for analyses of cost and sources of revenues.
- Rehabilitation of existing equipment to be used in the remaining portions of the city, and
- Implementation of a community participation and sensitivity training program.

This alternative should realize the following improvements in the pilot areas (and ultimately citywide):

a. Infrastructure

The elimination of trash from streets will have a positive impact on traffic flow, permitting collection equipment to reach previously inaccessible areas.

The elimination of blockages in drainage structures will halt both erosion and the accumulation of stagnant water.

b. Health

The reduction of uncollected, untreated garbage and the elimination of stagnant water will help to reduce or eliminate the contamination of groundwater and surface water. This will reduce the incidence of malaria, diarrhea, and other water-

borne diseases.

c. Economic Development

The potential economic benefits of adequate garbage collection are:

- Improved work force productivity due to the improved health of the labor force and more efficient use of infrastructure

- Improved economic prospects resulting from the improved overall appearance of the city

- Improved economic opportunities for entrepreneurs in recycling, and

- Improved public sector assistance due to the more efficient use of maintenance and repair funds.

d. Air Quality

Improvement of the SWM system will improve air quality via:

- reducing the current practice of burning garbage,
- reducing offensive odors, and
- reducing the amount of dust during dry periods.

e. Recycling of Solid Waste

A complementary recycling program, focusing on composting, would add the following benefits:

- Extending the life of landfills by reducing the volume of garbage, and

- Developing new sources of income by utilizing intensive labor to produce recycled material.

f. Quality of Life

The improvement in all of the areas described above plus the improvement in the cities' overall appearance will provide a better quality of life to the population.

III. INSTITUTION ANALYSIS

3.1. GENERAL

In both cities studied, the collection and disposal of solid waste is the responsibility of the Technical Services Department of the Municipality. This responsibility includes cleaning streets drainage structures and markets as well as maintenance and repair of drainage structures and streets.

3.2 MANAGEMENT ORGANIZATION OF THE MUNICIPALITIES CONCERNING SWM

Each city is managed by a Mayor and four Assistants. In addition, each city has a Board of Directors. Like the Mayor and his Assistants, all members of the Board are elected.

The General Secretary and the Director of Technical Services, among other responsibilities, are responsible for the collection and disposal of solid waste. The Financial Services Department is responsible for the solid waste management budget. (see Figure 1).

3.3 APPROVAL OF MUNICIPAL BUDGETS

The preparation and implementation of municipal budgets are the responsibility of the Mayor. The process of approval begins at the level of the Municipality and ends with the approval of the Ministry of Interior. (see Figure 2)

3.4 COLLECTION OF TAXES AND AVAILABLE FUNDS FOR MUNICIPAL USE

The Municipality collects all taxes and submits them to the National Treasury. The State retains 75% of these receipts, placing the remaining 25% in a nominal account for the Municipality's use. (see Figure 3)

3.5 PAYMENTS OF INVOICES SUBMITTED TO MUNICIPALITIES

Payment of invoices follows the cycle indicated in Figure 4. The process could take two-to-three months or more depending on availability of funds in the nominal account and in the National Treasury.

3.6 IMPACTS DUE TO DELAY OF PAYMENTS

Delays of payments add to the problems of the SWM system. Even when funds are available for necessary maintenance of collection equipment, contractors are reluctant to provide the needed services because of the anticipated payment delay.

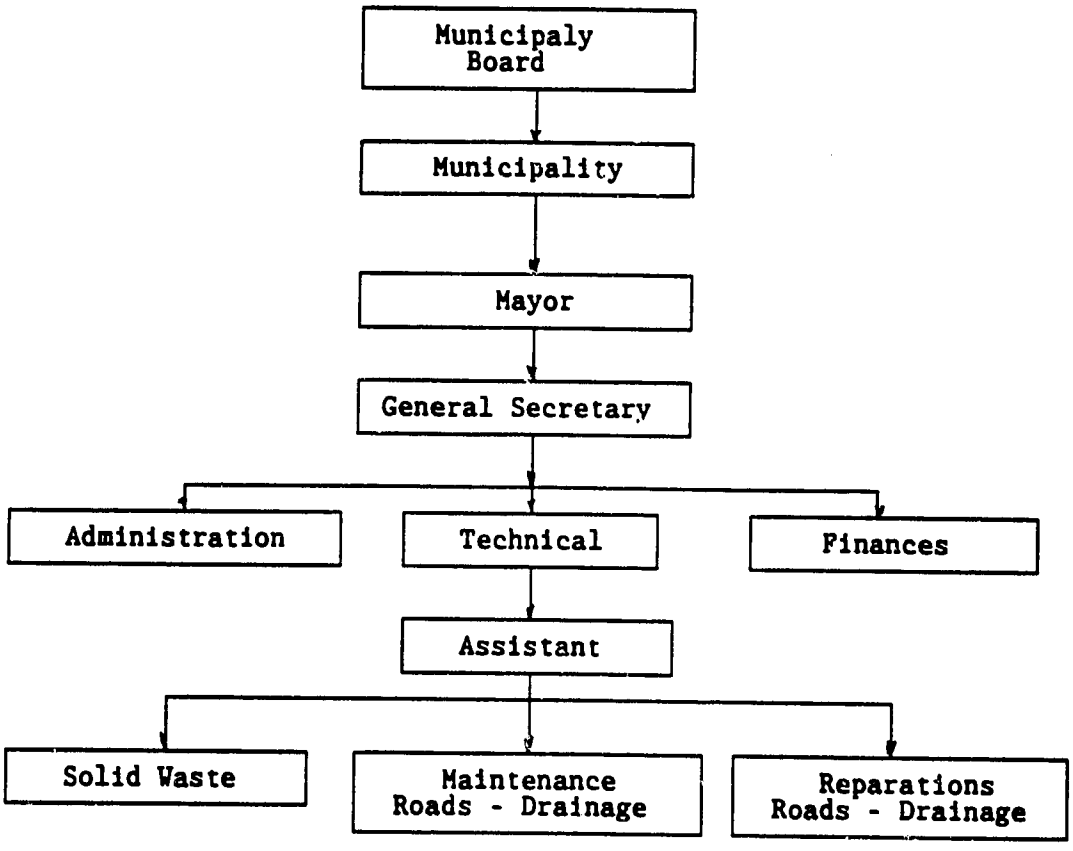

FIGURE I - ORGANIZATION CHART

3.7 MANAGEMENT ALTERNATIVES

The problems outlined in previous chapters and in Volumes 2 and 3 justify, in the opinion of the consultants, a recommendation for a privatized SWM organization.

The situation of each city dictates the types of organization to be considered. Two alternatives for privatization for Sinfra and Tiassale were studied; one alternative considered the privatization of the entire city and the other a "pilot" privatization program.

3.7.1 Basis for Selection of Recommended Solution

The SWM recommendations for Sinfra and Tiassale were based on the findings of field surveys, discussions with municipal officials, and visual inspection of both cities.

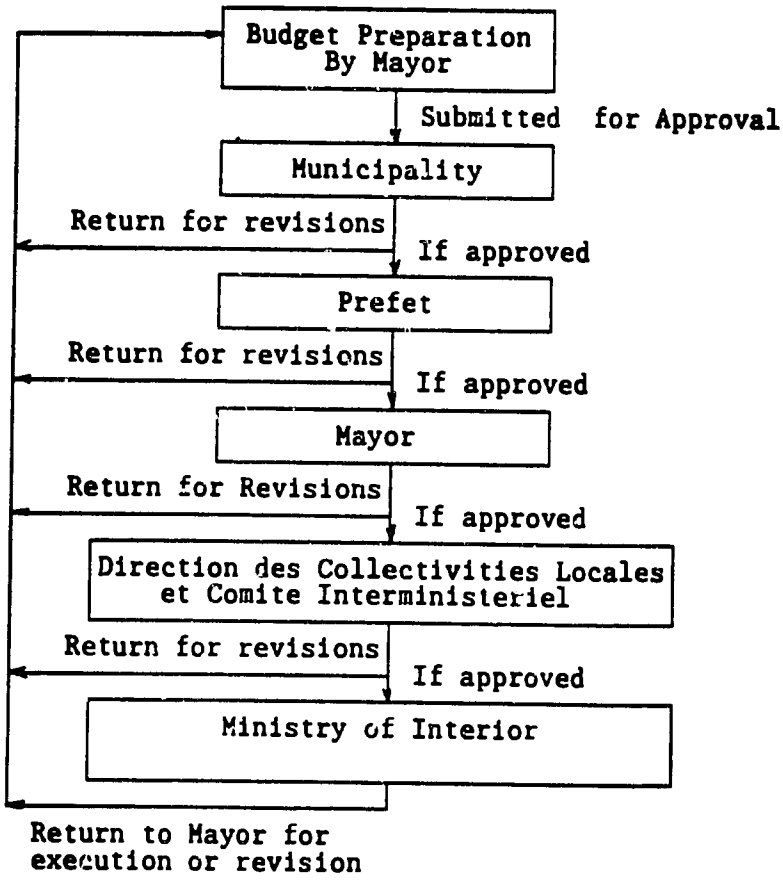

FIGURE 2 - MUNICIPAL BUDGETS APPROVAL PROCESS

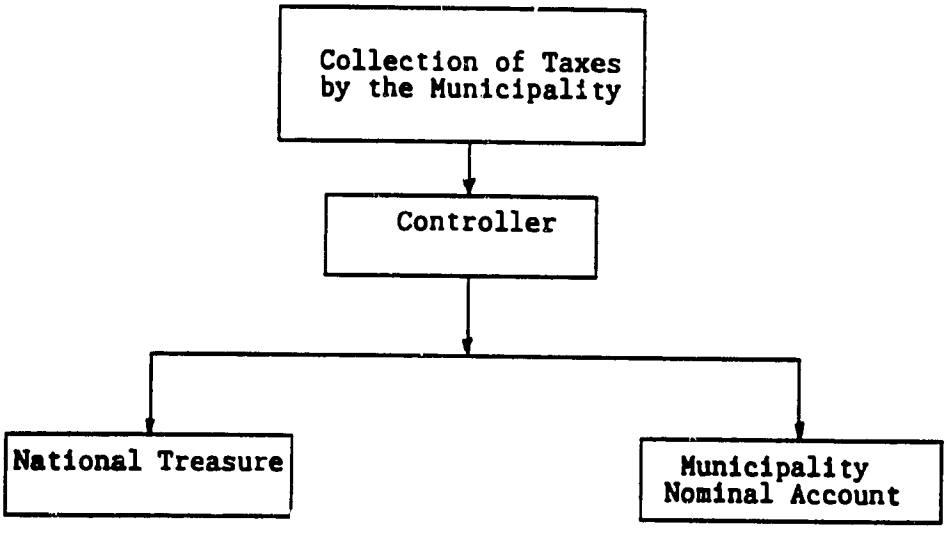

FIGURE 3 - TAX COLLECTION AND LOCATION OF FUNDS

3.7.1.1 Survey Results

A summary of the results of the surveys are outlined below.

Description	Sinfra	Tiassale
Number of People/house	9	7
Disposal of organic material	60 %	60%
Disposal of solid waste		
- At a collection point	10%	10%
- Any place	90%	90%
Responsibility for garbage collection and treatment		
- Municipality	40%	40%
- Private	40%	40%
Willingness to pay for collection services	20%	40%
Community participation	minimal	minimal

From the above answers it is clear that the populations of Sinfra and Tiassale are inadequately informed on their roles in the SWM system. This suggests that any technical changes in the municipal SWM system must be accompanied by community sensitivity training.

3.7.1.2 Visual Inspection and Meetings with Technical Service Personnel

The present disposal methods and the absence of recycling programs indicate that training programs for technical personnel are needed. This finding was apparent during discussions with officials responsible for SWM, and was confirmed by visual inspection of streets, dumpsites, and drainage structures. (See Annex A, for content of technical training program)

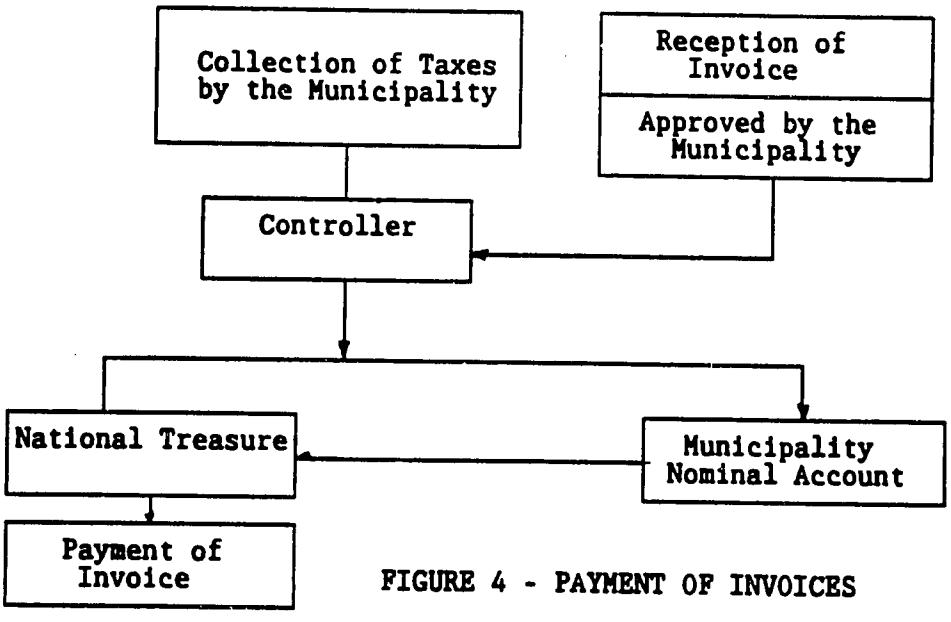

FIGURE 4 - PAYMENT OF INVOICES

3.8 RECOMMENDED ALTERNATIVE

To accomplish the objectives described above we recommend the "pilot" privatization alternative -- Alternative III -- for both Sinfra and Tiassale.

The pilot program for each city, to be undertaken as a private enterprise, should be conducted as follows:

Phase I - Years 1 and 2 - Pilot Program

a. Sensitivity training sessions

b. Technical Workshops for Municipal Technical Personnel

c. Private collection and treatment of the solid waste produced in the "pilot" zone -- an area with a population of no more than 15,000 people.

d. Minimum charges (see payment schedule for Sinfra and Tiassale in Volumes 2 and 3)

Phase II - Years 3 to 5 - Citywide privatization of SWM

3.9 PILOT PROGRAM GOALS

The purpose of the pilot program is to permit a small-scale privatization experiment prior to unleashing a full-blown program. This experiment will offer insights into the larger program planned in Phase II. Through the pilot program, one can expect to learn:

a. the relative costs and efficiencies of public SWM versus private SWM;

b. the appropriate type of SWM services for the particular municipality;

c. the appropriate provider of the collection/treatment services (e.g., a network of small-scale entrepreneurs vs. a single large provider);

d. the willingness of the population to pay for services; and

e. the potential for the development of private sector recycling programs.

3.10 IMPLEMENTATION SCHEDULE

The implementation schedule for the recommended technical workshops and sensitivity training are indicated in Figure 5.

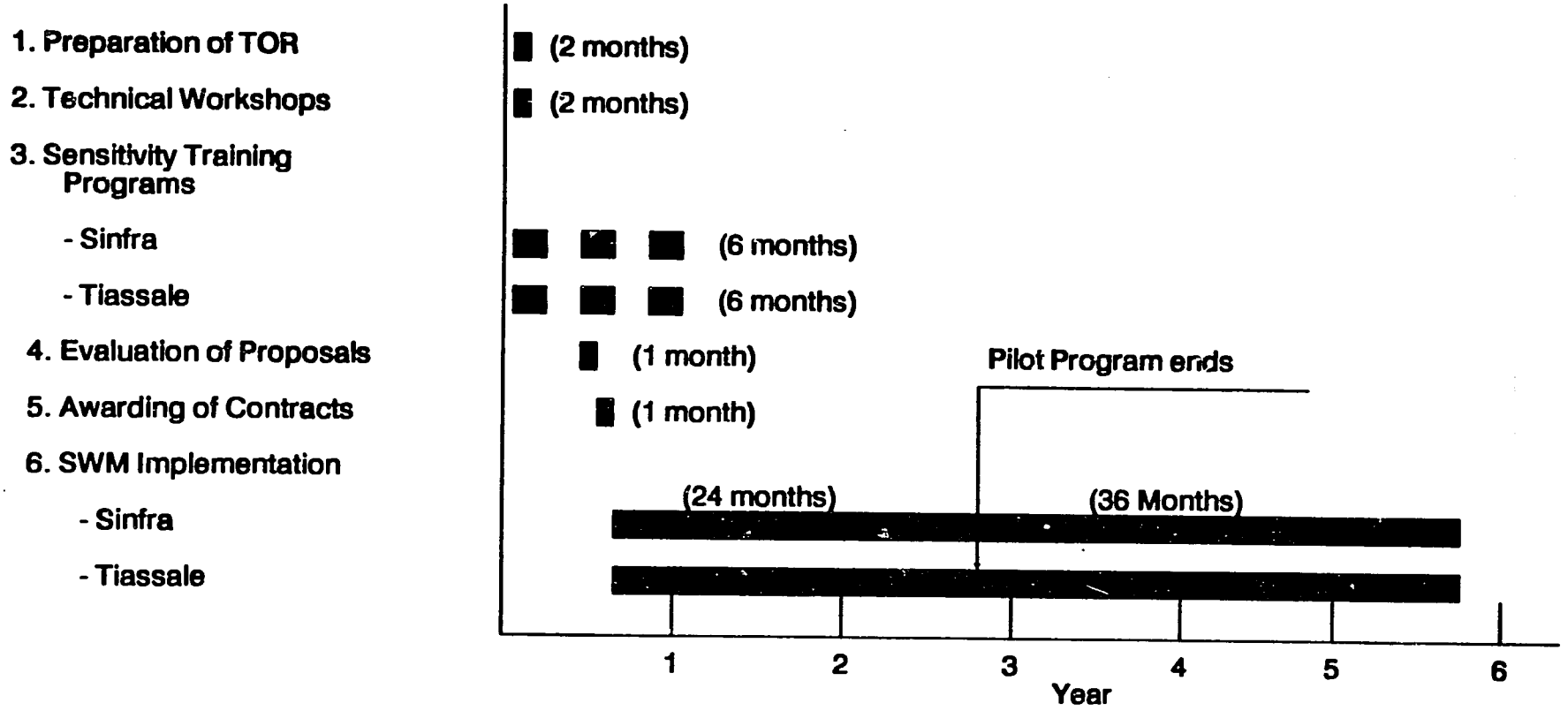

FIGURE 5 - IMPLEMENTATION SCHEDULE

APPENDIX A - TECHNICAL WORKSHOP

A TECHNICAL WORKSHOP

A. 1 Objectives

The overall objective of the workshop is to consolidate the knowledge skills, and aptitude of the participants, as well as to provide them with new knowledge to allow them yo identify new concepts in the design, application, and supervision of the various components of solid waste mamagement.

A. 2 General Objectives

The General Objectives of the workshop are:

- to motivate participants to engage actively in the seminar
- to broaden participant's knowledge of various aspects of the process of solid waste
- to increase particpants' knowledge of various aspects of the process of solid waste collection
- to understand, conceptualize, and evaluate technical procedures involved in re-use and recycling
- to understand, analyze, and apply technical knowledge in the field of sanitary landfill design
- to analyze and identify alternatives for solving management problems from technical, administrative, and financial standpoints
- to provide suficient instruction to enable particpants to develop their own action plan in certain prioritu areas of solid waste management: design collection systems and sanitary landfills, recycling, management and finance

A. 3 Term of References

A. 3.1 Initial Phase

The ultimate objective is to conduct a workshop on the collection, treatment and disposal of the solid waste for technicians from municipal governments. In compliance with this objective an inicial mission is necessary to study the existing conditions and prepare the design for the workshop program.

the task to be carried out during this phase include the following:

- meetings with organizing authorities

18

- meeting with individuals from the Technical Department of the municipalities. The primary objectives of these meetings are:

  i. to identify the topics to be presented during the workshop
  ii. to identify, in the field, methods used in collection, treatment and disposal of solid waste in garbage dmps and sanitary landfills
  iii. to prepare the program and establish the date for conducting the seminar workshop
  iv. to prepare a report covering the initial mission

A 3.2 Final Phase

The task to be carrid out in the during the second phase should include:

- review the design of the seminar developed in the initial phase

- present, during the workshop, technical and practical explanations of the following subjects:

  i. basic concepts of the technical components of solid waste management
  ii. collection of solid waste
  iii. re-use of solid waste
  iv. sanitary landfills
  v. concepts of solid waste management
  vi. concepts of solid waste financing

- work, through practical execises, in each of the above subjects

- discuss with the participants form each city any of the problems related to each subject

- hold sessions in with particpants divide into groups to apply the concepts learned

A. 4. Methological Orientation of the Workshop

The workshop should use a participative and experimental methology in accordance with the principles od informal education.

The learning process should include the following:

- an introduction to data that will generate the particpants learning cicle

- a critical analysis on the group's part

- access to scientific or technical generalizations

- application of theoretical knowledge to real-life situations

APPENDIX B - QUESTIONNAIRES

Technical Questionnaire B-1
Survey Questionnaire B-7

B-1 TECHNICAL QUESTIONNAIRE

Municipal Services

Person(s) interviewed: Position:

1. Demographic

1.1 Populatiion:
1.2 Annual growth rate:
1.3 Percentage: Men: Women: Children

2. Management

2.1 Manager:
2.2 Administrative:
2.3 Technical:
. Chief:
. Engineer:
. Technicians:
. Other: (Specify)

3. Municipal Services - Discussions Points

3.1 Solid Waste:
3.1.1 Collection
- Collective:
- Individuals:
- Private:
- Other: (Specify)

3.1.2 Disposal
- Landfill: Open site:
- Streets: Ditches:
- Other: (Specify)

3.1.3 Treatment/Separation
- Landfill
- Other Locations
- None:

3.1.4 Recycle
- Compost:
- Biogas
- Scavanger:
- Other (Specify)

3.1.5 Equipment

- Collecting:
- Treatment:
- Other: (Specify)

3.1.6 Programs

- Past:
- Present:
- Future: 5 year Program:

3.2 Wastewater

3.2.1 Collection

- Latrines:
- Individual
- Public
- Open fields
- Other: (specify)

3.2.2 Disposal (Latrines)

- Open fields
- Ditches
- Other (specify)

3.2.3 Programs

- Existing:
- Future:
- Short term
- Five year program
- Long term

3.2.4 Wastewater Treatment

- Co-Compost:
- Biogas:
- Other: (specify)

3.3 Water Supply

3.3.1 Sources:

- Surface: river: pond:
- Well: manual: pump:
- Water tank:

- Other (specify)

3.3.2 Water Contamination - Causes

- Garbage accumulation: Stagnation
- Wastewater disp[osal near water sources:
- Latrines near water well
- Other: (specify)

3.4 Drainage

3.4.1 Existing Systems

- Ditches:
- Drainage Structures:
- Pipes:
- Waterways:
- Other: (specify)

3.4.2 Proposed projects

- Short Term:
- Five year plan:
- Long Term:

3.4.3 Maintenance

- Who:
- How often
  Monthly
  Weekly
  Never

3.4.4 Repairs

- Who:

3.5 Road Network

3.5.1 Existing:

Paved roads:
Unpaved Roads:
Other: (specify)

3.5.2 Program:

Existing:
Future:
Short term:
Five years:
Long Term:

3.5.3 Maintenance

3.5.4 Repair

4. Other Services

4.1 Electricity

Service per day: 21 h 12h 6h 3h none

4.2 Telecomunication

Phone:
Fax:
Other (specify)

4.3 Tansportation

Surface:

Road:

Railroad:

Sea:

Air:

4.4 Health Services

- Facilities
- Individuals
  Doctors:
  Nurses:
  Paramedics
  Other:

4.6 Sloughterhouses

How many?

5. Environmental concerns

5.1 Sources of water contamination:

Industrial
Hospitals
Solid Waste accumulation

5.2 Air Contamination

Burning waste
Industrial
Vehicles

6 Conservation

6.1 Energy efficiency

Charcol:
Gas:
Other:

6.2 Forest

7. Land use

7.1 Land Reclamation

7.2 Reforestation:

8. Budget

Federal
City

9. Estimated Annual Income

B - 2 ENQUETES MENAGES

1. ZONE:

---

2. CARACTERISTIQUES

QUARTIER SPONTANNE:___ CITE:___ QUARTIER RESIDENTIEL ___

---

3. PRODUCTION D'ORDURES

COMBIEN DE PERSONNES EN TOUTES VIVENT-ELLE DANS LA MAISON?:

1-3 __ 4-6 __
7-9 __ +10 __

---

4. COMMENT DISPOSEZ VOUS DES ORDURES CHEZ VOUS?:

SEAU __ PANIER __
GRAND SAC__ BROUETTE__

---

5. TYPE D'ORDURES

MATIERES ORGANIQUES - DISPOSE VOUS DE DECHETS VEGETAUX, ALIMENTAIRES ET AUTRES?: __ OUI ___NO

---

6. EGALEMENT, AVEZ VOUS L'ABITUDE DE JETER DES MATIERES NON ORGANIQUES TELLES QUE?:

PASTIQUES:_OUI _NO, METAL(BOITE)_OUI _ NO CARTON _ OUI_NO

---

7. RECYCLAGE: AVEZ VOUS DEJA ACHETE DES OBJETS OU THE MATERIEL QUI A ETE TRANSFORME?:

MORCEAU DE BOIS __ OUI __NO,
DES ENGRAIS OU FERTILIANTS __OUI __ NO
DE FUMIER __OUI __ NO
COMPOST __OUI __ NO

---

8. QUE FAITES-VOUS DES ORDURES LE PLUS SOUVENT?:
DEVANT CHEZ MOI___ OU COIN DE LA RUE__ DANS LE RABINE ___
SUR UN TERRAIN VACANT __ DANS LA LATRINES__ OU IN POINT PRECIS DE COLLECTE__ JE LE BRULER__ SANS REPONSE___

---

9. QU'AURIEZ-VOUS SUGGERE EN MATIERE DE COLLECTE__PRIVE__MAIRIE?

---

10. SI UN ORGANISME PRIVE. ETES-VOUS DISPOSE A PAYER POUR CE SERVICE?

__1.000 FCFA/SEM __800 FCFA/SEM __600 FCFA/SEM
__ 500 FCFA/SEN __400/FCFA/SEM __300 FCFA/SEM
__ 200 FCFA/SEM

REDSO/PMO/UD

MUNICIPAL DEVELOPMENT SUPPORT PROJECT
681-0004

PRIVATE PROVISION OF SOCIAL SERVICES (PPSS)
PDC-1008-C-00-9091-00

SOLID WASTE STUDY

for

SINFRA

VOLUME 2 OF 3

by
Jean Tchimon Assemian
and
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ICMA
Washington, DC
USA

28

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I. EXISTING CONDITIONS

1.1. BACKGROUND

The commune of Sinfra is located in the Central/Western part of the Ivory Coast, approximately 100 km west of Yamoussoukro. The city has developed at the intersection of three major roads: Yamoussoukro-Issia, Daloa-Oume, and Gagnoa-Bouafle. (See Figure I)

Sinfra is an essentially agricultural commune with a strongly integrated population of ivorians (Baoule, Senoufo) and non-ivorians (Nigerians, Mauritanians, Malians and Burkinians).

Area

Area of the Commune	16,700	ha
Area of Sinfra	440	ha
Percentage of urban/commune	2.63	%
Property division	485	ha.

Population

1988	40,430
1992	48,400

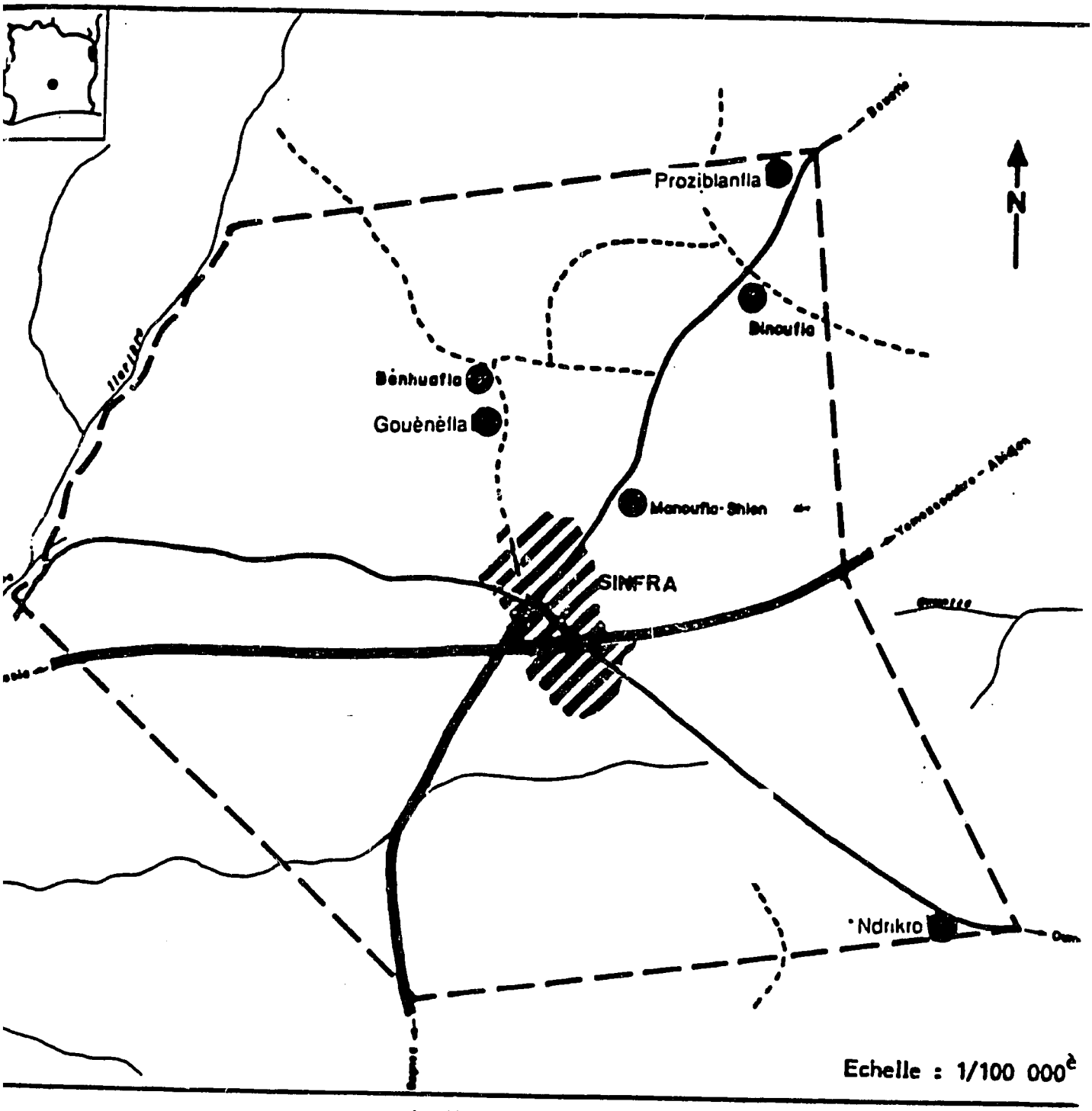
Population Growth 4.6%

At the present growth rate the projected population for five years is indicated below.

Year	Population
1992	48400
1993	50626
1994	52955
1995	55391
1996	57939
1997	60604

The Commune encompasses Sinfra and six villages:

City	Population (1988)	Population (1992)
Benhaufla	2299	2752
Binoufla	1097	1313
Gouenefla	1661	1988
Manoufla Shien	284	340
Ndrikro	763	913
Proziblanfla	1118	1338



LEGENDE

- Limite de terroire communal
- Route goudronnée
- Route en terre
- Rivière
- Espace urbanisé
- Village rattaché à la commune

FIGURE 1 - MUNICIPALITY OF SINFRA

Density

Sinfra has a density of 77 person/ha.

Topography

The topography is basically flat, surrounded by secondary forest. The forest is exploited for agricultural purposes.

Weather

The climate is characterized by two rainy seasons: a major season covering April to mid-July, and a minor season which begins mid-September and ends mid-November.

Type of Residences:

There are two types of residences:

a. Medium Level

Medium level residences are located in the residential area where revenues are high. Sanitary facilities are either indoor or outdoor, and are generally relatively well maintained.

b. Low Level

Low level residences are located in poor areas. The sanitary facilities are located outside the houses and generally are not well maintained.

1.2 ECONOMIC RESOURCES

The majority of employment is generated by the agricultural sector, with cocoa and coffee production leading the way. Corn, gnames, and manioc are also commercially produced.

At present, the combination of low coffee and cocoa prices in the world market and the long dry periods to which the area has been subjected, Sinfra is experiencing difficult economic times.

1.2.1 Agricultural Activities

The agriculture production for 1991 was as follows:

Coffee:	5,000
Cocoa:	28,812
Rice:	7,500
Corn:	3,000

1.2.2 Industrial Activities

Wood Products

This is the only industrial activity. This activity started in 1991, with a production of 6,000 m^3/y.

1.3 INFRASTRUCTURE

Other than the three downtown sections of major roads, few of the streets in town are paved or lined with gutters.

In addition to the two markets, there are three bus/taxi stations, a hospital with two doctors and a dentist, two secondary schools and slaughter facilities. Running water and 24 hour electricity are available in most neighborhoods, with access dependent on ability to pay.

1.4 MANAGEMENT

The city is managed by the Mayor, Mr. Diop Adama, an engineer based in Abidjan. (Figure 2 shows the management organization of the city)

The Technical Department is run by Mr. Adu Kanga. His major responsibilities include the supervision of collection and discharge of solid waste, and the maintenance and reparation of road and drainage structures.

1.5 PROJECT-RELATED CONDITIONS

1.5.1 Erosion and Stagnation

Erosion is a significant concern in sloping residential areas, where a majority of roads are impassable and houses are crumbling at their foundations. While many of these neighborhoods have attempted to channel water to downhill areas, the ditches are insufficient and poorly maintained. (See picture 1) Flat areas are noticeable for the presence of stagnant water. (See picture 2)

1.5.2 Washwater

Washwater from daily usage is routinely discarded in the streets and between houses. This practice exacerbates the stagnation problem and poses a threat of contamination to local wells.

1.5.3 Wastewater

Wells are prevalent and subject to contamination by the proliferation of uncontained latrines. The tendency of these latrines to flood during heavy rainfall is similarly problematic. An additional problem is posed by the widespread practice of urinating at roadside or at the side of buildings.

PICTURE 1 - Garbage Accumulation

PICTURE 2 - Stagnant Wastewater

BEST AVAILABLE DOCUMENT

SINFRA

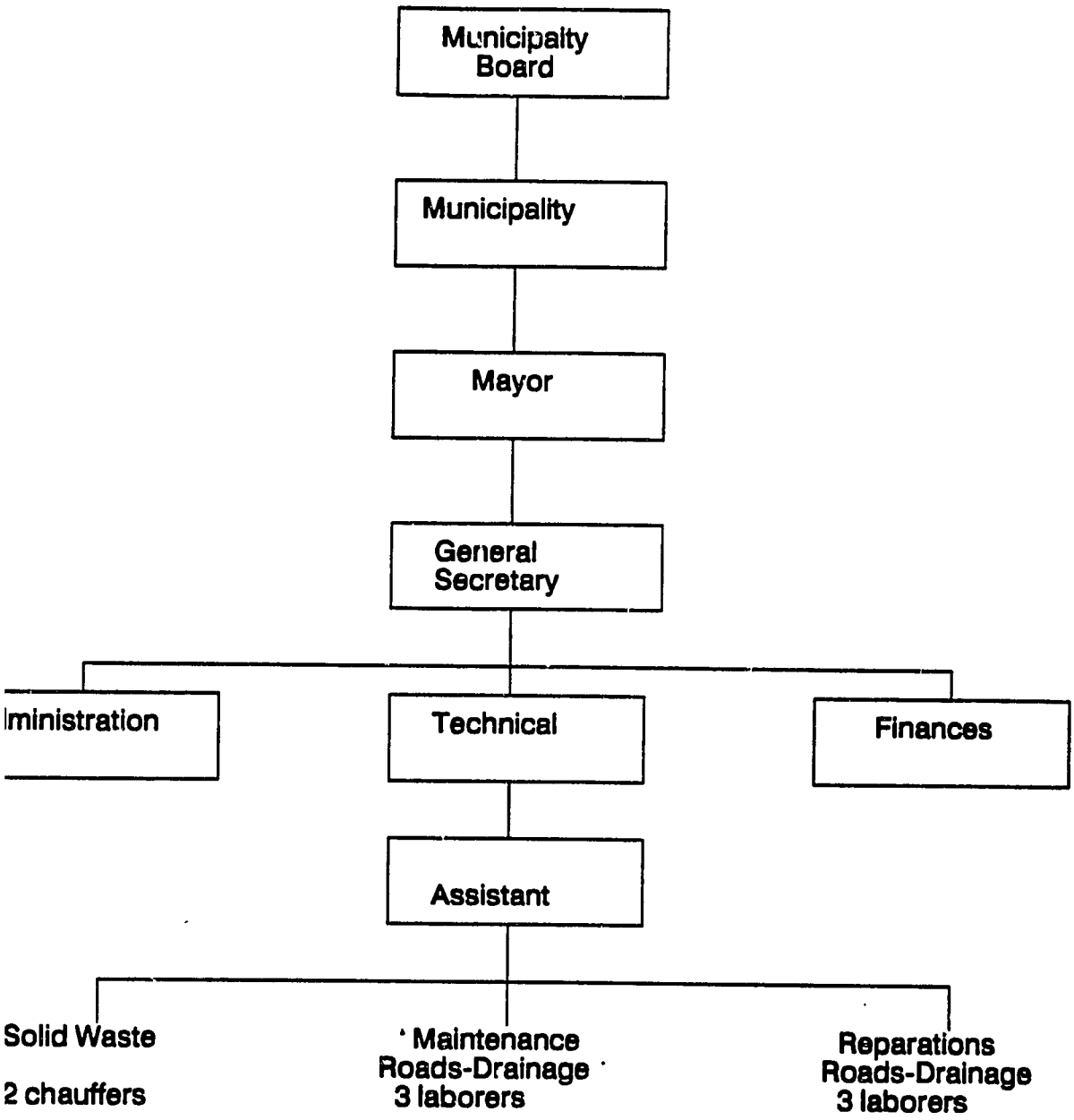


Figure 2 - ORGANIZATION CHART

PICTURE 3 - Unhealthy Environment

PICTURE 4 - Collection Equipment

BEST AVAILABLE DOCUMENT

1.5.4 Solid Waste

Solid waste is a major problem for the city. The main areas where the garbage remains uncollected are the Houphouet Boigny and the Deaulabougou neighborhoods. Huge piles of garbage on the streets and in empty lots are not merely unsightly and malodorous but also a health hazard. (see picture 3)

The collection system has deteriorated progressively for lack of equipment maintenance and repair, poor street conditions, traffic congestion, and indiscriminate discharges.

Waste is disposed in an assigned area located approximately 2.5 kilometers from downtown. The waste is dumped with no treatment.

The Technical Services Department operates two collection trucks daily with three workers and a driver each (presently, due to municipal financial difficulties, there is only a single operating truck[1] with a driver and 2 workers). Trucks follow regular circuits through both commercial and residential areas. Trash is collected only twice a week. (See picture 4)

In early 1992 a landfill was built but not opened due to lack of equipment. The disposal capacity was estimated at 15.000 m3.

1.6 IMPACT ON HUMAN HEALTH

1.6.1 General

Under warm, moist conditions, organic waste becomes an ideal breeding place for disease-causing organisms. Pathogens predominate, having easy access to the waste via vectors. In the case of solid waste, the primary vectors are flies, rodents and mosquitoes.

The generation of harmful organisms and their transmission is not the only health hazard. Similarly important are the health risks posed by the indiscriminate disposal of solvents, pesticides, and medical waste.

A number of sources of potential health hazards can be easily identified:

- **Municipal refuse** containing human fecal matter and industrial waste.
- **Organic material**, whose decomposition can release contaminants into drainage, seepage and the atmosphere.
- **Open burning of waste** in the dumps creates extensive air pollution.

---

1 The second truck required major repair work.

- Accumulation of piles of garbage in empty lots and streets.

1.6.2 Identification of Major Diseases

According to the statistics obtained in the Sinfra hospital, the major solid waste/wastewater-related sicknesses are:

- Enteric Diseases

  Diarrhea is a prevalent and chronic problem in environments where there are lax hygiene habits and the population is exposed to contaminated sources of food and drink.

- Malaria

  Wherever water accumulates, such as in ditches or near broken pipes, a natural urban breeding place for the anopheles mosquito is located. Malaria is transmitted through the bite of the infected female of this species.

- Respiratory ailments

  The generation of harmful smoke from burning garbage and dust during dry seasons cause and exacerbate respiratory diseases.

1.7 DEFINITION OF BASIC PARAMETERS

1.7.1 General

The parameters shown below were used for the development of a five year financial analysis.

a. Population (1992): 48,400

b. Population growth: 4.6%

c. Waste Generation Rates

Waste generation rates are difficult to determine since there is no available data concerning solid waste production. However, based on the consultants' experience, the following solid waste production rates can be estimated:

- high income	0.70 kgr/pers
- medium income	0.60 kgr/pers
- Low income	0.40 Kgr/pers
- Miscellaneous	10 % of total

d. Density, Composition, and Moisture

Density, composition and moisture are the main parameters used for determining appropriate garbage collection and treatment

design.

Density and composition are especially important, as they vary from area to area in the city. In wealthy neighborhoods, density tends to be low and garbage tends to have a high percentage of non-putrescible materials such as paper, plastics, glass, and metals. The garbage composition in lower-income areas, by contrast is mostly organic, with natural compaction. For the purposes of this analysis, the density used for the calculation of the volume to be transported was 0.50.

The following list shows the ranges of municipal refuse composition for low income communities[2] (% of total refuse, by weight):

Paper	1 to 10%
Glass, ceramics	1 to 10%
Metals	1 to 5%
Plastics	1 to 5%
Leather, rubber	1 to 5%
Wood, Bones, Straw	1 to 5%
Textiles	1 to 5%
Vegetable/Putrescible	40 to 85%

1.7.2 Solid Waste Production and Collection Costs

Collection and disposal were calculated using a solid waste management model written in Quick Basic. A sumple of typical runs are included in Appendix A.

2

Source: Environmental Management of Urban Solid Waste in Developing Countries - by Sandra J. Cointreau

II. IMPACT OF INADEQUATE WASTE COLLECTION ON THE ENVIRONMENT

2.1. GENERAL

The conditions observed during the field visit to Sinfra were deplorable. Piles of solid waste have accumulated in almost every empty space, in the streets, and at intersections. These accumulations negatively affect other sectors of the city's infrastructure, as well as the health of the population. Furthermore, the evident neglect of the solid waste situation breeds widespread public apathy toward the problem, thereby further compounding it.

2.2 IMPACT ON THE CITY INFRASTRUCTURE

The trash discharged in the streets is carried into the drainage system, clogging pipes and ditches and forcing water to find its way down the streets until it reaches flat areas where it stagnates. In some locations, after a heavy rain, accumulation of mud, sludge, and garbage is not unusual.

2.3 IMPACTS ON THE HEALTH OF THE POPULATION

2.3.1 Garbage Accumulation

In addition to the solid waste indiscriminately discharged, the collected garbage is dumped untreated in open land in areas outside the limits of the city. During the rainy season, these accumulations become ideal breeding places for disease-producing organisms. During the dry season, the accumulations generate contaminated dust that blows over the city, promoting respiratory diseases.

According to the chief doctor the three major sickness treated in the hospital are: malaria, diarrhea and bronchitis. Sanitary conditions are contributing factors in the prevalence and severity of all three.

See section 1.6.1 for a listing of potential health hazards posed by poor waste collection and disposal.

2.3.2 Identification of Major Diseases

See section 1.6.2

2.4 AIR POLLUTION

The industrial activities of Sinfra have no impact on air quality. However, lack of maintenance of the unpaved roads do contribute to the prevalence of airborne dust. In Sinfra this situation is aggravated by the presence of piles of garbage (see Picture 5). Some waste is burned in the open to reduce the volume and control odors (See Picture 6).

PICTURE 5 - Piles of Garbage

PICTURE 6 - Air Contamination

BEST AVAILABLE DOCUMENT

Little attention is paid to the fact that open burning decreases air quality. The low temperature and the open burning increase the emission of particles, carbon monoxide, and hydrocarbons. Some of the emissions associated with open burning are[3] :

Particles	8.0 kgr. per ton.
Sulfur oxide	0.5 kgr. per ton.
Carbon monoxide	2.0 kgr. per ton.
Nitrogen oxide	3.0 kgr. per ton.

---

3 Source: Market Survey of Solid Waste Management, Port-au-Prince Water and Sanitation for Health Project (WASH)

III. SURVEY APPROACH

3.1 GENERAL

There are three groups of waste producers -- household, commercial and industrial -- each contributing to the production of waste in varying ways.

3.1.1 Households

As this group is presumed to be the biggest producer of waste and also the most unknown in terms of production and disposal habits, most of the survey emphasis was placed here.

A household questionnaire was used to identify some of the basic parameters to be used for the elaboration of the alternatives for the solid waste collection system.

The questionnaire asked questions relating to waste production, quality of service, and willingness to pay for solid waste collection. (Sample of questionnaire in Appendic C, Volume 1) A total ten household questionnaires were completed by the Technical Services Department of Sinfra.

3.1.2 Commercial and Industrial

No survey was performed for the commercial and industrial sector, because the incidence in the overall solid waste production was estimated to be minor.

3.2 SURVEY OUTCOME

The key findings of the survey are outline below:

a. Number of people per house:

10 or more	70 %
7-9	10 %
4-6	20 %

The average household in Sinfra, then, is made up of about nine people.

b. Disposal of Organic Material

60% of residents dispose of organic material.
40% of the survey's respondents had no comment.

c. Composition of Non-Organic Waste

Plastics	70%
Cartons	40%
Metal	70%

d. Purchase of recycled waste

No positive response to this question.

e. Location of garbage disposal

In front of my house	50%
At a collection point	10%
In a ditch	10%
In an empty lot	10%
Burned	20%

f. Responsibilities for Garbage Collection

Municipality	40%
Private	40%
do not know	20%

g. Willingness to pay for Collection Service

1000 FCFA/w	0%
500 FCFA/w	10%
200 FCFA/w	10%
Unwilling to pay	80%

h. Community Participation

100% responded that currently there is no community participation in the SWM system, but that they would like to know more about potential in this area.

IV. ALTERNATIVES AND RECOMMENDED SOLUTIONS

4.1 GENERAL

The system for the collection and treatment of solid waste in Sinfra has deteriorated through the years. The most important reason is that no investment has been made for replacement and reparation of existing equipment. The present collection level of service is estimated at only 50%.

4.2 PRESENT COLLECTION CAPABILITY

- Equipment

Two trucks (models 1986 and 1987) with a capacity of 5 m^3 each collect garbage 6 days a weeks. The daily collection capacity is estimated at 22.5 m^3 (4.5 trips each day). It is estimated, however, that 50% of the time one or more of the trucks are broken.

- Collection Personnel

Each truck is operated by a driver and three laborers.

- Operation Costs

Table I indicates the actual expenditures* and the estimated operating cost necessary to maintain the same level of service for 1991. All data was provided by the Finance Department of Sinfra.

TABLE I - PRESENT EXPENDITURE AND ESTIMATED OPERATING COSTS in FCFA

Description	Expended	Required	Shortfall
Diesel	1,999,935	2,438,000	428,065
Salary	5,658,114	5,658,114	-
Repairs and Maintenance	3,478,167	7,740,000	4,261,833
Depreciation	-	-	-
Total	11,362,216	15,836,114	4,473,898

The following can be concluded:

- Depreciation was not estimated.
- Maintenance and repairs were reduced to almost half of the amount estimated.

To maintain the present level of service it will be required to allocate an additional 4.47 million FCFA annually.

4.3 ALTERNATIVE SOLUTIONS

Three alternatives were studied.

4.3.1 ALTERNATIVE I - MINIMUM INVESTMENT

This alternative proposes:

- that Solid Waste Management remains a municipal responsibility, and
- rehabilitation of equipment.

4.3.1.1 Assumptions

- Increase electricity surcharge from 1 FCFA/kw-h to 4.57 FCFA/kw-h
- Repair collecting equipment, estimated cost 2.9 million FCFA
- Purchase and rehabilitation of equipment as follows: (see Table II and Figure 3)

Year 1 - Rehabilitation of trucks,
estimated cost 2.9 millions FCFA

Year 4 - 1 Tractor and 2 containers on wheels
estimated cost 9.9 millions FCFA

Year 5 - 1 Truck with a capacity of 5m3 (Approx. 3 Ton)
estimated cost 12.9 million FCFA

- Additional charges on electricity bills are:

Year 1 - 13,700,000 FCFA
Year 2 - 14,330,200 FCFA
Year 3 - 14,989,390 FCFA
Year 4 - 15,678,900 FCFA
Year 5 - 16,400,130 FCFA

4.3.1.2 Major Constraints

- Increased electricity surcharge
- Only electricity users pay for services of collection and treatment of solid waste
- Level of production of the waste collectors
- Disposal habits of the population.
- Repair and maintenance capability of the municipality

ALTERNATIVE I - MINIMUM INVESTMENT

TABLE II - CASH FLOW - ADDITIONAL RESOURCES

Description	Yea	Year 2	Year 3	Year 4	Year 5
Population	48400.00	50626.40	52955.21	55391.15	57939.15
Growth	0.046	0.046	0.046	0.046	0.046
# Houses	5377.78	5625.16	5883.91	6154.57	6437.68
Revenues					
Municip'y	10000.00	10000.00	10000.00	10000.00	10000.00
Energy charges SW	13700.00	14330.20	14989.39	15678.90	16400.13
Total Rev	23700.00	24330.20	24989.39	25678.90	26400.13
Expenses					
Present	20733.00	21308.00	21881.00	22456.00	23031.00
Reparat/Purch.	2937.00			9900.00	
Total	23670.00	21308.00	21881.00	32356.00	23031.00
Balance	30.00	3022.20	3108.39	-6677.10	3369.13
Interest charges	18.00	18.00	18.00	18.00	18.00
Interest Cgarges				-1201.88	
Working capital	30.00	3052.20	6160.59	-1718.39	1650.74
Estimated Energy kw/h/year('000)	3000.00	3138.00	3282.35	3433.34	3591.27
SW charge/kw/h	4.57	4.57	4.57	4.57	4.57

SINFRA - COTE D'IVOIRE

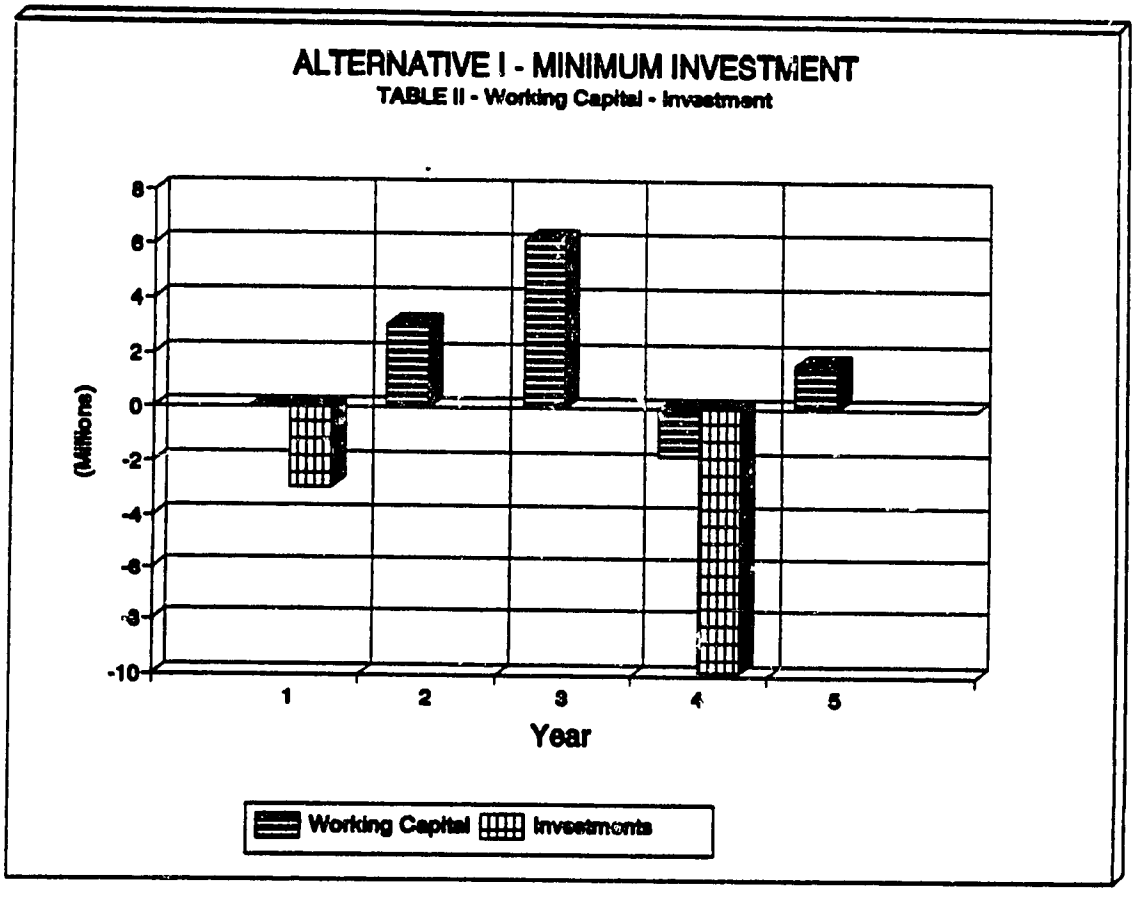


Figure 3 - ALTERNATIVE I - MINIMUM INVESTMENT

4.3.2 ALTERNATIVE II - PRIVATIZATION OF THE SWM SYSTEM

Alternative II proposes the rehabilitation of the existing equipment, and purchase of new equipment as required (see Table III and Figure 4).

The financial analysis of this alternative was calculated using a charge of 6,750 FCFA per house (estimated 9 people/house).

4.3.2.1 Assumptions

- Repair collecting equipment, estimated cost 2.9 million FCFA
- Purchase and rehabilitation equipment as follows: (see Table III and Figure 3)

Year 1 - Rehabilitation of trucks, estimated cost 2.9 millions FCFA

Year 2 1 Tractor and 2 containers on wheels estimated cost 9.9 millions FCFA

Year 3 - 1 Truck with a capacity of 5m3 (Approx 3 Ton.) estimated cost 12.9 million FCFA

4.3.2.2 Major Constraints

- The population is not prepared to pay for the collection of their solid waste
- Disposal habits of the population

4.3.3 ALTERNATIVE III PILOT PROGRAM

This alternative proposes the rehabilitation of existing equipment and the purchase of a tractor, two containers, and a truck with a capacity of 5 m^3. (See Table V and Figure 6)

This solution should be implemented in two phases:

- Phase I Implementation of a two year pilot program

The Houphouet Bogny area, with an estimated population of 15,000 people, was selected as the area for the development of the pilot program (See figure 5).

- Phase II Implementation of privatization of the solid waste management of Sinfra.

ALTERNATIVE II - SOLID WASTE MANAGEMENT - PRIVATIZATION

TABLE III - CASH FLOW AND INVESTMENT SCHEDULE

Description	Year 1	Year 2	Year 3	Year 4	Year 5
Population	48400.00	50626.40	52955.21	55391.15	57939.15
Growth	0.046	0.046	0.046	0.046	0.046
# Houses	5377.78	5625.16	5883.91	6154.57	6437.68
Rev/House	6750.00	6750.00	6750.00	6750.00	6750.00
Total Rev	36300.00	37969.80	39716.41	41543.37	43454.36
Expenses	32042.00	32042.00	32042.00	32042.00	32043.00
Profit 15%	15.00	15.00	15.00	15.00	15.00
Total	36848.30	36848.30	36848.30	36848.30	36849.45
Depreciation	580.00	2480.00	5040.00	5040.00	5040.00
Balance	31.70	3601.50	7908.11	9735.07	11644.91
Investment Sche	2900.00	9900.00	12800.00		
Cash	-2868.30	-9683.09	-16317.94	-9520.10	411.19
Interest 18%	-516.29	-1742.96	-2937.23	-1713.62	74.01
Working Capital	-3384.59	-11426.05	-19255.17	-11233.72	485.20

SINFRA - COTE D'IVOIRE

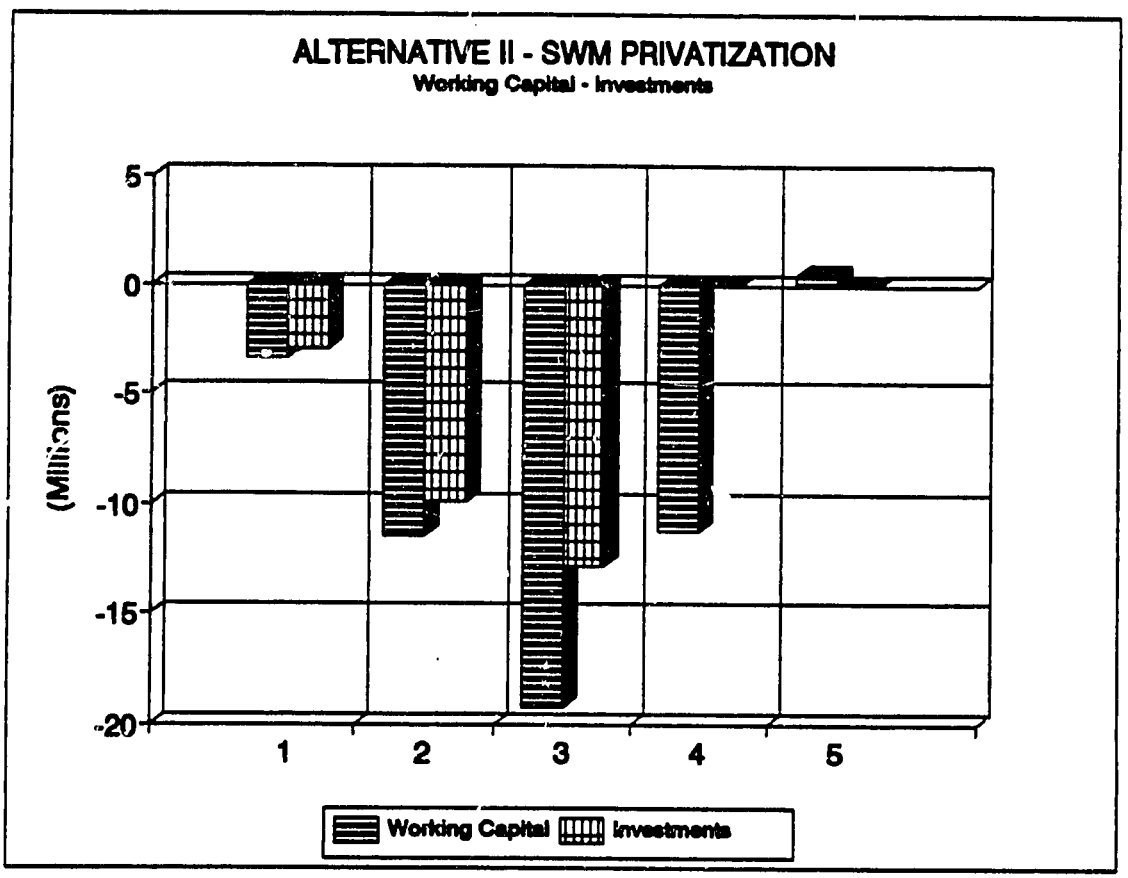


Figure 4 - ALTERNATIVE II - PRIVATIZATION

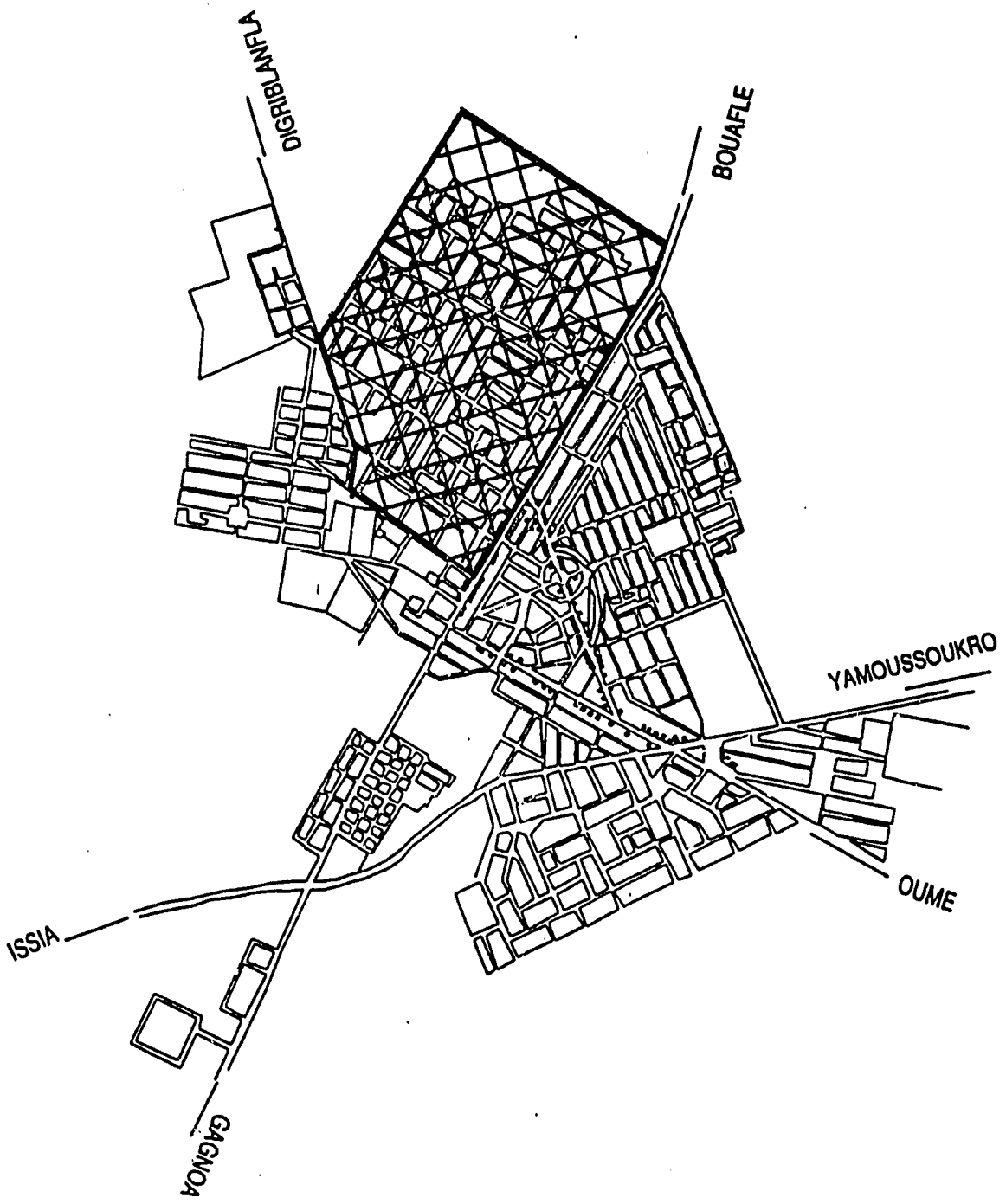


Figure 5 - Pilot Area

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ALTERNATIVE III - PILOT PROGRAM - PRIVATIZATION

TABLE IV - WORKING CAPITAL WITHOUT FINANCIAL SUPPORT

Description	Year	Year	Year	Year	Year
Population	48400.00	50626.40	52955.21	55391.15	57939.15
Growth	0.046	0.046	0.046	0.046	0.046
# Houses	5377.78	5625.16	5883.91	6154.57	6437.68
Payment per/hou	3650.00	3650.00	11150.00	11150.00	11150.00
Municip'y	10000.00	10000.00			
Tax/Elec+Add Re	3000.00	3138.00			
P/pay	1666.67	1666.67	5295.52	55391.15	57939.15
Paym contrac	6083.33	6083.33	65605.63	68623.49	71780.17
Total Rev	19083.33	19221.33	65605.63	68623.49	71780.17
Expenses	34909.74	34909.74	34909.74	34909.74	34909.74
Profit %	15.00	15.00	15.00	15.00	15.00
Profit	5236.46	5236.46	5236.46	5236.46	5236.46
Total Exp.	40146.20	40146.20	40146.20	40146.20	40146.20
Investment Schedule					
Cash/Deprec.	2276.00	2276.00	2276.00	4540.00	2276.00
Balance	-18786.87	-18648.87	27735.43	33017.28	33909.96
Rehab/Purch	-12837.00		-12800.00		
Sub-Balance	-31623.87	-55965.03	-51103.31	-27284.62	1714.11
Interest 18%	-5692.30	-10073.71	-9198.60	-4911.23	
Working Capital	-37316.16	-66038.74	-60301.91	-32195.86	1714.11

SINFRA - COTE D'IVOIRE

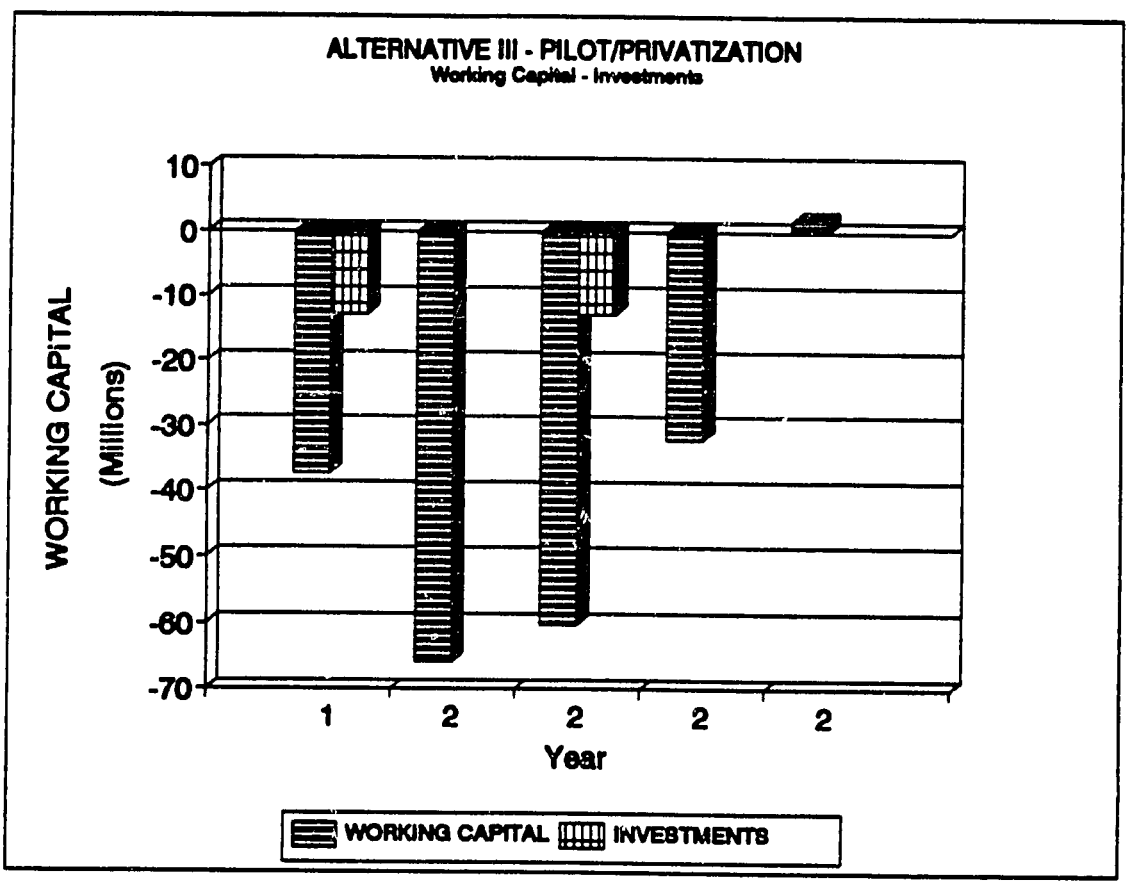

Figure 6 - ALTERNATIVE III - WITHOUT FINANCING SUPPORT

4.3.3.1. Assumptions:

a. Estimated Revenues

- Year 1

  Charges to the population 3650 FCFA/year/house
  Electricity surcharges 3.0 millions FCFA
  Municipality contribution estimated 10 millions FCFA

- Year 2

  Charges to the population 3650 FCFA/year/house
  Electricity surcharges 3.138 Millions
  Municipality contribution estimated 10 millions FCFA

- Years 3-5

  Charges to the population of 11,150 FCFA/year/house

b. Schedule of Investments

- Year 1

  Rehabilitation of equipment
  estimated cost 2.9 millions FCFA

  Purchase 1 tractor and 2 containers on wheels
  estimated cost 9.9 millions FCFA

- Year 3

  Purchase of 1 truck
  estimated cost 12.8 millions

4.3.3.2 Constraints

- High investment and payment by the population.
- Only a portion of the population will participate in the program for the first two years.

4.3.3.3 Advantages

- The population will have the opportunity to participate in community sensitivity training.

- The alternative addresses the disposal habits of the population.

- During the implementation of the pilot program the municipality will use the rehabilitated equipment for the collection of garbage produced in the other portions of the city.

4.4 RECOMMENDED ALTERNATIVE

Based on the benefits described above and the adjustment period required by the population to convert from a public to private system of Solid Waste Management, we recommend alternative III.

V. CONCLUSIONS AND RECOMMENDATION

5.1 CONCLUSIONS

5.1.1 Financial Constraints

The local government structure for collection and disbursement of funds represents a constraint for the implementation of the solid waste management program (see Vol.1 for description of budget approval process). This situation has motivated the following:

- A municipal failure to provide the community with the necessary service of collection and treatment of solid waste.
- A municipal failure to enforce regulation of disposal and management of solid waste. Moreover, the absence of regulations has encouraged indiscriminate dumping.
- Lack of definition of the amount of surcharge on the electricity consumption and excessive delay of payments by the electric company.

5.1.2 Deficient Understanding of Solid Waste and Its Impacts

Throughout the field visit and the responses of the survey the following conclusions can be drawn:

- The population indiscriminately disposes of its garbage in streets, empty lots, and into drainage structures.
- The population does not relate garbage accumulation to water-related sickness.
- The population burns garbage without knowing the related respiratorial implications.

5.2 RECOMMENDATIONS

Based on the finding of this study the consultants recommend the following:

a. Sensitivity program

The community-wide sensitivity program should cover the impacts of improper collection and treatment of solid waste on:

Health
Drainage infrastructure
Air/Water quality
Quality of life

b. Training programs

Solid Waste Management Workshops should be conducted in the following topics:

Solid Waste Collection
Solid Waste Treatment
Recycling and Re-use of Solid Waste
Sanitary Landfill
Management
Solid Waste Management and its applicability to concrete situations

c. Financial Support

In order to implement the recommended alternative, the municipality will require financial assistance for:

a. Implementation of the recommended pilot program.
b. Implementation of workshops
c. Implementation of sensitivity training programs

Table VI shows the revenues necessary to implement Alternative III with and without financial support.

TABLE V - WORKING CAPITAL WITH FINANCIAL SUPPORT

Description	Year	Year	Year	Year	Year
Population	48400.00	50626.40	52955.21	55391.15	57939.15
Growth	0.046	0.046	0.046	0.046	0.046
# Houses	5377.78	5625.16	5883.91	6154.57	6437.68
Payment per/hou	1825.00	1825.00	10500.00	10500.00	10500.00
Municip'y	10000.00	10000.00			
Tax/Elec+Add Re	3000.00	3138.00			
P/pay	1666.67	1666.67	5295.52	55391.15	57939.15
Paym contrac	3041.67	3041.67	61781.08	64623.01	67595.67
Total Rev	16041.67	16179.67	61781.08	64623.01	67595.67
Expenses	34909.74	34909.74	34909.74	34909.74	34909.74
Profit %	15.00	15.00	15.00	15.00	15.00
Profit	5236.46	5236.46	5236.46	5236.46	5236.46
Total Exp.	40146.20	40146.20	40146.20	40146.20	40146.20
Investment Schedule					
Cash/Deprec.	2276.00	2276.00	2276.00	4540.00	2276.00
Balance	-21828.53	-21690.53	23910.88	29016.81	29725.47
Rehab/Purch			-12800.00		
Sub-Balance	-21828.53	-47448.20	-44878.00	-23939.23	1477.18
Interest 18%	-3929.14	-8540.68	-8078.04	-4309.06	
Working Capital	-25757.67	-55988.88	-52956.04	-28248.29	1477.18

SINFRA - COTE D'IVOIRE

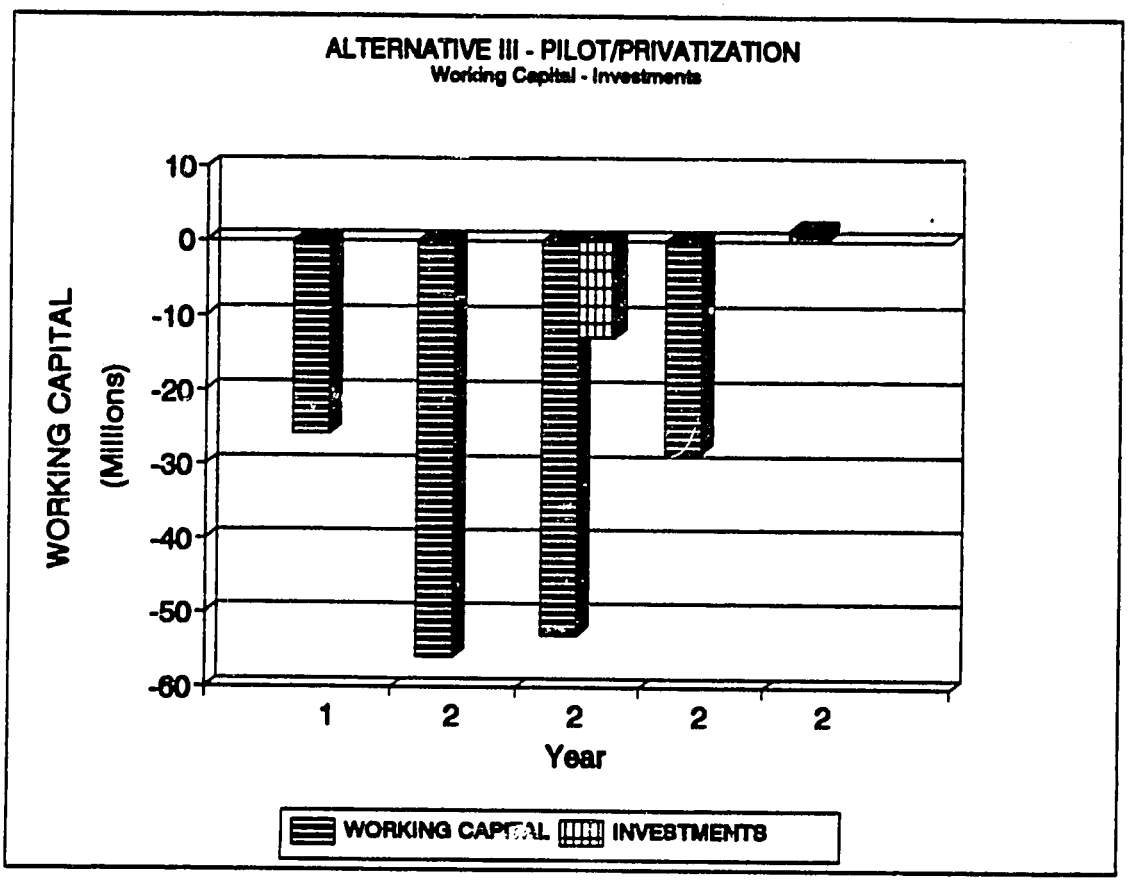

Figure 7 - ALTERNATIVE IV - WITH FINANCIAL SUPPORT

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TABLE VI - ALTERNATIVE III - WITH/WITHOUT FINANCIAL SUPPORT

Description	With Support	Without Support
Financial Support in millions FCFA	12.8	0
Payment for services		
Year 1		
Municipality in millions FCFA	10.0	10.0
Electricity surcharge in millions FCFA	3.0	3.0
Population FCFA/house	3,650	1,825
Year 2		
Municipality in millions FCFA	10.0	10.0
Electricity surcharge in millions FCFA	3.1	3.1
Population FCFA/house	3,650	1,825
Year 3 - Year 5 Payments in FCFA/house	11,150	10,500

APPENDIX - FINANCIAL ANALYSES

Alternative II	A - 1
Alternative III	A - 20

File SWMM-2TF

11-24-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: SINFRA
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

  POPULATION: 48,400

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,840
MOYENNE	60	29,040
BAS	30	14,520

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.39
MOYENNE	0.60	17.42
BAS	0.40	5.81
SOUS-TOTAL		26.62
DIVERS		2.66
TOTAL		29.28

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE #	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1986	22.5	1.1	1	0.50	12.38
CAMION	102	1987	22.5	1.1	1	0.50	12.38
TOTAL							24.75

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

TAUX DE PRODUCTION DE CHAQUE CAMION ESTIME A 75%

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 20.82 Tons

POURCENTAGE DE COLECTE 0.71 %

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE #	MODEL ANNEE	COUTS
CAMION	101	1986	12,900.00
CAMION	102	1987	12,900.00
TOTAL		FCFA	25,800.00
CONTENEURS	1	3.00	3.00
TOTAL		FCFA	25,803.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	552.00
MANOEUVRES	408.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08
ABSENCE	0.12

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1986	0	15	1128	3	2157	3285.19
CAMION	1987	0	15	1128	3	2157	3285.19
TOTAL							6,570.37

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.20
CONTENUERS	0.33

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.100
CONTENEURS	0.050

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.20
CONTENEURS	0.20

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN Rparations
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	5160.00	0.99	5160.99
ENTRETEIN	2580.00	0.99	2580.99
REPARATIONS	5160.00	0.60	5160.60
TOTAL	12900.00	2.58	12902.58

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	18.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
VEH-M # 1	6200.00	1149.71	1240.00	620.00	%1240.00	4,249.71
Moto # 2	300.00	182.66	60.00	30.00	60.00	332.66
TOTAL						4,582.38

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
DIRECT	1100.00	1	0.17	1287.00
ADJOIN	700.00	1	0.08	756.00
MANOE	408.00	4	0.08	1762.56
TOTAL				3805.56

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	3805.56
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.00
TOTAL	3805.56
SOMMAIRE	
SIEGE	0.00
TRANSPORT	4,582.38
SALAIRES	3,805.56
SOUS-TOTAL	8,387.94
ASSURANCE (.01 % SOUSTOTAL)	0.84
UTILITAIRES (.02 % SOUSTOTAL	1.68
TOTAL	8,390.46

1.7 ANALYSE DE LA SITUATION PRESENT

ANNEE 1992

TABLE X SOMMAIRE - ANALISE FINANCIERE 1992

(EN MILLIER FCFA)

DESCRIPTION	COUTS
- COLLECTE	
OPERATION	6,570.37
AMORTISSEMENT	5,160.99
ENTRETIEN	2,580.99
REPARATION	5,160.60
TOTAL	19,472.96
- TRAITEMENT	
DECHARGE	0.00
STATION DE TRANSFERT	0.00
COMPOSTAGE	0.00
- ADMINISTRATION	
ADMINISTRATION	8,390.46
- AUTRES DEPENSES	
AUTRES DEPENSES	0.00
SOUS-TOTAL	27,863.41
DIVERS (10%)	2,786.34
TOTAL	27,873.41

COUT PAR TONNE FCFA 3668.40

* AUTRES DEPENSES

CHAPITRE 2 - PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	12900.00	
CAPACITE - METRE CUBIE	22.50	(4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10	
GASOIL	15.00	LITRES
NOMBRE DE JOURS DE TRAVAIL	307	
AMORTISSEMENT	2580.00	
ENTRETIEN	1290.00	
REPARATION	2580.00	

MAN D'OEUVRE		
CHAUFFEUR	1	
MANOEUVRE	3	
DENSITE DES DECHTES SOLIDES	1.10	
CAPACITE DE COLLECTE		20.82

- CONTENEURS

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	0.990
ENTRETIEN	0.150
Reparation	0.600

- COUTS D'OPERATION

SALAIRES	2156.96
CARBURANT	1128.22

- REMBOURSEMENT 4125.13

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 50,626

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	5.06	3.54
MOYENNE	30.38	18.23
BAS	15.19	6.08
SOUS-TOTAL		27.84
DIVERS		2.78
TOTAL		30.63

- BESOINS DE COLLECTE

PRODUCTION 1993 30.63

Cap. de coll. pres 20.82

- PROJECTIONS POUR NIVEAU DE SERVICE = 80 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 3.69 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 0

CAPACITE DE COLLECTION POUR 1993 20.82

COUT DES VEH. ADDITIONEL	0.00
COUT, VEH. EXISTANT	25,800.00
TOTAL COUT DE COLLECTE	25,800.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENEUEURS= 0

COUTS ADDITIIONEL	0.00
COUTS DES CONTENEURS EXISTANT	3.00
TOTAL COUTS DES CONTENEURS	3.00

TOTAL COUTS DES EQUIP. DE COLLECTE 25,803.00

- REMBOURSEMENT

EQUIPEMENT	0.00	
AMORTISSEMENT VEH.	5,160.00	
AMORTISSEMENT CONTENEURS	0.99	
TOTAL AMORTISSEMENT		5,160.99

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.15
TOTAL ENTRETIEN	2,580.15

- REPARATION

VEHICULES	5,160.00
CONTENEURS	0.60
TOTAL REPARATIONS	5,160.60

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL COUTS D'OPERATION	6,570.37

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.30		3.71	
MOYEN	31.77		19.06	
BAS		15.89		6.35
SOUS-TOTAL				29.13
DIVERS				2.91
TOTAL				32.04

- BESOINS DE COLLECTE

PRODUCTION 1994 32.04

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 4.81 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1994		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	3.00

TOTAL	3.00
TOTAL EQUIPEMENT	25,803.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	0.99
TOTAL	5,160.99

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.15
TOTAL	2,580.15

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.60
TOTAL	5,160.60

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.54		3.88	
MOYEN	33.23		19.94	
BAS		16.62		6.65
SOUS-TOTAL				30.47
DIVERS				3.05
TOTAL				33.51

- BESOINS DE COLLECTE

PRODUCTION 1995 33.51

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 5.99 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1995 20.82
COUT DES VEH. ADDITIONEL 0.00
COUT DES VEH. EXISTANT 25,800.00
Total 25,800.00

- CONTENEUR ADDITIONEL

NOMBRE 0

COUT ADDITIONEL 0.00
COUT CONT. EXISTANT 3.00
TOTAL 3.00

Total EQUIPEMENT 25,803.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	0.99
TOTAL	5,160.99

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.15
TOTAL	2,580.15

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.60
TOTAL	5,160.60

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 57,939

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.79		4.06	
MOYEN	34.76		20.86	
BAS		17.38		6.95
SOUS-TOTAL				31.87
DIVERS				3.19
TOTAL				35.05

- BESOINS DE COLLECTE

PRODUCTION 1996 35.05

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 7.23 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1996 20.82
COUT DES VEH. ADDITIONEL 0.00
COUT DES VEH. EXISTANT 25,800.00
Total 25,800.00

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL 3.00
COUT CONT. EXISTANT 3.00
TOTAL 6.00

Total EQUIPEMENT 25,806.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	1.98
TOTAL	5,161.98

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.30
TOTAL	2,580.30

- REPARATION

VEHICULE	5,160.00
CONTENEURS	1.20
TOTAL	5,161.20

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 60,604

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	6.06		4.24	
MOYEN	36.36		21.82	
BAS		18.18		7.27
SOUS-TOTAL				33.33
DIVERS				3.33
TOTAL				36.67

- BESOINS DE COLLECTE

PRODUCTION 1997 36.67

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 8.52 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1997		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE	1	
COUT ADDITIONEL		3.00
COUT CONT. EXISTANT		3.00
TOTAL		6.00
Total EQUIPEMENT		25,806.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	1.98
TOTAL	5,161.98

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.30
TOTAL	2,580.30

- REPARATION

VEHICULE	5,160.00
CONTENEURS	1.20
TOTAL	5,161.20

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	0.00	0.00	0.00	0.00	0.00
AMORTISSEMENT	5,160.99	5,160.99	5,160.99	5,161.98	5,161.98
ENTRETIEN	2,580.15	2,580.15	2,580.15	2,580.30	2,580.30
REPARATIONS	5,160.60	5,160.60	5,160.60	5,161.20	5,161.20
OPERATION	6,570.37	6,570.37	6,570.37	6,570.37	6,570.37
TOTAL COLLECTE	19,472.11	19,472.11	19,472.11	19,473.86	19,473.86
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	8,390.46	8,390.46	8,390.46	8,390.46	8,390.46
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	0.00	0.00	0.00	0.00	0.00
SOUSTOTAL	27,862.57	27,862.57	27,862.57	27,864.31	27,864.31
DIVERS (15 %)	4,179.39	4,179.39	4,179.39	4,179.65	4,179.65
TOTAL	32,041.96	32,041.96	32,041.96	32,042.22	32,043.96

* AUTRES DEPENSES

File SWMM-2TF

11-24-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: SINFRA
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

  POPULATION: 48,400

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,840
MOYENNE	60	29,040
BAS	30	14,520

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.39
MOYENNE	0.60	17.42
BAS	0.40	5.81
SOUS-TOTAL		26.62
DIVERS		2.66
TOTAL		29.28

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE #	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1993	22.5	1.1	1	0.50	12.38
TRACTR	102	1993	20.0	1.1	1	0.50	11.00
TOTAL							23.38

CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

TAUX DE PRODUCTION DE CHAQUE CAMION ESTIME A 75%

OMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

') 307 JOURS/365JOURS=) 19.66 Tons

URCENTAGE DE COLECTE 100%

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE #	MODEL ANNEE	COUTS
CAMION	101	1993	12,900.00
TRACTR	102	1993	6,300.00
TOTAL		FCFA	19,200.00
CONTENEURS	2	1800.00	3600.00
TOTAL		FCFA	22,800.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	573.30
MANOEUVRES	420.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08

ABSENCE	0.08

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1993	0	15	1128	3	2154	3282.66
TRACTR	1993	0	15	1128	2	1661	2789.09
TOTAL							6,071.76

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.10
CONTENUERS	0.07

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.200
CONTENEURS	0.200

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.10
CONTENEURS	0.10

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN Rparations
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	1920.00	237.60	2157.60
ENTRETEIN	3840.00	237.60	4077.60
REPARATIONS	1920.00	360.00	2280.00
TOTAL	7680.00	835.20	8515.20

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	1.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
Car-m # 201	9000.00	1149.71	900.00	1800.00	900.00	4,749.71
Mot-a # 202	600.00	182.66	60.00	120.00	60.00	422.66
TOTAL						5,172.38

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
Assist	573.00	1	0.08	620.56
TOTAL				620.56

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	620.56
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.22
TOTAL	620.78
SOMMAIRE	
SIEGE	0.00
TRANSPORT	5,172.38
SALAIRES	620.78
SOUS-TOTAL	5,793.16
ASSURANCE (.03 % SOUSTOTAL)	1.74
UTILITAIRES (.01 % SOUSTOTAL	0.58
TOTAL	5,795.47

- COLLECTE

PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	18000.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	1800.00
ENTRETIEN	3600.00
REPARATION	1800.00

MAN D'OEUVRE

CHAUFFEUR	1
MANOEUVRE	3

DENSITE DES DECHTES SOLIDES 0.50

CAPACITE DE COLLECTE 9.46

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	118.800
ENTRETIEN	360.000
Reparation	180.000

- COUTS D'OPERATION

SALAIRES	2154.44
CARBURANT	1128.22

- REMBOURSEMENT 4148.48

9D

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 50,626

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	5.06	3.54
MOYENNE	30.38	18.23
BAS	15.19	6.08
SOUS-TOTAL		27.84
DIVERS		2.78
TOTAL		30.63

- BESOINS DE COLLECTE

PRODUCTION 1993 30.63

Cap. de coll. pres 19.66

- PROJECTIONS POUR NIVEAU DE SERVICE = 97 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 10.05 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 1

CAPACITE DE COLLECTION POUR 1993 29.12

COUT DES VEH. ADDITIONEL	18,000.00
COUT, VEH. EXISTANT	19,200.00
TOTAL COUT DE COLLECTE	37,200.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 1

COUTS ADDITIONEL	1,800.00
COUTS DES CONTENEURS EXISTANT	3,600.00
TOTAL COUTS DES CONTENEURS	5,400.00
TOTAL COUTS DES EQUIP. DE COLLECTE	42,600.00

REMBOURSEMENT		
EQUIPEMENT	4,148.48	
AMORTISSEMENT VEH.	1,920.00	
AMORTISSEMENT CONTENEURS	356.40	
TOTAL AMORTISSEMENT		2,276.40
ENTRETIEN - EQUIPEMENT		
VEHICULES	7,440.00	
CONTENEURS	1,080.00	
TOTAL ENTRETIEN	8,520.00	
REPARATION		
VEHICULES	3,720.00	
CONTENEURS	540.00	
TOTAL REPARATIONS	4,260.00	
COUTS D'OPERATION		
EQUIP. EXISTANT	6,071.76	
SALAIRES	2,154.44	
CARBURANT	1,128.22	
TOTAL COUTS D'OPERATION	9,354.42	

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENU
TABLE XII - PROJECTIONS 1994

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.30		3.71	
MOYEN	31.77		19.06	
BAS		15.89		6.35
SOUS-TOTAL				29.13
DIVERS				2.91
TOTAL				32.04

BESOINS DE COLLECTE

PRODUCTION 1994 32.04

CAPACITE DE COLLECTE 19.66

PROJECTION POUR NIVEAU DE SERVICE= 97

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 11.42 tons

VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 1

CAPACITE DE COLLECTE POUR 1994 29.12
COUT DES VEH. ADDITIONEL 18,000.00
COUT DES VEH. EXISTANT 19,200.00
Total 37,200.00

CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL 1,800.00
COUT CONT. EXISTANT 3,600.00
TOTAL 5,400.00

TOTAL EQUIPEMENT 42,600.00

REMBOURSEMENT

EQUIPEMENT	4,148.48
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40

ENTRETIEN - EQUIPEMENT

VEHICULES	7,440.00
CONTENEURS	1,080.00
TOTAL	8,520.00

REPARATION

VEHICULE	3,720.00
CONTENEURS	540.00
TOTAL	4,260.00

COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	2,154.44
CARBURANT	1,128.22
TOTAL D'OPERATION	9,354.42

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 57,939

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.79		4.06	
MOYEN	34.76		20.86	
BAS		17.38		6.95
SOUS-TOTAL				31.87
DIVERS				3.19
TOTAL				35.05

- BESOINS DE COLLECTE

PRODUCTION 1996 35.05

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 14.34 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 2

CAPACITE DE COLLECTE POUR 1996		38.59
COUT DES VEH. ADDITIONEL	36,000.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	55,200.00	

- CONTENEUR ADDITIONEL

NOMBRE	1	
COUT ADDITIONEL		1,800.00
COUT CONT. EXISTANT		3,600.00
TOTAL		5,400.00
Total EQUIPEMENT		60,600.00

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.54		3.88	
MOYEN	33.23		19.94	
BAS		16.62		6.65
SOUS-TOTAL				30.47
DIVERS				3.05
TOTAL				33.51

- BESOINS DE COLLECTE

PRODUCTION 1995 33.51

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 12.85 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 1

CAPACITE DE COLLECTE POUR 1995 29.12
COUT DES VEH. ADDITIONEL 18,000.00
COUT DES VEH. EXISTANT 19,200.00
Total 37,200.00

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL 1,800.00
COUT CONT. EXISTANT 3,600.00
TOTAL 5,400.00

Total EQUIPEMENT 42,600.00

REMBOURSEMENT	
EQUIPEMENT	4,148.48
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40
ENTRETIEN - EQUIPEMENT	
VEHICULES	7,440.00
CONTENEURS	1,080.00
TOTAL	8,520.00
REPARATION	
VEHICULE	3,720.00
CONTENEURS	540.00
TOTAL	4,260.00
COUTS D'OPERATION	
EQUIP. EXISTANT	6,071.76
SALAIRES	2,154.44
CARBURANT	1,128.22
TOTAL D'OPERATION	9,354.42

- REMBOURSEMENT

EQUIPEMENT	8,296.97
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40

- ENTRETIEN - EQUIPEMENT

VEHICULES	11,040.00
CONTENEURS	1,080.00
TOTAL	12,120.00

- REPARATION

VEHICULE	5,520.00
CONTENEURS	540.00
TOTAL	6,060.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	4,308.88
CARBURANT	2,256.45
TOTAL D'OPERATION	12,637.08

98

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 60,604

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	6.06		4.24	
MOYEN	36.36		21.82	
BAS		18.18		7.27
SOUS-TOTAL				33.33
DIVERS				3.33
TOTAL				36.67

- BESOINS DE COLLECTE

PRODUCTION 1997 36.67

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 15.91 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 2

CAPACITE DE COLLECTE POUR 1997		38.59
COUT DES VEH. ADDITIONEL	36,000.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	55,200.00	

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL	1,800.00
COUT CONT. EXISTANT	3,600.00
TOTAL	5,400.00
Total EQUIPEMENT	60,600.00

REMBOURSEMENT	
EQUIPEMENT	8,296.97
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40
ENTRETIEN - EQUIPEMENT	
VEHICULES	11,040.00
CONTENEURS	1,080.00
TOTAL	12,120.00
REPARATION	
VEHICULE	5,520.00
CONTENEURS	540.00
TOTAL	6,060.00
COUTS D'OPERATION	
EQUIP. EXISTANT	6,071.76
SALAIRES	4,308.88
CARBURANT	2,256.45
TOTAL D'OPERATION	12,637.08

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	4,148.48	4,148.48	4,148.48	8,296.97	8,296.97
AMORTISSEMENT	2,276.40	2,276.40	2,276.40	2,276.40	2,276.40
ENTRETIEN	8,520.00	8,520.00	8,520.00	12,120.00	12,120.00
REPARATIONS	4,260.00	4,260.00	4,260.00	6,060.00	6,060.00
OPERATION	9,354.42	9,354.42	9,354.42	12,637.08	12,637.08
TOTAL COLLECTE	24,410.82	24,410.82	24,410.82	33,093.48	33,093.48
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	5,795.47	5,795.47	5,795.47	5,795.47	5,795.47
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	150.00	150.00	150.00	150.00	150.00
SOUSTOTAL	30,356.29	30,356.29	30,356.29	39,038.96	39,038.96
DIVERS (15 %)	4,553.44	4,553.44	4,553.44	5,855.84	5,855.84
TOTAL	34,909.74	34,909.74	34,909.74	36,212.14	44,894.80

* AUTRES DEPENSES

Education	100,000 FCFA
Decharge	50,000 FCFA

REDSO/PMO/UD

MUNICIPAL DEVELOPMENT SUPPORT PROJECT
681-0004

PRIVATE PROVISION OS SOCIAL SERVICES (PPSS)
PDC-1008-C-00-9091-00

SOLID WASTE STUDY

for

SINFRA AND TIASSALE, COTE D'IVOIRE

SINFRA

VOLUME 2 OF 3

by
Jean Tchimon Assemian
and
Mito Bessalel, PE
Consultants

ICMA
Washington, DC
USA

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I EXISTING CONDITIONS

1.1. BACKGROUND

The commune of Sinfra is located in the Central/Western part of the Ivory Coast, approximately 100 km West of Yamoussoukro. The city has developed at the intersection of three major roads: Yamoussoukro-Issia, Daloa-Oume, and Gagnoa-Bouafle. (See Figure I)

Sinfra is a commune essentially agricutural with strong immigration of ivorians (Baoule, Senoufo) and non-ivorian (Nigerien, Mauritanians, Malians and Burkinians)

Area

Area of the Commune	16,700	ha
Area of Sinfra	440	ha
Percentage of urban/commune	2.63	%
Property division	485	ha.

Population

1988	40,430
1992	48,400

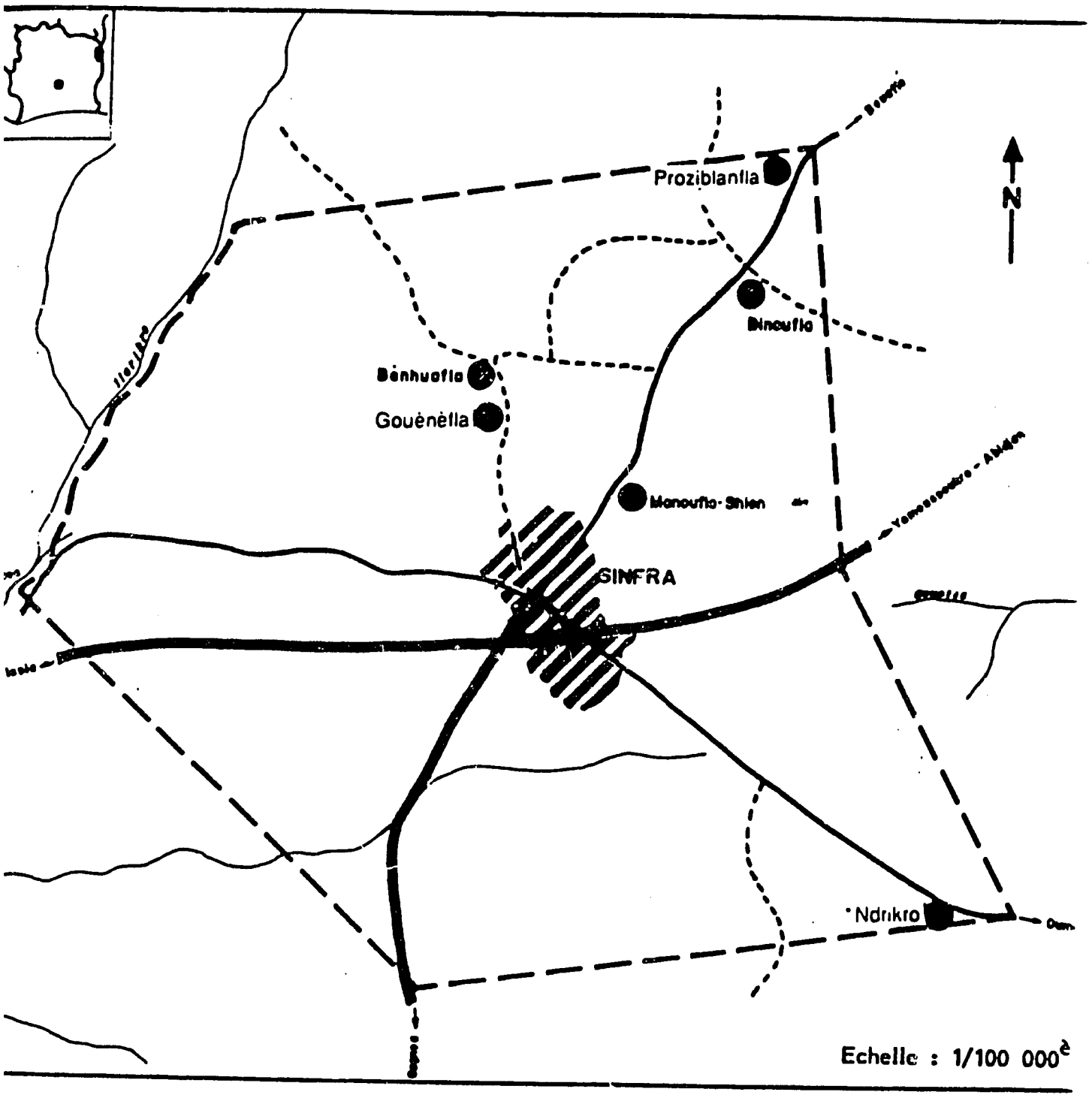
Population Growth 4.6%

The Commune encompasses Sinfra and six villages:

City	Population (1988)	Population (1992)
Benhaufla	2299	2752
Binoufla	1097	1313
Gouenefla	1661	1988
Manoufla Shien	284	340
Ndrikro	763	913
Proziblanfla	1118	1338

At the present growth rate the projected population for five years is indicated below.

Year	Population
1992	48400
1993	50626
1994	52955
1995	55391
1996	57939
1997	60604



LEGENDE

- Limite de terroire communal
- Route goudronnée
- Route en terre
- Rivière
- Espace urbanisé
- Village rattaché à la commune

FIGURE 1 - MUNICIPALITY OF SINFRA

Density

Sinfra has a density of 77 person/ha

Topography

The topography is basically flat, surrounded by secondary forest. The forest is exploited for agriculture purposes.

Weather

The area is characterized by two rainy seasons, a major season covering April to mid-July and a minor season which begins mid September and ends mid-November.

Type of Residences:

There are two types of residences:

a. Medium Level

Medium level residences are located in the residential area where revenues are high.

b. Low Level

Low level residencies are located in poor areas. The sanitary facilities are located outside the houses and generally are not well maintained.

1.2 ECONOMIC RESOURCES

The majority of employment is generated by the agricultural sector, with cocoa and coffee production. Corn, gnames, and manioc are also commercially produced.

At present economic problems are due to low prices of coffee and cocoa in the world market and because the the area has been affected by long dry periods.

1.2.1 Agricultural Activities

The agriculture production for 1991 was as follows:

Coffee:	5,000
Cocoa:	28,812
Rice:	7,500
Corn:	3,000

1.2.2 Industrial Activities

Wood Products

This is the only industrial activity. This activity started in 1991, with a production of 6,000 m^3/y.

1.3 INFRASTRUCTURE

Other than the three downtown sections of major roads, few of the streets in town are paved or lined with gutters.

In addition to the two markets, there are three bus/taxi stations, a hospital with two doctors and a dentist, two secondary schools and slaughter facilities. Running water and 24 hour electricity are available in most neighborhoods, with access dependent on ability to pay.

1.4 MANAGEMENT

The city is managed by the Mayor, Mr. Diop Adama, an engineer based in Abidjan. (Figure 2 shows the management organization of the city)

The Technical Department is run by Mr. Adu Kanga. His major responsibilities include the supervision of collection and discharge of solid waste, maintenance and reparation of road and drainage structures.

1.5 PROJECT-RELATED CONDITIONS

5.1 Erosion and Stagnation

Erosion is a significant concern in sloping residential areas, where a majority of roads are impassable and houses are crumbling at their foundations. While many of these neighborhood have attempted to channel water to downhill areas, the ditches are insufficient and poorly maintained (See picture 1). Flat areas are noticeable for the presence of stagnat water (See pictures 2)

1.5.2 Washwater

Washwater from daily usage is routinely discarded in the streets and between houses. these exacerbates the stagnation and poses a threar of contamination to local wells.

1.5.3 Wastewater

Wells are prevalent and subject to contamination by the proliferation of uncontained latrines. The tendency of these

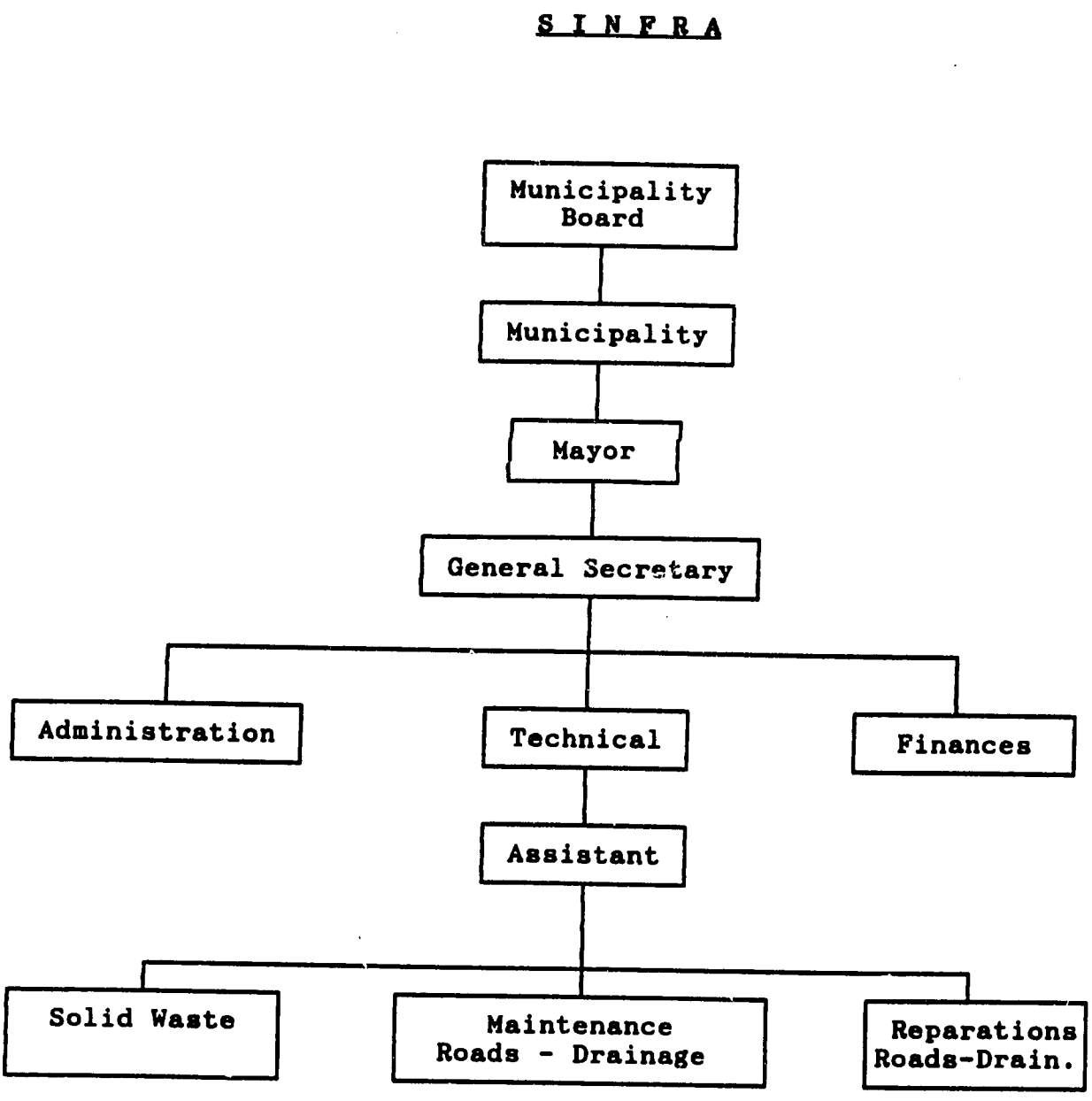
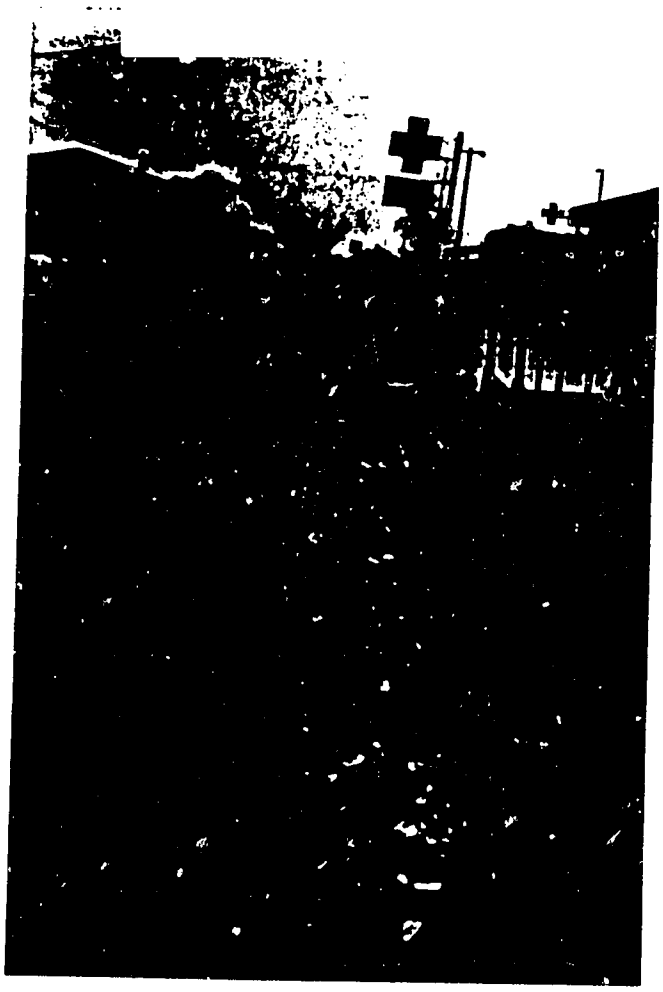


FIGURE 2 - ORGANIZATION CHART



PICTURE 1 - Garbage Accumulation

PICTURE 2 - Stagnant Wastewater

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latrines to flood during heavy rainfall is similarly problematic. An additional problem is posed by the wide spread practice of urinating at roadside or at the side of buildings.

1.5.4 Solid Waste

Solid waste is a major problem for the city. The main areas where the garbage remain uncollected are the Houphouet Boigny and the Deaulabougou neighborhoods. Huge piles of garbage on the streets and empty lots are not merely unsightly and malodorous but also a health hazard (see picture 3)

The collection system has deteriorated progressively for lack of equipment maintenance and repair, poor conditions of the streets, traffic congestions, and indiscriminate discharges.

Waste is disposed in an assigned area located approximately 2.5 kilometers from downtown. The waste is dumped with no treatment.

The Technical Department operates two collection trucks daily with three workers and a driver each (presently due to economic reasons only a driver and 2 workers). Trucks follows regular circuits through both commercial and residential areas. Trash is collected only twice a week*. (See picture 4)

Early 1992 a landfill was built but was not opened due to lack of equipment. The disposal capacity was estimated at 15.000 m3.

1.6 IMPACT ON HUMAN HEALTH

1.6.1 General

Under worm, moist conditions, organic waste become ideal breeding places for disease-causing organisms. Pathogens, have easy access to the waste via vectors. With solid waste, the primary vectors are flies, rodents and mosquitoes. The generation of harmful organisms and their transmission is not the only health hazardous. Many potentially unhealthy materials, such as solvents and pesticides containers, medical waste.

The source of potential health hazardous conditions could be identify in:

- First most municipal refuse contains human faecal matter and industrial waste

- Second the decomposition of organic material can release contaminants into drainage, seepage and atmospheric emissions. The principal course for these contaminants would be leachate into ground water and surface waters.

- Third, the open burning of waste in the dumps and accumulate

PICTURE 3 - Unhealthy Environment

PICTURE 4 - Collecting Equipment

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piles of garbage in empty lots and streets creates extensive pollution.

1.6.2 Identification of Major Diseases

According with the statistic obtain in the Sinfra hospital the major sold waste-wastewater related sickness were:

- Enteric Diseases primary diarrheas

  Prevalent develop in environment were there is lax of hygiene habits and expose to contaminate sources of food and drink.

- Malaria

  Water accumulated in ditches, broken pipes are breeding places for mosquitoes in urban areas. Malaria is transmitted through a bite of an infected (female) anopheles mosquito.

- Respiratory

  Generation of harmful smoke from burning garbage and dust during dry seasons are some of the causes of respiratory diseases

1.7 DEFINITION OF BASIC PARAMETERS

1.7.1 General

The parameters shown below were used for the development of a five year financial analysis.

a. Population for year 1992 48,400

b. Population growth: 4.6%

c. Waste Generation Rates

The estimation of waste generation rate is difficult since there is no available data concerning solid waste production. It is not only difficult to collect accurate data, but also to quantify the amount to be collected.

---

* During our visit only one truck was in working condition. The second truck required major repair work. We were informed that it was not possible to repair it due to lack funds.

The coefficient used for the estimation of solid waste production are the following:

- high income	0.70 kgr/pers
- medium income	0.60 kgr/pers
- Low income	0.40 Kgr/pers
- Miscellaneous	10 % of total

d. Density, Composition, and Moisture

Density, composition and moisture the main parameters used for the estimation of the garbage collection and treatment. Density is especially important for the design of the required collection system, and waste treatment. Waste density varies from area to area in the city.

In wealthy neighborhoods density tends to be low and garbage tends to have a high percentage of non-putrescible materials such as paper, plastics, glass, and metals. The garbage composition in lower-income areas is mostly organic, with natural compactation. Density used for the calculation of the volume to be transported was 0.50.

The following lists ranges of municipal refusal composition for low income communities (% of weight)*

Paper	1 to 10
Class, ceramics	1 to 10
Metals	1 to 5
Plastics	1 to 5
Leather, rubber	1 to 5
Wood, Bones, Straw	1 to 5
Textiles	1 to 5
Vegetable/Putrescible	40 to 85

1.7.2 Solid Waste Production and Collection Costs

Collection and disposal were calculated using a solid waste management model written in Quick Basic. A sample of typical runs are included in Annex A.

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* Source: Environmental Management of Urban Solid Waste in Developing Countries - By Sandra J. Cointreau

II. IMPACT OF INADEQUATE WASTE COLLECTION ON THE ENVIRONMENT

2.1. GENERAL

The conditions observed during the field reconnaissance in Sinfra were deplorable. Piles of solid waste have been accumulated in almost every empty space, on the streets, and intersections, affecting other sectors of the city's infrastructure and the health of the population, and breading widespread apathy.

2.2 IMPACT ON THE CITY INFRASTRUCTURE

The trash discharged in the streets is carried into the drainage system, clogging pipes and ditches and forcing water to find its way down the streets until it reaches flat areas where it stagnates. In some locations, after a heavy rain, accumulation of mad, sludge, and garbage is not unusual.

2.3 IMPACTS ON THE HEALTH OF THE POPULATION

2.3.1 Garbage Accumulation

In addition to the solid waste indiscriminately discharged, the collected garbage is dumped untreated in open land in areas outside the limits of the city. During the rainy season, these accumulations became an ideal breeding places for decease producing organisms. During the dry season the generate contaminated dust that blows over the city is also a source of respiratory deceases.

During our visit to Sinfra hospital, according with the chief doctor the three major sickness treated in the hospital are: malaria, diarrhea and bronchitis. This conditions is very important because in Sinfra the main source of larvae breading is stagnant water.

source of potential health hazardous conditions could be identify in:

- Refuse contains organinc, human faecal matter and industrial waste

- Refuse decomposition can release contaminants into drainage, seepage and atmospheric emissions. The principal course for these contaminants would be leachate into ground water and surface waters.

- Refuse open burning of waste in empty lots and streets creates extensive pollution.

2.3.2 Identification of Major Diseases

According with the statistic obtaind in the Hospital of Sinfra the major solid waste-wastewater related sickness were:

- Enteric Diseases Primary Diarrheas

  Prevalent develop in environment were there is lax of hygiene habits and expose to contaminate sources of food and drink.

- Malaria

  Water accumulated in ditches, broken pipes are breeding places for mosquitoes in urban areas. Malaria is transmitted through a bite of an infected (female) anopheles mosquito.

- Respiratory Disease

  Generation of harmful smoke from burning garbage and dust during dry seasons are some of the causes of respiratory diseases

2.4 AIR POLLUTION

The industrial activities in Sinfra ~~and Tiassalé~~ ~~have~~ has no impact on air quality. However, lack of maintenance of the unpaved roads are responsible for concentration of dust. In Sinfra this situation is aggravated by the presence of piles of garbage (see Picture 1). Some waste is burned in the open to reduce the volume, control odors (See Picture 3). Open burning decreases air quality. The low temperature and the open burning increase the emission of particles, carbon monoxide, and hydrocarbons. Some of emissions factor associates with open burning are:

Particles	8.0 kgr. per ton.
Sulfur oxide	0.5 kgr. per ton.
Carbon monoxide	42.0 kgr. per ton.
Nitrogen oxides	3.0 kgr. per ton.

Picture 5 - Piles of Garbage

Picture 6 - ~~Garbage is burned in the open~~
Air Contamination

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III - SURVEY APPROACH

2.1 GENERAL

Several groups have roles of varying significance in the production of solid waste. There are three groups of waste producers - household, commercial and industrial.

2.1.1 Households Sampling

Most emphasis was placed on this group presumed to be the biggest producer of waste and also the most unknown in terms of production and disposal habits. A questionnaire was used to identify some of the basic parameters to be used for the elaboration of the alternatives for the solid waste collection*

The questionnaire asked questions related to waste production, quality of service, and willingness to pay for solid waste collection (Sample of questionnaire in Annex B). A total ten household questionnaires were completed by the Service Technical of Sinfra.

2.1.2 Commercial and Industrial

No survey was performed for the commercial and industrial sector, because the incidence in the overall solid waste production was estimated to be minor.

3.2 SURVEY OUTCOME

The key findings of the survey are outline below:

a. Number of people per house:

10 or more	70 %
7-9	10 %
4-6	20 %

For the purpose of the study the ratio used was use nine person/house

b. Disposal of Organic Material

60 % of residents dispose organic material

---

* The questionnaire used for the households survey was adopted from a questionnaire used by WASH (Water and Sanitation for Health Project (WASH) for the Solid Waste Management of Port-au Prince.

c. Type of Non-Organic Material

Plastics	70%
Cartons	40%
Metal	70%

d. Purchase of recycled waste

No positive response to this question

e. Location of Garbage disposade

In front of my house	50%
At a collection point	10%
In a ditch	10%
In an empty lot	10%
Burned	20%

f. Responsibilities for Garbage Collection

Municipality	40%
Private *	40%
do not know	20%

* 50 % Will not pay for service

g. Willingness for Payment of Collection Service

1000 FCFA/w	0%
500 FCFA/w	10%
200 FCFA/w	10%

IV ALTERNATIVES AND RECOMMENDED SOLUTIONS

4.1 GENERAL

Collection and treatment of the solid waste has deteriorated through years. The most important reason is that no investment was made for replacement and reparation of existing equipment. The present collection level of service was estimated at 50%.

4.2 PRESENT COLLECTION CAPABILITY

- Equipment

Two truck models 1986 and 1897 with a capacity of 5 m^3 each. Trucks collect garbage 6 days a weeks. The daily collection capacity was estimated at 22.5 m^3 (4.5 trips each day). It was estimated 50% of the time trucks were broken.

- Collection Personnel

Each truck is operated by a driver and three laborers.

- Operation Costs

The table I indicated shows the actual expenditures* and the estimated operated cost necessary to maintain the same level of service FOR 1991.
for

TABLE I - PRESENT EXPENDITURE AND ESTIMATED OPERATING COSTS in FCFA

Description	Expended	Required	Addt'l Expenditures
Diesel	1,999,935	2,438,000	428,065
Salary	5,658,114	5,658,114	-
Repairs and Maintenance	3,478,167	~~10,440,000~~ 7,740.000	~~6,961,833~~ 4,261,833
Depreciation	-	-	-
Total	11,362,216	~~18,561,114~~	~~7,389,898~~

The following can be concluded:

- Depreciation was not estimated
- Maintenance and repairs were reduced to almost half of the amount estimated.

To maintain the present level of service it will be required to allocate an additional 7,4 millions FCFA

---

* Data provided by the Finances Department

4.2 ALTERNATIVE SOLUTIONS

4.3 Three alternatives were study

4.3.1 ALTERNATIVE I - MINIMUM INVESTMENT

This alternative proposes

- The Solid Waste Management remains as the municipality responsibilities.
- Rehabilitation of equipment

4.3.1.1 Assumptions

- Increase electricity surcharge from 1 FCFA/kw-h to 4.4 FCFA/kw-h
- Repair collecting equipment, estimated cost 2.9 million FCFA
- Purchase and rehabilitation of equipment as follows: (see Table III and Figure 3)

  Year 1 - Rehabilitation of trucks, estimated cost 2.9 millions FCFA

  Year 4 - 1 Tractor and 2 containers on wheels estimated cost 9.9 millions FCFA

  Year 5 - 1 Truck with a capacity of 5m3 (Approx 3 Ton.) estimated cost 12.9 million FCFA

- Additional charges on electricity bills are:

  Year 1 - 10,200,000 FCFA
  Year 2 - 10,669,200 FCFA
  Year 3 - 11,159,980 FCFA
  Year 4 - 11,673,340 FCFA
  Year 5 - 12,210,320 FCFA

4.3.1.2 Major Constraints

Major constraints of these alternative are:

- Increase electricity surcharge
- Only electricity users pay for services of collection and treatment of solid waste
- Level of production of the waste collectors
- Disposal habit of the population.
- Repair and maintenance capability of the municipality

4.3.2 ALTERNATIVE II - PRIVATIZATION OF THE SWM

Alternative II proposes the rehabilitation of the existent equipment, and purchase of new equipment as required(see Table IV and Figure 4).

The financial analysis was calculated using a charge of 6,750 FCFA per house (estimated 7 person/house)

4.3.2.1 Assumptions

- Repair collecting equipment, estimated cost 2.9 million FCFA
- Purchase and rehabilitation equipment as follows: (see Table III and Figure 3)

Year 1 - Rehabilitation of trucks, estimated cost 2.9 millions FCFA
- 1 Tractor and 2 containers on wheels estimated cost 9.9 millions FCFA

Year 3 - 1 Truck with a capacity of 5m3 (Approx 3 Ton.) estimated cost 12.9 million FCFA

4.3.2.2 Major Constraints

Mayor constraints of this alternative are:

- The population is not prepared to pay for the collection of the solid waste

- Disposal habits of the population

4.3.3 <u>ALTERNATIVE III PILOT PROGRAM</u>

This alternative proposes the rehabilitation of existing equipment and the purchase of tractor two containers and a truck with a capacity of 5 m^3.

This solution should be implemented in two phases

- Phase I Implementation of two years pilot program

The Houphouet Bogny with an estimated population of 15,000 people was selected as the area for the development of the pilot program (See figure 5).

- Phase II Implementation of privatization of the solid waste management of Sinfra.

4.3.3.1. Assumptions:

a. Estimated Revenues

- Year 1 Charges to the population 7300 FCFA/year/house
Electricity surcharges 3.0 millions FCFA
Municipality contribution estimated 10 millions FCFA

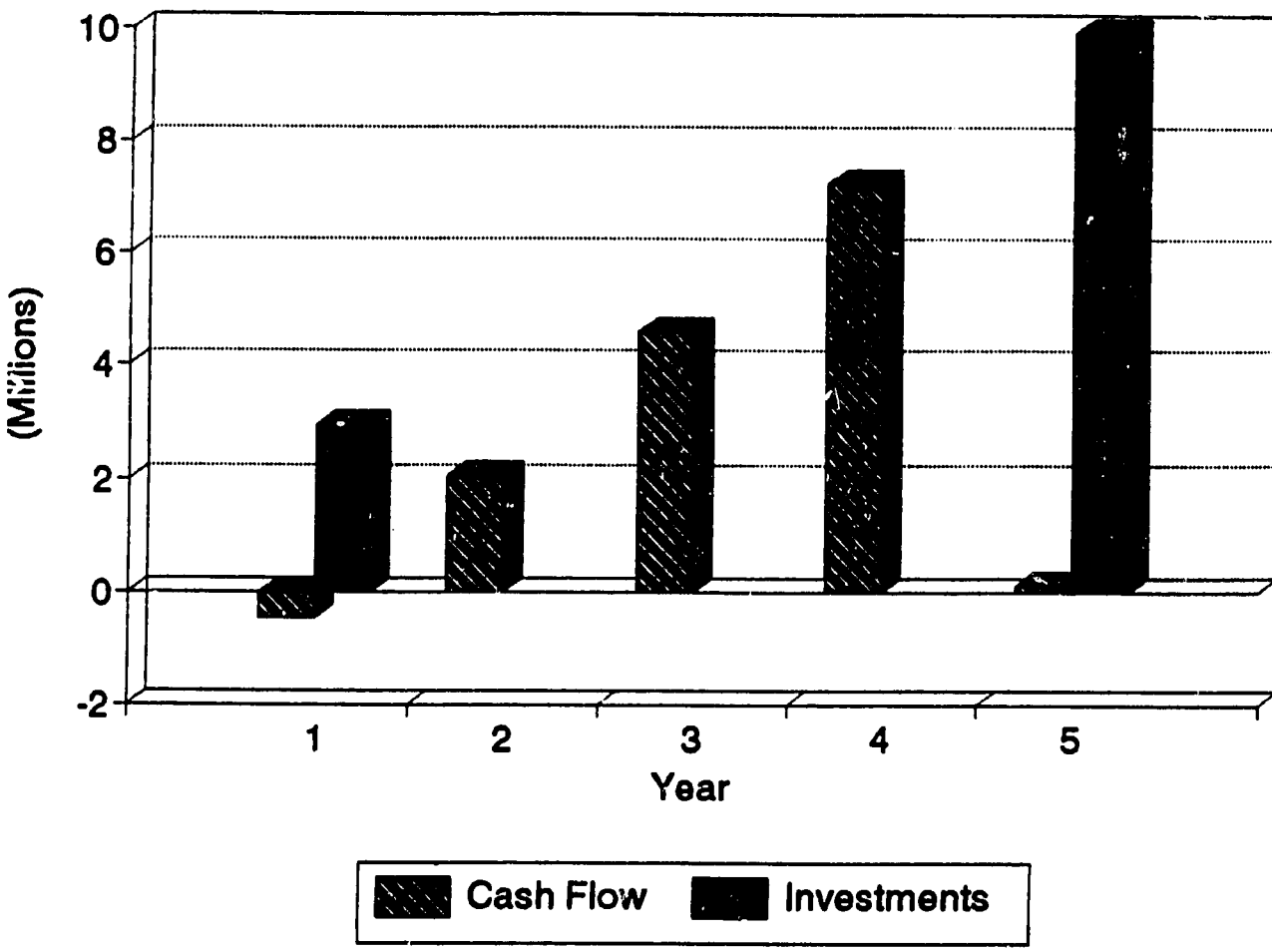
ALTERNATIVE I - MINIMUM INVESTMENT

TABLE II - CASH FLOW - PRESENT RESOURCES

Description	Year	Year	Year	Year	Year
Population	48400.00	50626.40	52955.21	55391.15	57939.15
Growth	0.046	0.046	0.046	0.046	0.046
# Houses	5377.78	5625.16	5883.91	6154.57	6437.68
Revenues					
Municip'y	10000.00	10000.00	10000.00	10000.00	10000.00
Tax/Elec	3000.00	3138.00	3282.35	3433.34	3591.27
Addit Rev	10200.00	10669.20	11159.98	11673.34	12210.32
Total Rev	23200.00	23807.20	24442.33	25106.68	25801.59
Expenses					
Present	20733.00	21308.00	21881.00	22456.00	23031.00
Reparation	2937.00				9900.00
Total	23670.00	21308.00	21881.00	22456.00	32931.00
Balance	-470.00	2499.20	2561.33	2650.68	-7129.41
Cash	-470.00	2029.20	4590.53	7241.21	111.80
Addit rev/kw	3.40	3.40	3.40	3.40	3.40

SINFRA - COTE D'IVOIRE

ALTERNATIVE I - MINIMUM INVESTMENT
TABLE II - CASH FLOW - INVESTMENT



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LTERNATIVE II - SOLID WASTE MANAGEMENT - PRIVATIZATION

TABLE III - CASH FLOW AND INVESTMENT SCHEDULE

:scription	Year 1	Year 2	Year 3	Year 4	Year 5
›pulation	48400.00	50626.40	52955.21	55391.15	57939.15
:owth	0.046	0.046	0.046	0.046	0.046
‡ Houses	5377.78	5625.16	5883.91	6154.57	6437.68
:v/House	6750.00	6750.00	6750.00	6750.00	6750.00
›tal Rev	36300.00	37969.80	39716.41	41543.37	43454.36
:penses	32042.00	32042.00	32042.00	32042.00	32043.00
ofit 15%	15.00	15.00	15.00	15.00	15.00
tal	36848.30	36848.30	36848.30	36848.30	36849.45
preciation	580.00	2480.00	5040.00	5040.00	5040.00
lance	31.70	3601.50	7908.11	9735.07	11644.91
vestment Schedule	2900.00	9900.00	12800.00		
sh	-2868.30	-9683.09	-16317.94	-9520.10	411.19
terest 18%	-516.29	-1742.96	-2937.23	-1713.62	74.01
rking Capital	-3384.59	-11426.05	-19255.17	-11233.72	485.20

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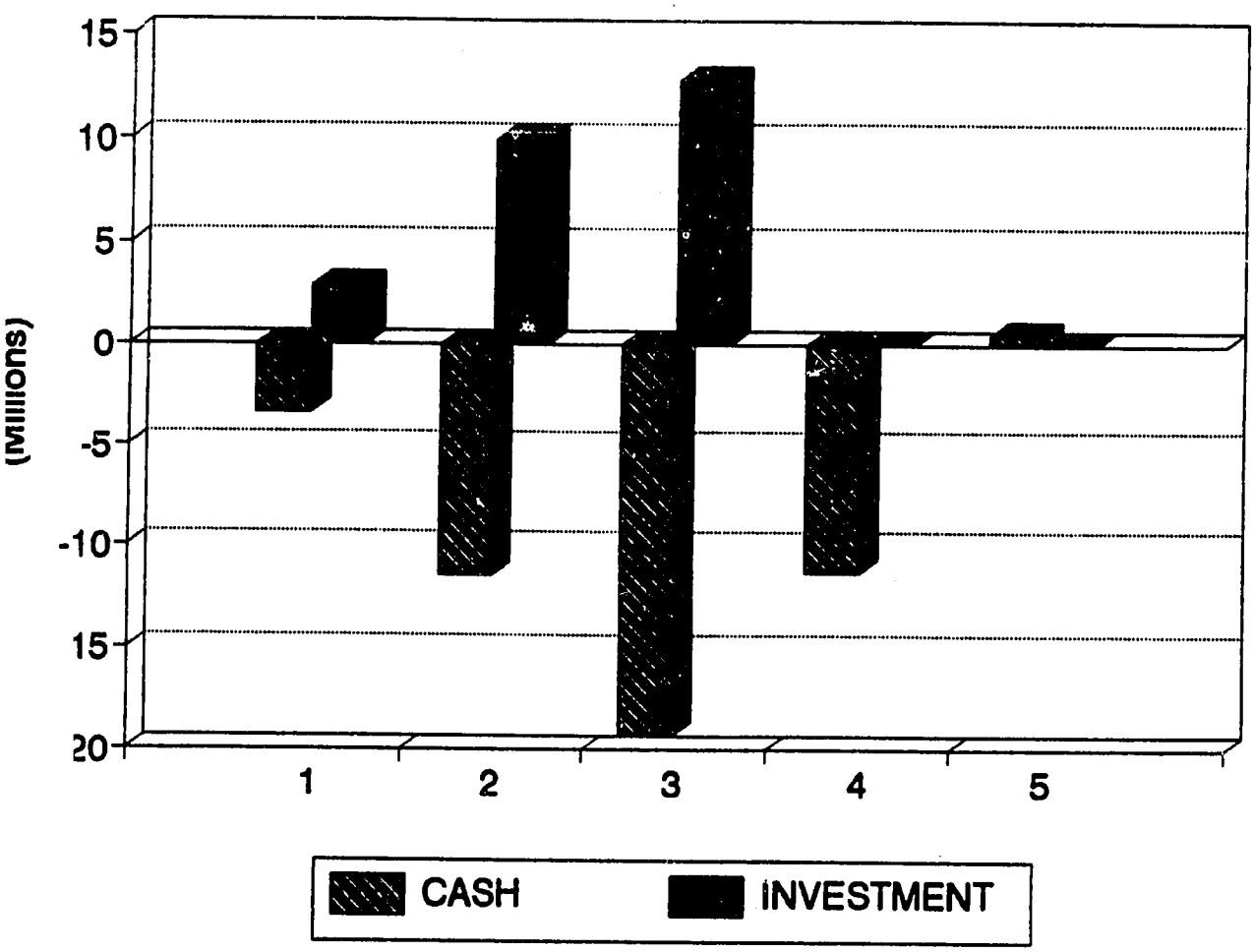
ALTERNATIVE II - SWM PRIVATIZATION
CASH - INVESTMENT SCHEDULE



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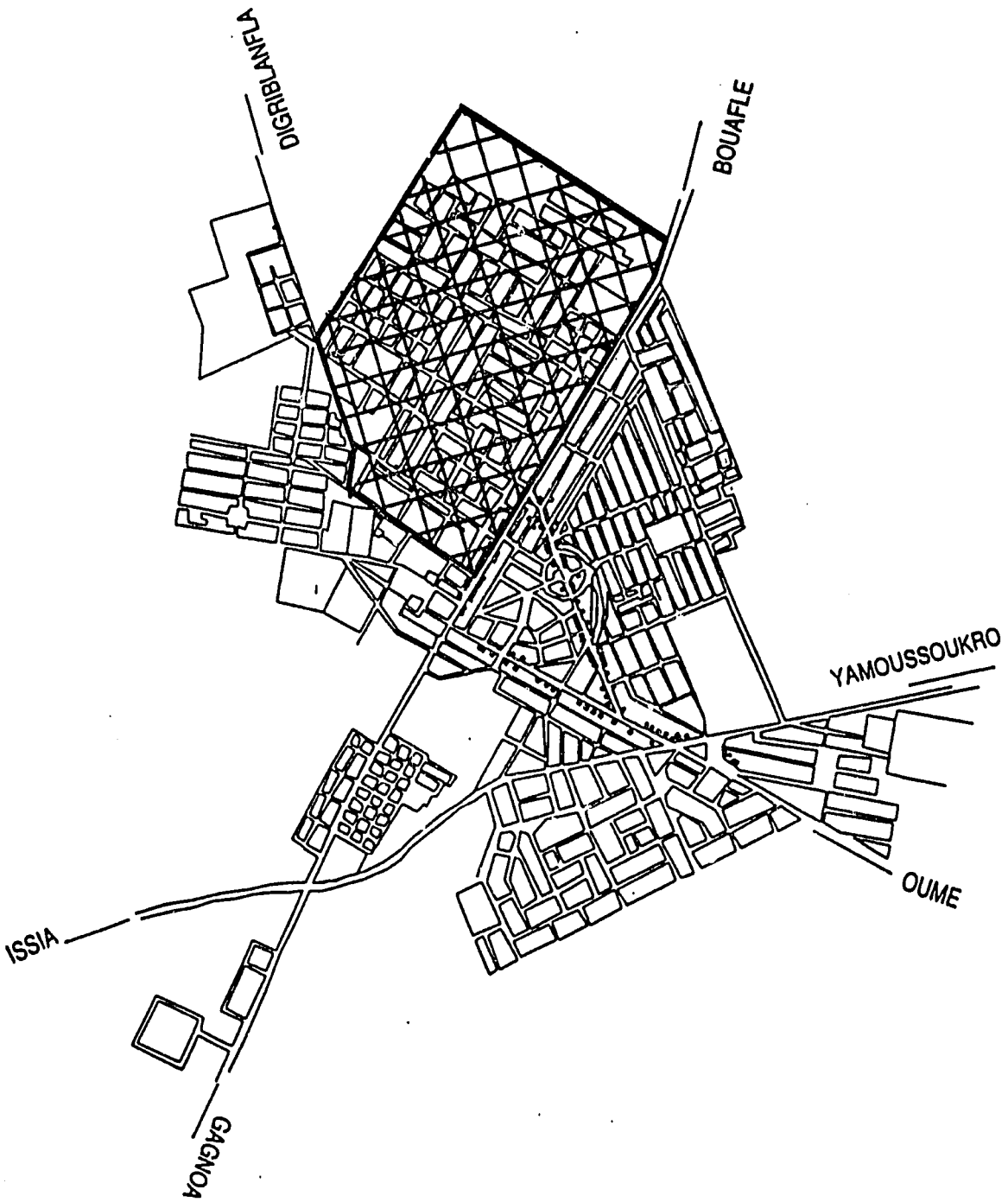

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ALTERNATIVE III - PILOT PROGRAM - PRIVATIZATION

TABLE IV - WORKING CAPITAL - INVESTMENT SCHEDULE

)escription	Year	Year	Year	Year	Year
?opulation	48400.00	50626.40	52955.21	55391.15	57939.15
;rowth	0.046	0.046	0.046	0.046	0.046
# Houses	5377.78	5625.16	5883.91	6154.57	6437.68
'ayment per/hou	7300.00	7300.00	10250.00	10250.00	10250.00
lunicip'y	10000.00	10000.00			
'ax/Elec+Add Re	3000.00	3138.00			
'/pay	1666.67	1666.67	5295.52	55391.15	57939.15
'aym contrac	12166.67	12166.67	60310.11	63084.37	65986.25
'otal Rev	25166.67	25304.67	60310.11	63084.37	65986.25
'xpenses	34909.74	34909.74	34909.74	34909.74	34909.74
'rofit %	15.00	15.00	15.00	15.00	15.00
'rofit	5236.46	5236.46	5236.46	5236.46	5236.46
otal Exp.	40146.20	40146.20	40146.20	40146.20	40146.20
nvestment Schedule					
ash/Deprec.	2276.00	2276.00	2276.00	2276.00	2276.00
alance	-12703.53	-12565.53	22439.90	25214.17	28116.05
ehab/Purch	-12837.00		-12800.00		
ub-Balance	-25540.53	-42703.36	-40750.07	-22870.91	1128.38
nterest 18%	-4597.39	-7686.61	-7335.01	-4116.76	
orking Capital	-30137.83	-50389.97	-48085.08	-26987.67	1128.38

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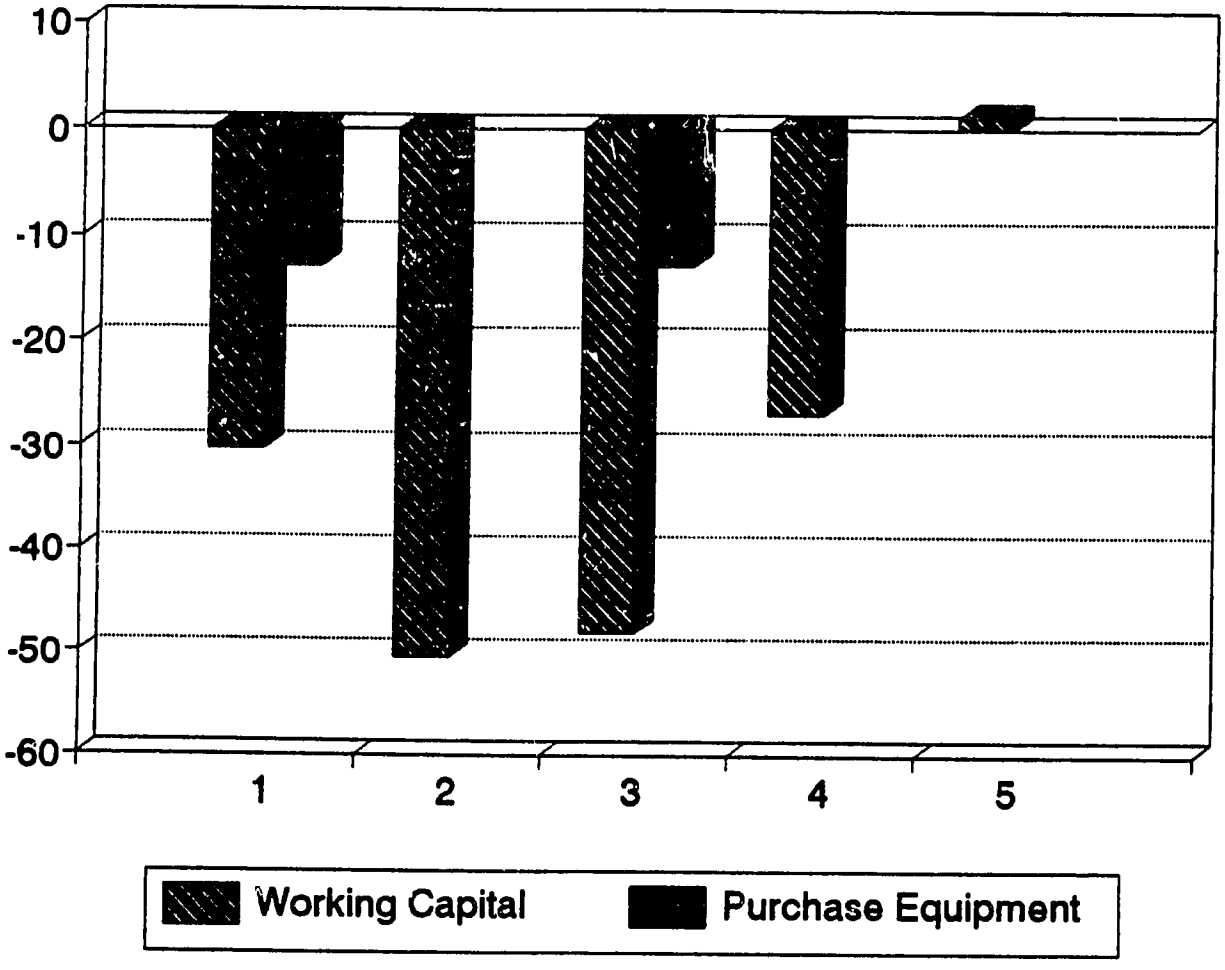
ALTERNATIVE III - PILOT PROGRAM

Working Capital - Purchase Equipment



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- Year 2 Charges to the population 7300 FCFA/year/house
  Electricity surcharges 3.138 Millions
  Municipality contribution estimated 10 millions FCFA

- Years 3-5 Charges to the population of 10250 FCFA/year/house

b. Schedule of Investments

- Year 1 Rehabilitation of equipment
  estimated cost 2.9 millions FCFA
  Purchase 1 tractor and 2 containers on wheels
  estimated cost 9.9 millions FCFA

  Year 3 Purchase of 1 truck
  estimated cost 12.9 millions

4.3.3.2 Constraints

- High investment and payment by the population.
- Only a portion of the population will participate in the program for the first two years.

4.3.3.3 Advantages

- The population will have the opportunity to participate in community sensitivity training

- During the implementation of the pilot program the municipality will use the rehabilitated equipment for collection garbage produced in the other portion of the city.

4.4 RECOMMENDED ALTERNATIVE

Based on the benefits described above and the adjustment period required by the population form public to privatization of SWM management we recommend alternative III.

V CONCLUSIONS AND RECOMMENDATION

5.1 CONCLUSIONS

5.1.1 Financial Constraints

The local government structure for collection and disbursement of funds represents a constraint for the implementation of the solid waste management (*). This situation has motivated the following:

- The municipality has failed to provide the community with the necessary service of collection and treatment of solid waste.

- To enforce regulation of disposal and management of solid waste. The absence of regulations has encouraged indiscriminate dumping.

- Lack of definition of the amount of surcharge on the electricity consumption and excessive delay of payments by the electric company.

5.1.2 Deficient Knowledge of Solid Waste and its Impacts

Throught the field visit and the responses of the survey the following cuold be drawn:

- The population indiscriminate dispose garbage in streets, empty lots and drainage of structures

- The population does not relate garbage accumulation to water related sickness

- The population burns garbage without without knowing the related respiratorial deseases

5.2 RECOMMENDATIONS

Based on the finding of this study the consultants recommends the following:

a. Sensitivity program

The sensitivity program should include the analysis of:

- Impact on health due to lack of collection and treatment of solid waste.

- Impact of the infrastructure specially on drainage structures

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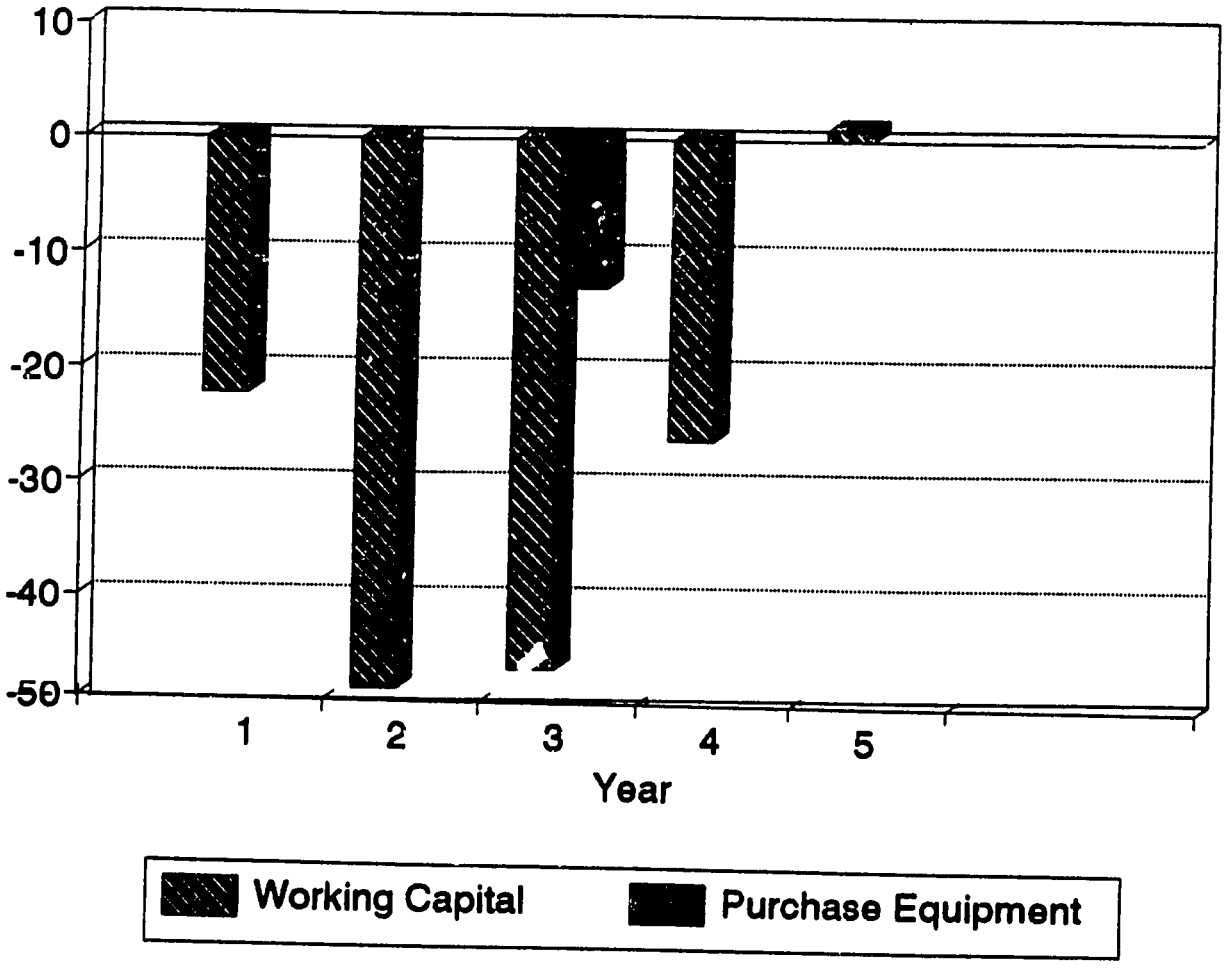
* Process for budget approval see Volume 1

ALTERNATIVE IIIA - PILOT PROGRAM
Working Capital - Purchase Equipment



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ERNATIVE IIIA PILOT PROGRAM

TABLE V - WORKING CAPITAL - INVESTMENT SCHEDULE

:ription	Year	Year	Year	Year	Year
ılation	48400.00	50626.40	52955.21	55391.15	57939.15
ırth	0.046	0.046	0.046	0.046	0.046
louses	5377.78	5625.16	5883.91	6154.57	6437.68
ıent per/hou	3650.00	3650.00	10100.00	10100.00	10100.00
.cip'y	10000.00	10000.00			
.'Elec+Add Re	3000.00	3138.00			
ay	1666.67	1666.67	5295.52	55391.15	57939.15
■ contrac	6083.33	6083.33	59427.52	62161.18	65020.60
al Rev	19083.33	19221.33	59427.52	62161.18	65020.60
enses	34909.74	34909.74	34909.74	34909.74	34909.74
fit %	15.00	15.00	15.00	15.00	15.00
fit	5236.46	5236.46	5236.46	5236.46	5236.46
ıl Exp.	40146.20	40146.20	40146.20	40146.20	40146.20
:stment Schedule					
h/Deprec.	2276.00	2276.00	2276.00	2276.00	2276.00
ance	-18786.87	-18648.87	21557.32	24290.98	27150.40
ab/Purch o			-12800.00		
-Balance	-18786.87	-40817.37	-39407.18	-22209.49	943.20
crest 18%	-3381.64	-7347.13	-7093.29	-3997.71	
king Capital	-22168.50	-48164.50	-46500.47	-26207.20	943.20

SINFRA - COTE D'IVOIRE

BEST AVAILABLE DOCUMENT

- Impact on the quality of life

- Impact on air pollution.

b. Training programs*

Solid Waste Management Workshops should be conducted in the following topics:

Solid Waste Collection
Recycling and Re-use of Solid Waste
Sanitary Landfill
Management
Solid Waste Management and its applicability to concrete situations

3. Financial Support

In order to implement the recommended alternative, the municipality will require financial assistance for:

a Implementation of the recommended pilot program.
b Implementation of Workshops
c Implementation of sensitivity training programs
d Financial Support. Table V and picture 6 shows the required charges por implementation of alternative IIIa.

Table VI shows the revenues necessary to implement Alternative III with and without financial support.

TABLE VI - ALTERNATIVES III AND IIIA

Description	With Support	Without Support
Financial Support in millionsFCFA	12.8	0
Payment for services		
Year 1		
Municipality in millions FCFA	10.0	10.0
Electricity surcharge in millions .FCFA	3.0	3.0
Population FCFA/house	3,650	7,300
Year 2		
Municipality in millions FCFA	10.0	10.0

Electricity surcharge in millions FCFA	3.1	3.1
Population FCFA/house	3,650	7,300
Year 3 - Year 5 Payments in FCFA/house	10,100	10,250

ANNEX - FINANCIAL ANALYSES

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GESTION DES DECHETS SOLIDES

HAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: SINFRA
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

POPULATION: 48,400

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,840
MOYENNE	60	29,040
BAS	30	14,520

PRODUCTION JOURNALIERE DES ORDURES

ABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.39
MOYENNE	0.60	17.42
BAS	0.40	5.81
SOUS-TOTAL		26.62
DIVERS		2.66
TOTAL		29.28

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE #	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1986	22.5	1.1	1	0.50	12.38
CAMION	102	1987	22.5	1.1	1	0.50	12.38
TOTAL							24.75

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

TAUX DE PRODUCTION DE CHAQUE CAMION ESTIME A 75%

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 20.82 Tons

POURCENTAGE DE COLECTE 0.71 %

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE #	MODEL ANNEE	COUTS
CAMION	101	1986	12,900.00
CAMION	102	1987	12,900.00
TOTAL		FCFA	25,800.00
CONTENEURS	1	3.00	3.00
TOTAL		FCFA	25,803.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	552.00
MANOEUVRES	408.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08
ABSENCE	0.12

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1986	0	15	1128	3	2157	3285.19
CAMION	1987	0	15	1128	3	2157	3285.19
TOTAL							6,570.37

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.20
CONTENUERS	0.33

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.100
CONTENEURS	0.050

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.20
CONTENEURS	0.20

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN RparationS
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	5160.00	0.99	5160.99
ENTRETEIN	2580.00	0.99	2580.99
REPARATIONS	5160.00	0.60	5160.60
TOTAL	12900.00	2.58	12902.58

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	18.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
VEH-M # 1	6200.00	1149.71	1240.00	620.00	%1240.00	4,249.71
Moto # 2	300.00	182.66	60.00	30.00	60.00	332.66
TOTAL						4,582.38

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
DIRECT	1100.00	1	0.17	1287.00
ADJOIN	700.00	1	0.08	756.00
MANOE	408.00	4	0.08	1762.56
TOTAL				3805.56

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	3805.56
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.00
TOTAL	3805.56
SOMMAIRE	
SIEGE	0.00
TRANSPORT	4,582.38
SALAIRES	3,805.56
SOUS-TOTAL	8,387.94
ASSURANCE (.01 % SOUSTOTAL)	0.84
UTILITAIRES (.02 % SOUSTOTAL	1.68
TOTAL	8,390.46

1.7 ANALYSE DE LA SITUATION PRESENT

ANNEE 1992

TABLE X SOMMAIRE - ANALISE FINANCIERE 1992

(EN MILLIER FCFA)

DESCRIPTION	COUTS
- COLLECTE	
OPERATION	6,570.37
AMORTISSEMENT	5,160.99
ENTRETIEN	2,580.99
REPARATION	5,160.60
TCTAL	19,472.96
- TRAITEMENT	
DECHARGE	0.00
STATION DE TRANSFERT	0.00
COMPOSTAGE	0.00
- ADMINISTRATION	
ADMINISTRATION	8,390.46
- AUTRES DEPENSES	
AUTRES DEPENSES	0.00
SOUS-TOTAL	27,863.41
DIVERS (10%)	2,786.34
TOTAL	27,873.41

COUT PAR TONNE FCFA 3668.40

* AUTRES DEPENSES

CHAPITRE 2 - PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	12900.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	2580.00
ENTRETIEN	1290.00
REPARATION	2580.00

MAN D'OEUVRE	
CHAUFFEUR	1
MANOEUVRE	3
DENSITE DES DECHTES SOLIDES	1.10
CAPACITE DE COLLECTE	20.82

- CONTENEURS

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	0.990
ENTRETIEN	0.150
Reparation	0.600

- COUTS D'OPERATION

SALAIRES	2156.96
CARBURANT	1128.22

- REMBOURSEMENT 4125.13

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 50,626

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	5.06	3.54
MOYENNE	30.38	18.23
BAS	15.19	6.08
SOUS-TOTAL		27.84
DIVERS		2.78
TOTAL		30.63

- BESOINS DE COLLECTE

PRODUCTION 1993 30.63

Cap. de coll. pres 20.82

- PROJECTIONS POUR NIVEAU DE SERVICE = 80 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 3.69 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 0

CAPACITE DE COLLECTION POUR 1993 20.82

COUT DES VEH. ADDITIONEL 0.00
COUT, VEH. EXISTANT 25,800.00
TOTAL COUT DE COLLECTE 25,800.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 0

COUTS ADDITIIONEL 0.00
COUTS DES CONTENEURS EXISTANT 3.00
TOTAL COUTS DES CONTENEURS 3.00

TOTAL COUTS DES EQUIP. DE COLLECTE 25,803.00

- REMBOURSEMENT

EQUIPEMENT	0.00	
AMORTISSEMENT VEH.	5,160.00	
AMORTISSEMENT CONTENEURS	0.99	
TOTAL AMORTISSEMENT		5,160.99

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.15
TOTAL ENTRETIEN	2,580.15

- REPARATION

VEHICULES	5,160.00
CONTENEURS	0.60
TOTAL REPARATIONS	5,160.60

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL COUTS D'OPERATION	6,570.37

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.30		3.71	
MOYEN	31.77		19.06	
BAS		15.89		6.35
SOUS-TOTAL				29.13
DIVERS				2.91
TOTAL				32.04

- BESOINS DE COLLECTE

PRODUCTION 1994 32.04

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 4.81 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1994		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	3.00

TOTAL	3.00
TOTAL EQUIPEMENT	25,803.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	0.99
TOTAL	5,160.99

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.15
TOTAL	2,580.15

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.60
TOTAL	5,160.60

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.54		3.88	
MOYEN	33.23		19.94	
BAS		16.62		6.65
SOUS-TOTAL				30.47
DIVERS				3.05
TOTAL				33.51

- BESOINS DE COLLECTE

PRODUCTION 1995 33.51

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 5.99 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1995		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	3.00
TOTAL	3.00
Total EQUIPEMENT	25,803.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	0.99
TOTAL	5,160.99

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.15
TOTAL	2,580.15

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.60
TOTAL	5,160.60

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 57,939

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.79		4.06	
MOYEN	34.76		20.86	
BAS		17.38		6.95
SOUS-TOTAL				31.87
DIVERS				3.19
TOTAL				35.05

- BESOINS DE COLLECTE

PRODUCTION 1996 35.05

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 7.23 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1996		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL	3.00
COUT CONT. EXISTANT	3.00
TOTAL	6.00
Total EQUIPEMENT	25,806.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	1.98
TOTAL	5,161.98

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.30
TOTAL	2,580.30

- REPARATION

VEHICULE	5,160.00
CONTENEURS	1.20
TOTAL	5,161.20

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 60,604

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	6.06		4.24	
MOYEN	36.36		21.82	
BAS		18.18		7.27
SOUS-TOTAL				33.33
DIVERS				3.33
TOTAL				36.67

- BESOINS DE COLLECTE

PRODUCTION 1997 36.67

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 80 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 80 % NIVEAU DE SERVICE = 8.52 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1997		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL	3.00
COUT CONT. EXISTANT	3.00
TOTAL	6.00
Total EQUIPEMENT	25,806.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	5,160.00
AMORTISEMENT	1.98
TOTAL	5,161.98

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.30
TOTAL	2,580.30

- REPARATION

VEHICULE	5,160.00
CONTENEURS	1.20
TOTAL	5,161.20

- COUTS D'OPERATION

EQUIP. EXISTANT	6,570.37
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,570.37

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	0.00	0.00	0.00	0.00	0.00
AMORTISSEMENT	5,160.99	5,160.99	5,160.99	5,161.98	5,161.98
ENTRETIEN	2,580.15	2,580.15	2,580.15	2,580.30	2,580.30
REPARATIONS	5,160.60	5,160.60	5,160.60	5,161.20	5,161.20
OPERATION	6,570.37	6,570.37	6,570.37	6,570.37	6,570.37
TOTAL COLLECTE	19,472.11	19,472.11	19,472.11	19,473.86	19,473.86
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	8,390.46	8,390.46	8,390.46	8,390.46	8,390.46
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	0.00	0.00	0.00	0.00	0.00
SOUSTOTAL	27,862.57	27,862.57	27,862.57	27,864.31	27,864.31
DIVERS (15 %)	4,179.39	4,179.39	4,179.39	4,179.65	4,179.65
TOTAL	32,041.96	32,041.96	32,041.96	32,042.22	32,043.96

* AUTRES DEPENSES

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11-24-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: SINFRA
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

POPULATION: 48,400

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,840
MOYENNE	60	29,040
BAS	30	14,520

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.39
MOYENNE	0.60	17.42
BAS	0.40	5.81
SOUS-TOTAL		26.62
DIVERS		2.66
TOTAL		29.28

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	4,148.48	4,148.48	4,148.48	8,296.97	8,296.97
AMORTISSEMENT	2,276.40	2,276.40	2,276.40	2,276.40	2,276.40
ENTRETIEN	8,520.00	8,520.00	8,520.00	12,120.00	12,120.00
REPARATIONS	4,260.00	4,260.00	4,260.00	6,060.00	6,060.00
OPERATION	9,354.42	9,354.42	9,354.42	12,637.08	12,637.08
TOTAL COLLECTE	24,410.82	24,410.82	24,410.82	33,093.48	33,093.48
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	5,795.47	5,795.47	5,795.47	5,795.47	5,795.47
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	150.00	150.00	150.00	150.00	150.00
SOUSTOTAL	30,356.29	30,356.29	30,356.29	39,038.96	39,038.96
DIVERS (15 %)	4,553.44	4,553.44	4,553.44	5,855.84	5,855.84
TOTAL	34,909.74	34,909.74	34,909.74	36,212.14	44,894.80

* AUTRES DEPENSES

Education	100,000 FCFA
Decharge	50,000 FCFA

- REMBOURSEMENT

EQUIPEMENT	8,296.97
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40

- ENTRETIEN - EQUIPEMENT

VEHICULES	11,040.00
CONTENEURS	1,080.00
TOTAL	12,120.00

- REPARATION

VEHICULE	5,520.00
CONTENEURS	540.00
TOTAL	6,060.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	4,308.88
CARBURANT	2,256.45
TOTAL D'OPERATION	12,637.08

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 60,604

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	6.06		4.24	
MOYEN	36.36		21.82	
BAS		18.18		7.27
SOUS-TOTAL				33.33
DIVERS				3.33
TOTAL				36.67

- BESOINS DE COLLECTE

PRODUCTION 1997 36.67

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 15.91 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 2

CAPACITE DE COLLECTE POUR 1997		38.59
COUT DES VEH. ADDITIONEL	36,000.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	55,200.00	

- CONTENEUR ADDITIONEL

NOMBRE	1	
COUT ADDITIONEL		1,800.00
COUT CONT. EXISTANT		3,600.00
TOTAL		5,400.00
Total EQUIPEMENT		60,600.00

- REMBOURSEMENT

EQUIPEMENT	8,296.97
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40

- ENTRETIEN - EQUIPEMENT

VEHICULES	11,040.00
CONTENEURS	1,080.00
TOTAL	12,120.00

- REPARATION

VEHICULE	5,520.00
CONTENEURS	540.00
TOTAL	6,060.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	4,308.88
CARBURANT	2,256.45
TOTAL D'OPERATION	12,637.08

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 57,939

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.79		4.06	
MOYEN	34.76		20.86	
BAS		17.38		6.95
SOUS-TOTAL				31.87
DIVERS				3.19
TOTAL				35.05

- BESOINS DE COLLECTE

PRODUCTION 1996 35.05

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 14.34 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 2

CAPACITE DE COLLECTE POUR 1996		38.59
COUT DES VEH. ADDITIONEL	36,000.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	55,200.00	

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL	1,800.00
COUT CONT. EXISTANT	3,600.00
TOTAL	5,400.00
Total EQUIPEMENT	60,600.00

- REMBOURSEMENT

EQUIPEMENT	4,148.48
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40

- ENTRETIEN - EQUIPEMENT

VEHICULES	7,440.00
CONTENEURS	1,080.00
TOTAL	8,520.00

- REPARATION

VEHICULE	3,720.00
CONTENEURS	540.00
TOTAL	4,260.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	2,154.44
CARBURANT	1,128.22
TOTAL D'OPERATION	9,354.42

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.54		3.88	
MOYEN	33.23		19.94	
BAS		16.62		6.65
SOUS-TOTAL				30.47
DIVERS				3.05
TOTAL				33.51

- BESOINS DE COLLECTE

PRODUCTION 1995 33.51

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97 %

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 12.85 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 1

CAPACITE DE COLLECTE POUR 1995 29.12
COUT DES VEH. ADDITIONEL 18,000.00
COUT DES VEH. EXISTANT 19,200.00
Total 37,200.00

- CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL 1,800.00
COUT CONT. EXISTANT 3,600.00
TOTAL 5,400.00

Total EQUIPEMENT 42,600.00

- REMBOURSEMENT

EQUIPEMENT	4,148.48
AMORTISEMENT	1,920.00
AMORTISEMENT	356.40
TOTAL	2,276.40

- ENTRETIEN - EQUIPEMENT

VEHICULES	7,440.00
CONTENEURS	1,080.00
TOTAL	8,520.00

- REPARATION

VEHICULE	3,720.00
CONTENEURS	540.00
TOTAL	4,260.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	2,154.44
CARBURANT	1,128.22
TOTAL D'OPERATION	9,354.42

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 52,955

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.30		3.71	
MOYEN	31.77		19.06	
BAS		15.89		6.35
SOUS-TOTAL				29.13
DIVERS				2.91
TOTAL				32.04

- BESOINS DE COLLECTE

PRODUCTION 1994 32.04

CAPACITE DE COLLECTE 19.66

- PROJECTION POUR NIVEAU DE SERVICE= 97 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 11.42 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 1

CAPACITE DE COLLECTE POUR 1994 29.12
COUT DES VEH. ADDITIONEL 18,000.00
COUT DES VEH. EXISTANT 19,200.00
Total 37,200.00

· CONTENEUR ADDITIONEL

NOMBRE 1

COUT ADDITIONEL 1,800.00
COUT CONT. EXISTANT 3,600.00
TOTAL 5,400.00

TOTAL EQUIPEMENT 42,600.00

- REMBOURSEMENT

EQUIPEMENT	4,148.48	
AMORTISSEMENT VEH.	1,920.00	
AMORTISSEMENT CONTENEURS	356.40	
TOTAL AMORTISSEMENT		2,276.40

- ENTRETIEN - EQUIPEMENT

VEHICULES	7,440.00
CONTENEURS	1,080.00
TOTAL ENTRETIEN	8,520.00

- REPARATION

VEHICULES	3,720.00
CONTENEURS	540.00
TOTAL REPARATIONS	4,260.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,071.76
SALAIRES	2,154.44
CARBURANT	1,128.22
TOTAL COUTS D'OPERATION	9,354.42

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 50,626

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	5.06	3.54
MOYENNE	30.38	18.23
BAS	15.19	6.08
SOUS-TOTAL		27.84
DIVERS		2.78
TOTAL		30.63

- BESOINS DE COLLECTE

PRODUCTION 1993 30.63

Cap. de coll. pres 19.66

- PROJECTIONS POUR NIVEAU DE SERVICE = 97 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 97 % NIVEAU DE SERVICE = 10.05 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 1

CAPACITE DE COLLECTION POUR 1993 29.12

COUT DES VEH. ADDITIONEL	18,000.00
COUT, VEH. EXISTANT	19,200.00
TOTAL COUT DE COLLECTE	37,200.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 1

COUTS ADDITIIONEL	1,800.00
COUTS DES CONTENEURS EXISTANT	3,600.00
TOTAL COUTS DES CONTENEURS	5,400.00
TOTAL COUTS DES EQUIP. DE COLLECTE	42,600.00

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	118.800
ENTRETIEN	360.000
Reparation	180.000

- COUTS D'OPERATION

SALAIRES	2154.44
CARBURANT	1128.22

- REMBOURSEMENT 4148.48

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
Assist	573.00	1	0.08	620.56
TOTAL				620.56

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	620.56
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.22
TOTAL	620.78

SOMMAIRE

SIEGE	0.00
TRANSPORT	5,172.38
SALAIRES	620.78
SOUS-TOTAL	5,793.16
ASSURANCE (.03 % SOUSTOTAL)	1.74
UTILITAIRES (.01 % SOUSTOTAL	0.58
TOTAL	5,795.47

- COLLECTE

PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	18000.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	1800.00
ENTRETIEN	3600.00
REPARATION	1800.00

MAN D'OEUVRE

CHAUFFEUR	1
MANOEUVRE	3

DENSITE DES DECHTES SOLIDES 0.50

CAPACITE DE COLLECTE 9.46

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	1.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
Car-m # 201	9000.00	1149.71	900.00	1800.00	900.00	4,749.71
Mot-a # 202	600.00	182.66	60.00	120.00	60.00	422.66
TOTAL						5,172.38

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.10
CONTENUERS	0.07

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.200
CONTENEURS	0.200

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.10
CONTENEURS	0.10

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN Rparations
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	1920.00	237.60	2157.60
ENTRETEIN	3840.00	237.60	4077.60
REPARATIONS	1920.00	360.00	2280.00
TOTAL	7680.00	835.20	8515.20

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	573.30
MANOEUVRES	420.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08
ABSENCE	0.08

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1993	0	15	1128	3	2154	3282.66
TRACTR	1993	0	15	1128	2	1661	2789.09
TOTAL							6,071.76

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE #	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1993	22.5	1.1	1	0.50	12.38
TRACTR	102	1993	20.0	1.1	1	0.50	11.00
TOTAL							23.38

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

TAUX DE PRODUCTION DE CHAQUE CAMION ESTIME A 75%

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 19.66 Tons

POURCENTAGE DE COLECTE 10%

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE	MODEL ANNEE	COUTS
CAMION	101	1993	12,900.00
TRACTR	102	1993	6,300.00
TOTAL		FCFA	19,200.00
CONTENEURS	2	1800.00	3600.00
TOTAL		FCFA	22,800.00

REDSO/PMO/UD

MUNICIPAL DEVELOPMENT SUPPORT PROJECT
681-0004

PRIVATE PROVISION OS SOCIAL SERVICES (PPSS)
PDC-1008-C-00-9091-00

SOLID WASTE STUDY

for

SINFRA AND TIASSALE, COTE D'IVOIRE

TIASSALE

VOLUME 3 OF 3

by
Jean Tchimon Assemian
and
Mito Bessalel, PE
Consultants

ICMA
Washington, DC
USA

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I. EXISTING CONDITIONS

1. BACKGROUND

The commune of Tiassale is located 130 km North of Abidjan and 136 km South of Yamoussoukro. The Bandama and N'Zi rivers passes through Tiassalé. The Department encompasses two urban agglomerations, Tiassalé and N'Douci and four villages Taboitien, Niamoue, Nianda, and Kanganianze.(See Figure 1)

the beginning of Tiassale City can be traced to the establishment of the N'Gbattra. This settlers were displaced by the Baoules-Elomoin from Ghana. Tiassalé was a commercial center and a stopping point for travelers.

Area

Area of the Commune	16,800	ha
Area of Tiassale	490	ha
Percentage of urban/commune	2.93	%
Property division	630	ha.

Population

1988	39922
1992	45538

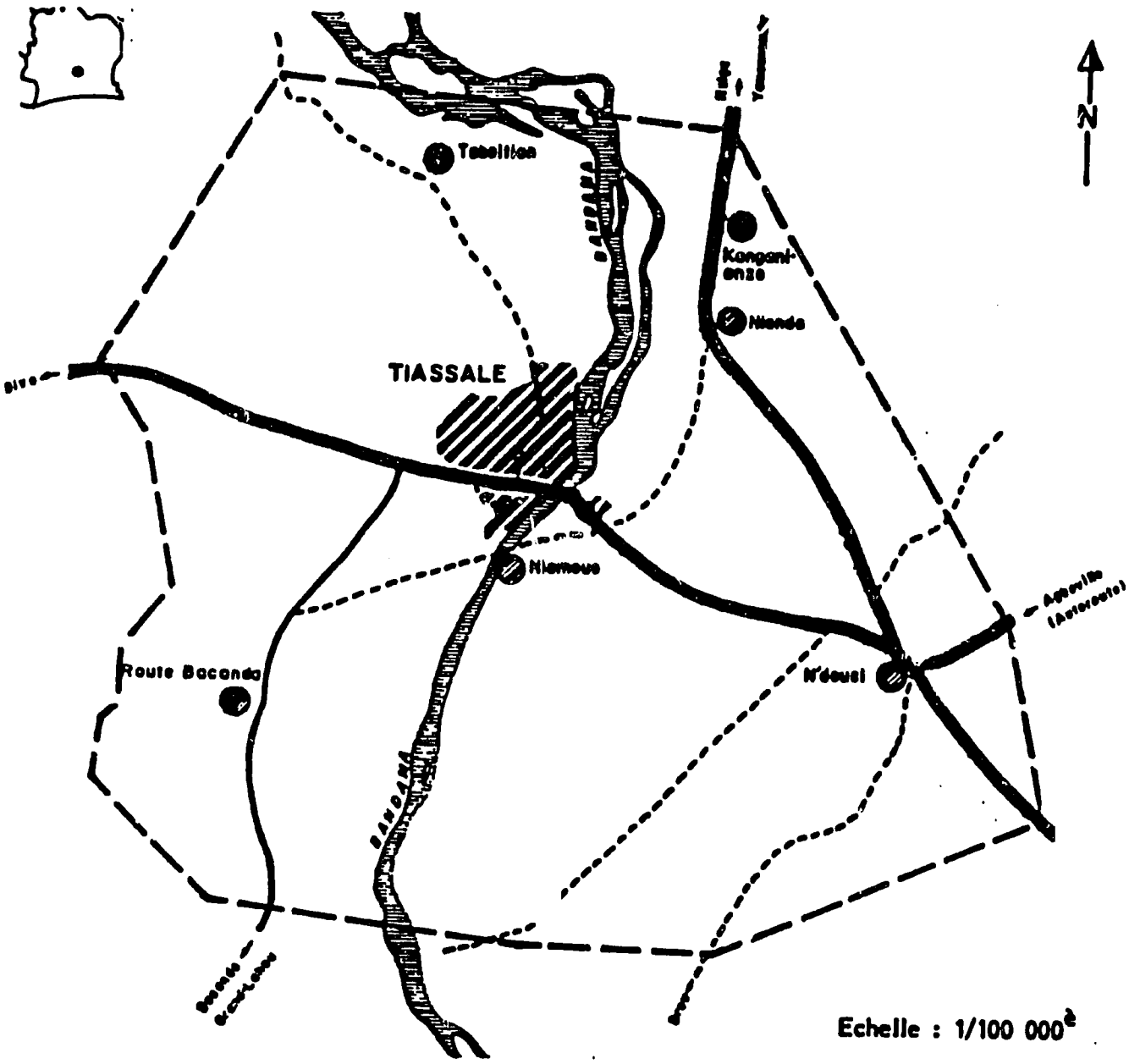
Population Growth 3.3 %

The population of the nearby villages is:

City	Population (1988)	Population(1992)
Tabotien	972	1004
Niamone	1378	1569
Nianda	1600	1821
Kanganianze	1870	2129

At the present growth rate the projected population for five years is indicated below.

Year	Population
1992	45538
1993	47040
1994	48593
1995	50197
1996	51853
1997	53564



LEGENDE

- Limite de territoire communal
- Route goudronnée
- Route en terre
- Piste
- Fleuve
- Rivière
- Espace ur
- Village rattaché à la commune

FIGURE 1 - MUNICIPALITY OF TIASSALE

Density

Tiassale has a density of 69 person/ha

Topography

The topography is basically flat, surrounded by secondary forest. The forest is exploited for agriculture purposes.

Weather

The city of Tiassalé is located in a tropical forest area characterized by two rainy seasons, a major season covering April to mid-July and a minor season which begins mid September and ends mid-November.

Type of Residences:

There are two types of residences:

a. Medium Level

Medium level residences are located in the residential area where revenues are high.

b. Low Level

Low level residencies are located in poor areas. The sanitary facilities are located outside the houses and generally are not well maintained.

1.2 ECONOMIC RESOURCES

The socio-economic activities of the city are linked to the environment specially the production of solid waste.

1.2.1 Agricultural Activities

The major industries are coffee cacao and pineapple. The agriculture production of 1991 were as follows:

Coffee:	7000 Tons
Cacao:	21000 Tons
Rice :	9100 Tons
Corn:	6700 Tons
Pineapple	8000 Tons

1.2.2 Industrial Activities

a. Wood Products

The production of wood for 1991 was approximately 10,000 Tons, the amount exported was 8700 tons were exported.

b. Pineapple

From 1989 to 1991 The S.A.F.C.O. processed 30,800 tons of pineapple.

1.3 INFRASTRUCTURE

Other than the old road to Toumodi and small portion of the main street are unpaved.

In Addition to the two markets there are bus/taxi stations. A hospital with three doctors and dentist. There is in not slaughter facilities.

Running water and 24 hours electricity are available in most neighborhoods, with access dependent on ability to pay.

The following services are provided by the city:

- 2 Preschool education centers, 1 private and 1 public
- 2 Kindergarten
- 3 French-Arab schools
- 1 Post office and savings in Tiassalé and N'Douci
- 1 Telephone company
- 1 Water Company
- 1 Electric Company
- 2 Pharmacies
- 1 Cinema
- 1 Hospital
- 1 Rural Health Clinic

1.4 MANAGEMENT

The city is managed by Mr. Rene Amichia, Mayor and his 31 advisers. The Mayor expressed his desires to provide the best possible sanitation system to the city. His desire is also shared by his first assistance and the General Secretary.

The technical department is run by Mr. Kambo. His major responsibilities include the supervision of the solid Waste collection and maintenance of roads and drainage structures.(See figure 2 shows the management organization chart)

1.5 PROJECT RELATED CONDITIONS

1.5.1. Erosion and Stagnation

The city contracted a private company to clean streets and ditches. This action has prevented erosion and stagnation. However, some of the areas are impassable due to the poor conditions of the roads. Flat areas are noticeable for the presence of stagnate water.(See Picture 1)

1.5.2 Washwater

T I A S S A L E

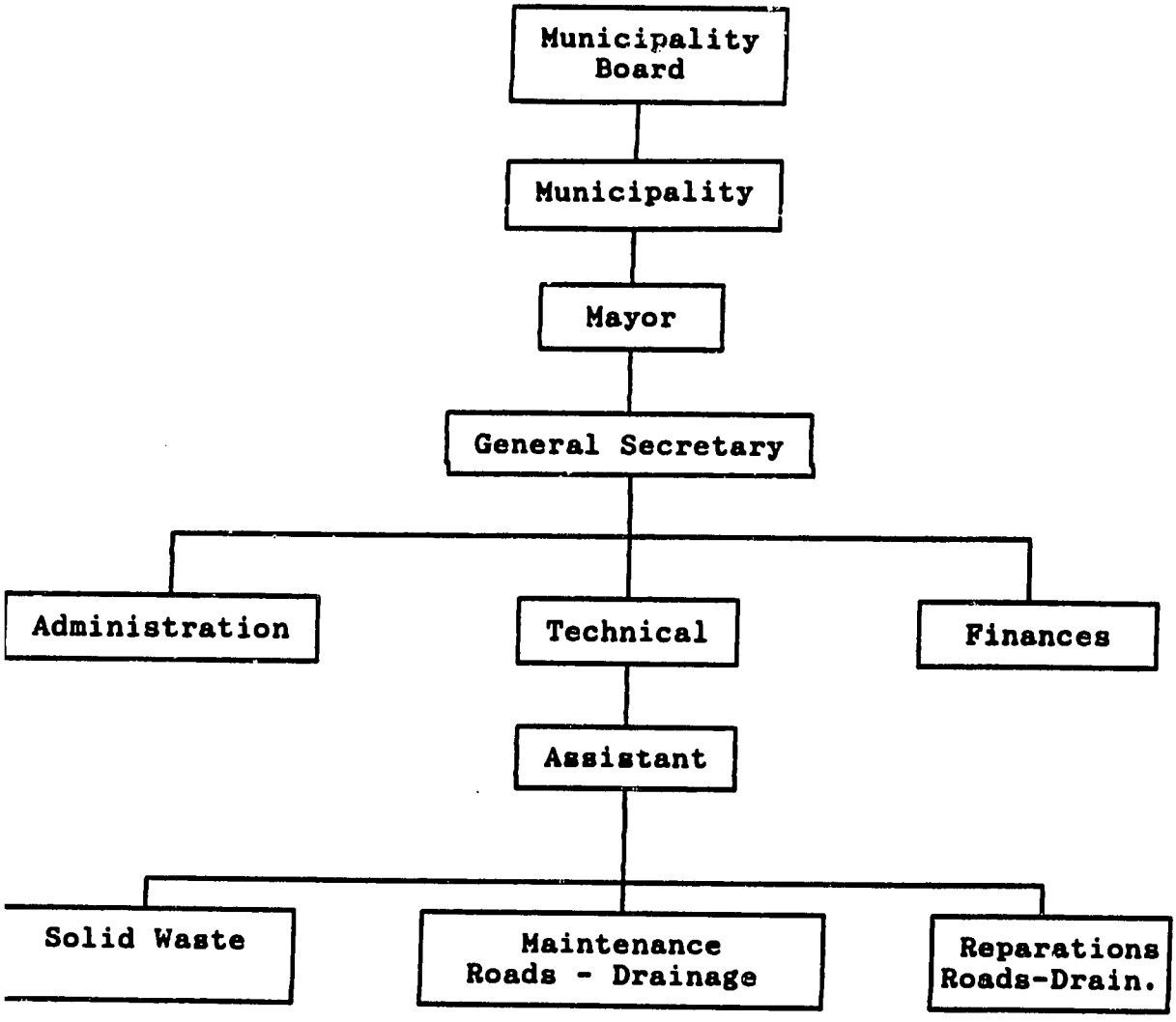


FIGURE 2 - ORGANIZATION CHART

Washwater from daily usage is routinely discarded in the streets and between houses, this exacerbates stagnation and poses contamination treat to the wells.

1.5.3 Wastewater

Wells are prevalent and subject to contamination by the proliferation on uncontained latrines. The tendency of these latrines to flood during heavy rainfall is similarly problematic. An additional problem is posed by the wide spread practice of urinating at roadside or at the side of buildings.

1.5.4 Solid Waste

Solid waste is noticeable absent from main roads and street, due to the effective collection of the municipality and the cleaning of the gutters. Off the main roads, however, the situation in some areas present a different picture since collector can not reach this areas.

Waste is disposed in an assigned area located approximately 2.5 kilometers from downtown. Waste is dumped with no treatment.

The municipal efforts are almost exclusively focused on trash collection. Cleaning of street and ditches are performed by a entrepreneur.

The Technical Department operates two collection truck daily with three workers and a driver each.(See Picture 2) Trucks follow regular circuits through both commercial and residential areas. One truck collects the garbage from Tiassale and the other collects the trash from N'Douci. The system appears to work well while the two truck are in good working conditions (estimated collection percentage 75%).

1.6 IMPACT ON HUMAN HEALTH

1.6.1 General

Under worm, moist conditions, organic waste become ideal breeding places for disease-causing organisms. Pathogens, have easy access to the waste via vectors. With solid waste, the primary vectors are flies, rodents and mosquitoes. The generation of harmful organisms and their transmission is not the only health hazardous. Many potentially unhealthy materials, such as solvents and pesticides containers, medical waste.

The source of potential health hazardous conditions could be identify in:

- First most municipal refuse contains human faecal matter and industrial waste

Picture 1 - Stagnant Wastewater

Picture 2 - Collection Equipment

BEST AVAILABLE DOCUMENT

- Second the decomposition of organic material can release contaminants into drainage, seepage and atmospheric emissions. The principal course for these contaminants would be leachate into ground water and surface waters.

- Third, the open burning of waste in the dumps and accumulate

  piles of garbage in empty lots and streets creates extensive pollution.

1.6.2 Identification of Major Diseases

According with the statistic obtain in the Sinfra hospital the major sold waste-wastewater related sickness were:

- Enteric Diseases primary diarrheas

  Prevalent develop in environment were there is lax of hygiene habits and expose to contaminate sources of food and drink.

- Malaria

  Water accumulated in ditches, broken pipes are breeding places for mosquitoes in urban areas. Malaria is transmitted through a bite of an infected (female) anopheles mosquito.

- Respiratory

  Generation of harmful smoke from burning garbage and dust during dry seasons are some of the causes of respiratory diseases

1.7 DEFINITION OF BASIC PARAMETERS

1.7.1 General

The parameters indicated below are the bases for the development of a five year financial analysis.

a. Population

Population year 1992	43,538
Population growth	3.3 %

b. Waste Generation Rates

The estimation of waste generation rate is difficult since there is no sampling of solid waste. It is not only difficult to collect accurate data, but also to quantify the amount.

The coefficient used for the estimation of solid waste production are the following:

high income	0.70 kgr/pers
Medium income	0.50 kgr/pers

Low income	0.40 Kgr/pers
Miscellaneous	10 % of total

d. Density, Composition, and Moisture

Density, composition and moisture are the main parameters used for the estimation of the garbage collection and treatment. Density is especially important for the design of the required collection system, and waste treatment. Waste density varies from area to area in the city.

In wealthy neighborhoods density tends to be low and garbage tends to have a high percentage of non-putrescible materials such as paper, plastics, glass, and metals. The garbage composition in lower-income areas is mostly organic, with natural compactation. Density used for the calculation of the volume to be transported was 0.50.

The following lists ranges of municipal refusal composition for low income communities (% of weight)*

Paper	1 to 10
Class, ceramics	1 to 10
Metals	1 to 5
Plastics	1 to 5
Leather, rubber	1 to 5
Wood, Bones, Straw	1 to 5
Textiles	1 to 5
Vegetable/Putrescible	40 to 85

1.7.2 Solid Waste Production and Costs

Collection and disposal were calculated using a solid waste management model written in Quick Basic. A sample of typical runs are included in Annex A.

* Source: Environmental Management of Urban Solid Waste in Developing Countries - By Sandra J. Cointreau

II. IMPACT OF INADEQUATE WASTE COLLECTION ON THE ENVIRONMENT

2.1. GENERAL

The conditions observed during the field reconnaissance in Tiassale in general were not good. Piles of solid waste have been accumulated, on the streets, and intersections, affecting other sectors of the city's infrastructure and the health of the population, and breading widespread apathy.

2.2 IMPACT ON THE CITY INFRASTRUCTURE

The trash discharged in the streets is carried into the drainage system, clogging pipes and ditches and forcing water to find its way down the streets until it reaches flat areas where it stagnates. In some locations, after a heavy rain, accumulation of mad, sludge, and garbage is not unusual.

2.3 IMPACTS ON THE HEALTH OF THE POPULATION

2.3.1 Garbage Accumulation

In addition to the solid waste indiscriminately discharged, the collected garbage is dumped untreated in open land in areas outside the limits of the city. During the rainy season, these accumulations became an ideal breeding places for decease producing organisms. During the dry season the generate contaminated dust that blows over the city is also a source of respiratory deceases.

During our visit to Tiassale hospital, according with the doctor the three major sickness treated in the hospital are: malaria, diarrhea and bronchitis.

source of potential health hazardous conditions could be identify in:

- Refuse contains organinc, human faecal matter and industrial waste

- Refuse decomposition can release contaminants into drainage, seepage and atmospheric emissions. The principal course for these contaminants would be leachate into ground water and surface waters.

- Refuse open burning of waste in empty lots and streets creates extensive pollution.

2.3.2 Identification of Major Diseases

According with the statistic obtaind in the Hospital of Tiassale the major solid waste-wastewater related sickness were:

- Enteric Diseases Primary Diarrheas

  Prevalent develop in environment were there is lax of hygiene habits and expose to contaminate sources of food and drink.

- Malaria

  Water accumulated in ditches, broken pipes are breeding places for mosquitoes in urban areas. Malaria is transmitted through a bite of an infected (female) anopheles mosquito.

- Respiratory Disease

  Generation of harmful smoke from burning garbage and dust during dry seasons are some of the causes of respiratory diseases

2.4 AIR POLLUTION

The industrial activities in Tiassalé has no impact on air quality. However, lack of maintenance of the unpaved roads are responsible for concentration of dust. This situation is aggravated by the presence of piles of garbage (see Picture 1). Some waste is burned in the open to reduce the volume, and control odors (See Picture 2). Open burning decreases air quality. The low temperature and the open burning increase the emission of particles, carbon monoxide, and hydrocarbons. Some of emissions factor associates with open burning are:

Particles	8.0 kgr. per ton.
Sulfur oxide	0.5 kgr. per ton.
Carbon monoxide	42.0 kgr. per ton.
Nitrogen oxides	3.0 kgr. per ton.

III - SURVEY APPROACH

3.1 GENERAL

Several groups have roles of varying significance in the production of solid waste. There are three groups of waste producers - household, commercial and industrial.

3.1.1 Households Sampling

Most emphasis was placed on this group presumed to be the biggest producer of waste and also the most unknown in terms of production and disposal habits. A questionnaire was used to identify some of the basic parameters to be used for the elaboration of the alternatives for the solid waste collection*

The questionnaire asked questions related to waste production, quality of service, and willingness to pay for solid waste collection (Sample of questionnaire in Annex B). A total ten household questionnaires were completed by the Service Technical of Tiassale

3.1.2 Commercial and Industrial

No survey was performed for the commercial and industrial sector, because the incidence in the overall solid waste production was estimated to be minor.

3.2 SURVEY OUTCOME

The key findings of the survey are outline below:

a. Number of people per house:

10 or more	20 %
7-9	40 %
4-6	40 %

For the purpose of the study the ratio used was used seven person/house

b. Disposal of Organic Material

60 % of residents dispose organic material

---

* The questionnaire used for the households survey was adopted from a questionnaire used by WASH (Water and Sanitation for Health Project (WASH) for the Solid Waste Management of Port-au Prince.

c. Type of Non-Organic Material

Plastics	90%
Cartons	80%
Metal	60%

d. Purchase of recycled waste

No positive response to this question

e. Location of Garbage despoised

In front of my house	30%
At a collection point	10%
In a ditch	0%
In an empty lot	20%
Burned	10%
Other	30%

f. Responsibilities for Garbage Collection

Municipality	40%
Private	40%
do not know	20%

g. Willingness for Payment of Collection Service

1000 FCFA/w	0%
500 FCFA/w	20%
300 FCFA/w	20%
200 FCFA/w	10%

h. 100% responded that there is no community participation, but they would like to know more about

1

IV ALTERNATIVES AND RECOMMENDED SOLUTIONS

4.1 GENERAL

Collection and treatment of the solid waste has deteriorated through years. The most important reason is that no investment was made for replacement and reparation of existing equipment. The present collection level of service was estimated at 75% . With one truck in working conditions the level of service was estimated at 50%).

4.2 PRESENT COLLECTION CAPABILITY

- Equipment

Two truck models 1986 and 1897 with a capacity of 5 m^3 each. Trucks collect garbage 6 days a weeks. The daily collection capacity was estimated at 22.5 m^3 (4.5 trips each day). It was estimated 50% of the time trucks were broken.

- Personnel

Each truck is operated by a driver and three laborers.

- Operation Costs

The table I indicated shows the actual expenditures* and the estimated operated cost necessary to maintain the same level of service for 1991.

TABLE I - PRESENT EXPENDITURE AND ESTIMATED OPERATING COSTS in FCFA

Description	Expended	Required	Addt'l Expenditures
Diesel	3,000,000	2,438,000	- 562,000
Salary	6,068,319	6,068,319	-
Repairs and Maintenance	961,940	7,740,000	6,778,060
Depreciation	-	-	-
Total	10,030,259	16,246,319	6,216,060

The following can be concluded:

- Depreciation was not estimated
- Maintenance and repairs were reduced to almost half of the amount estimated.

To maintain a level of service of 75% it will be required to allocate and additional 7,4 millions FCFA

* Data provided by the Finances Department

4.3 ALTERNATIVE SOLUTIONS

Three alternatives were study

4.3.1 ALTERNATIVE I - MINIMUM INVESTMENT

This alternative proposes

- The Solid Waste Management remains as the municipality responsibilities.
- Rehabilitation of equipment

4.3.1.1 Assumptions

- Increase electricity surcharge from 1 FCFA/kw-h to 3.4 FCFA/kw-h
- Repair collecting equipment, estimated cost 1.26 million FCFA
- Purchase and rehabilitation of equipment as follows: (see Table III and Figure 3)

Year 1 - Rehabilitation of trucks, estimated cost 1.26 millions FCFA

Year 4 - 1 Tractor and 2 containers on wheels estimated cost 9.9 millions FCFA

- Additional charges on electricity bills are:

Year 1	-	10,200,000 FCFA
Year 2	-	10,536,600 FCFA
Year 3	-	10,884,310 FCFA
Year 4	-	11,243,490 FCFA
Year 5	-	11,614,530 FCFA

4.3.1.2 Major Constraints

Major constraints of these alternative are:

- Increase electricity surcharge
- Only electricity users pay for services of collection and treatment of solid waste
- Low Level of production of the waste collectors
- Disposal habit of the population.
- Repair and maintenance capability of the municipality

4.3.2 ALTERNATIVE II - PRIVATIZATION OF THE SWM

Alternative II proposes the rehabilitation of the existent equipment, and purchase of new equipment as required (see Table III and Figure 4).

The financial analysis was calculated using a charge of 5,550 FCFA per house (estimated 7 person/house)

LTERNATIVE I - MINIMUM INVESTMENT

TABLE II - CASH FLOW - ADDITIONAL RESOURCES

scription	Year 1	Year 2	Year 3	Year 4	Year 5
pulation	45538.00	47040.75	48593.10	50196.67	51853.16
owth	0.033	0.033	0.033	0.033	0.033
Houses	6505.43	6720.11	6941.87	7170.95	7407.59
venues					
nicip'y	10000.00	10000.00	10000.00	10000.00	10000.00
ergy charges SW	10200.00	10536.60	10884.31	11243.49	11614.53
tal Rev	20200.00	20536.60	20884.31	21243.49	21614.53
cpenses					
resent	17325.00	17900.00	18474.00	19048.00	19622.00
parat/Purch.	1260.00			9900.00	
tal	18585.00	17900.00	18474.00	28948.00	19622.00
lance	1615.00	2636.60	2410.31	-7704.51	1992.53
rking Capital	1615.00	4251.60	6661.91	-1042.60	949.92
timated Energy /h/year('000)	3000.00	3099.00	3201.27	3306.91	3416.04
charge/kw/h	3.40	3.40	3.40	3.40	3.40

TIASSALE - COTE D'IVOIRE

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ALTERNATIVE I - MINIMUM INVESTMENT
TABLE II - Working Capital - INVESTMENT

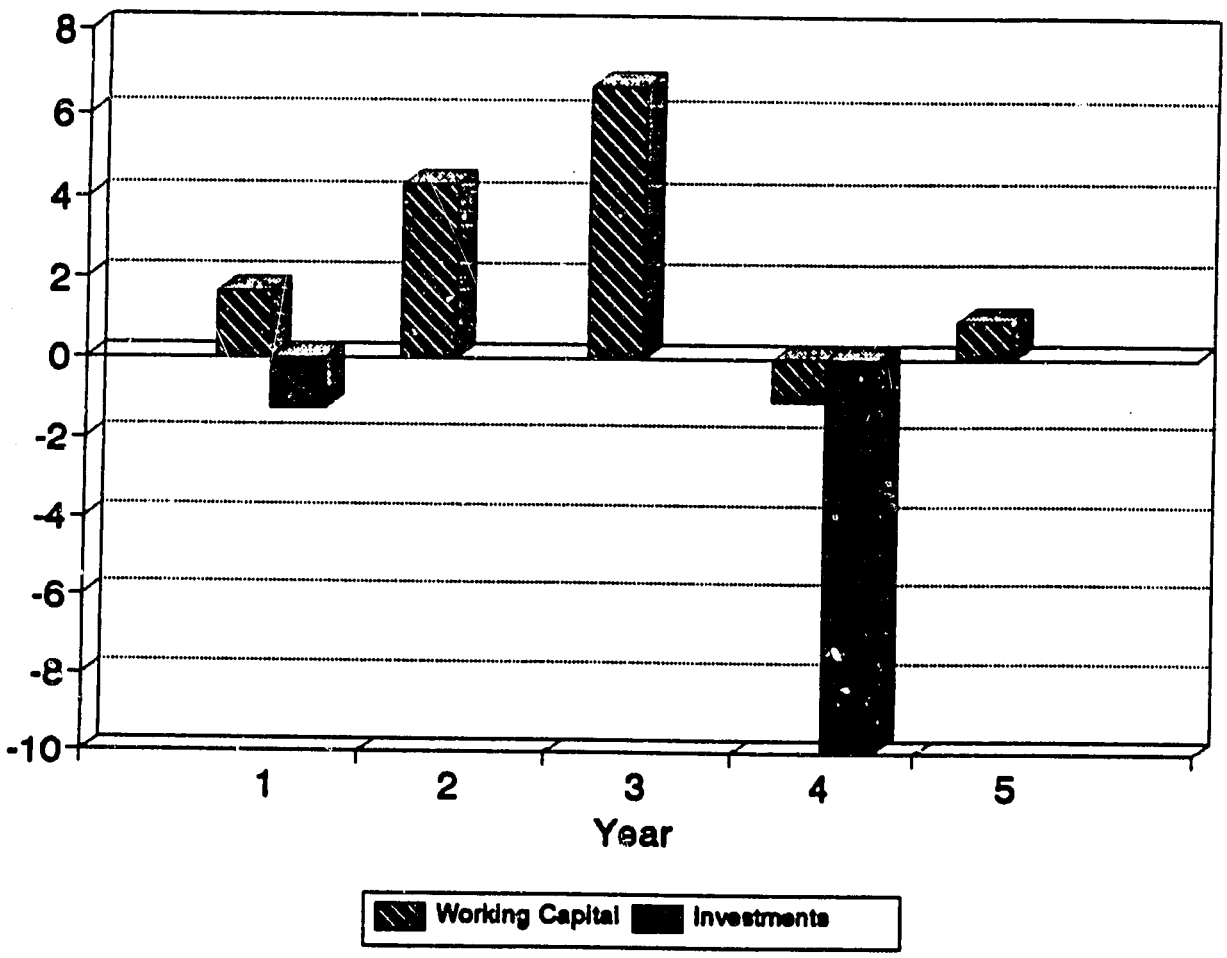

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Figure 2/93

4.3.2.1 Assumptions

- Repair collecting equipment, estimated cost 1.26 million FCFA
- Purchase and rehabilitation equipment as follows:
  (see Table III and Figure 3)

  Year 1 - Rehabilitation of trucks,
  estimated cost 1.26 millions FCFA
  - Purchase 1 tractor and 2 containers on wheels
  estimated cost 9.9 millions FCFA

  Year 4 - Purchase 1 truck with a capacity of 5m3 (Approx 3 Ton.)
  estimated cost 12.9 million FCFA

4.3.2.2 Major Constraints

Mayor constraints of this alternative are:

- The population is not prepared to pay for the collection of the solid waste

- Disposal habits of the population

4.3.3 <u>ALTERNATIVE III PILOT PROGRAM</u>

This alternative proposes the rehabilitation of existing equipment and the purchase of tractor two containers and a truck with a capacity of 5 m^3.

This solution should be implemented in two phases

- Phase I Implementation of two years pilot program

N'Douci with an estimated population of 15,000 people was selected as the area for the development of the pilot program (See figure 5).

- Phase II Implementation of privatization of the solid waste management of Tiassale

4.3.3.1. Assumptions:

a. Estimated Revenues

- Year 1 Charges to the population 1825 FCFA/year/house
  Electricity surcharges 3.0 millions FCFA
  Municipality contribution estimated 10 millions FCFA

- Year 2 Charges to the population 1825 FCFA/year/house
  Electricity surcharges 3.138 Millions
  Municipality contribution estimated 10 millions FCFA

TERNATIVE II - SOLID WASTE MANAGEMENT - PRIVATIZATION

TABLE III - WORKING CAPITAL AND INVESTMENT SCHEDULE

scription	Year 1	Year 2	Year 3	Year 4	Year 5
pulation	45538.00	47040.75	48593.10	50196.67	51853.16
owth	0.033	0.033	0.033	0.033	0.033
Houses	6505.43	6720.11	6941.87	7170.95	7407.59
r/House	5500.00	5550.00	5550.00	5550.00	5550.00
tal Rev	35779.86	37296.60	38527.39	39798.79	41112.15
penses	30852.00	30852.00	30852.00	30852.00	30852.00
ofit 15%	15.00	15.00	15.00	15.00	15.00
tal	35479.80	35479.80	35479.80	35479.80	35479.80
lance	300.06	1816.80	3047.59	4318.99	5632.35
vestment Schedule	1260.00	9900.00		12900.00	
preciation		1800.00	1800.00	4560.00	4560.00
king Capital	-959.94	-7243.15	-3699.33	-8386.21	296.62
eresr - 18%		-1303.77	-665.88	-1509.52	
al Cash	-959.94	-8546.91	-4365.20	-9895.73	296.62

TIASSALE - IVORY COAST

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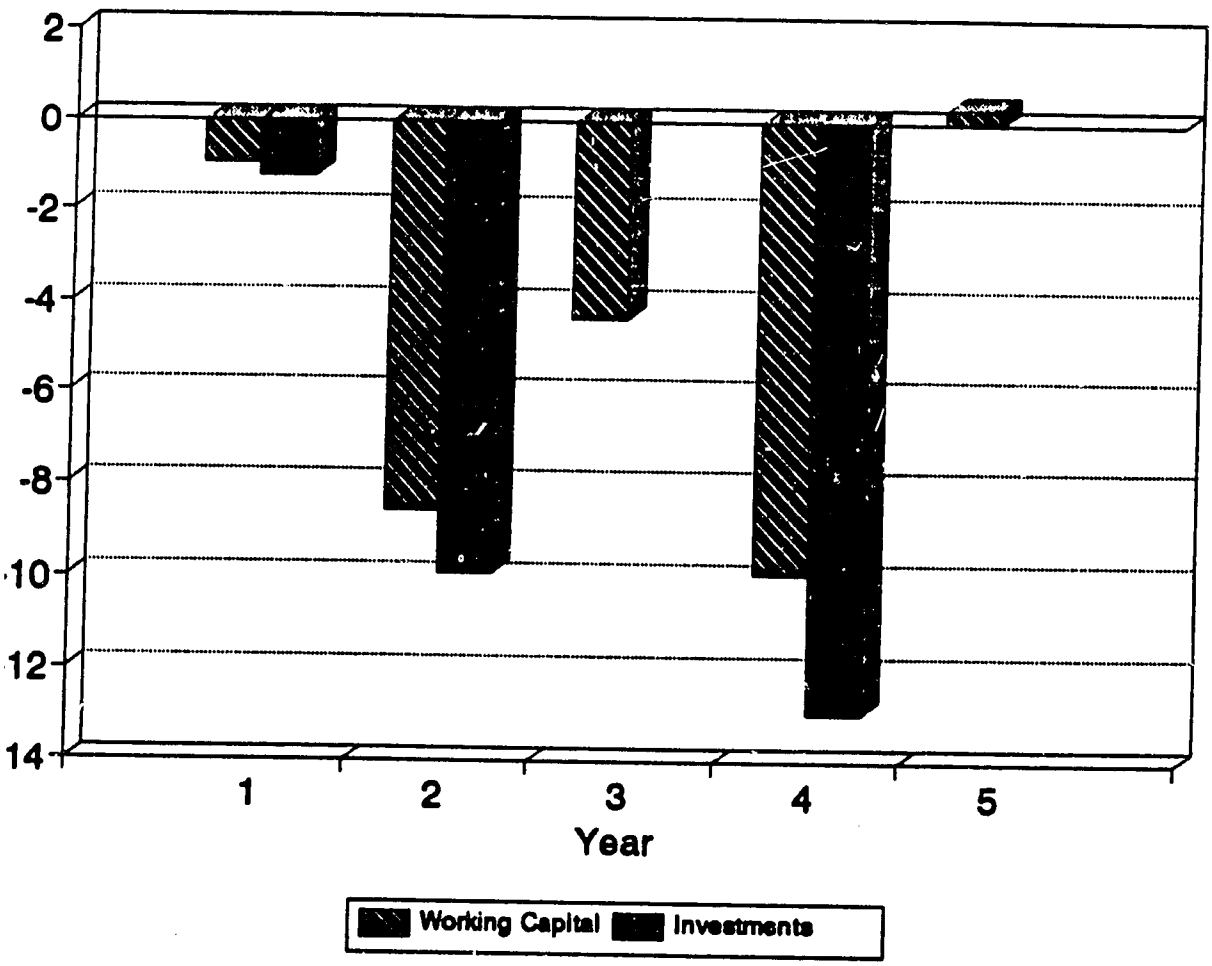
ALTERNATIVE II - PRIVATIZATION
TABLE II - Working Capital - Investment



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- Years 3-5 Charges to the population of 6100 FCFA/year/house

b. Schedule of Investments

- Year 1 Rehabilitation of equipment
  estimated cost 1.26 millions FCFA

- Year 2 Purchase 1 tractor and 2 containers on wheels
  estimated cost 9.9 millions FCFA

  Year 3 Purchase of 1 truck
  estimated cost 12.9 millions

4.3.3.2 Constraints

- High investment and payment by the population.
- Only a portion of the population will participate in the program for the first two years.

4.3.3.3 Advantages

- The population will have the opportunity to participate in community sensitivity trainingprograms

- During the implementation of the pilot program the municipality will use the rehabilitated equipment for collection garbage produced in Tiassale.

4.4 RECOMMENDED ALTERNATIVE

Based on the benefits described above and the adjustment period required by the population to adjust form public to private for Solid Waste Management we recommend alternative III.

LTERNATIVE III - PILOT PROGRAM - PRIVATIZATION

TABLE IV - CASH FLOW AND INVESTMENT SCHEDULE

escription	Year 1	Year 2	Year 3	Year 4	Year 5
pulation	45538.00	47040.75	48593.10	50196.67	51853.16
owth	0.033	0.033	0.033	0.033	0.033
Houses	6505.43	6720.11	6941.87	7170.95	7407.59
yment per House	1825.00	1825.00	6100.00	6100.00	6100.00
nicipality	10000.00	10000.00			
x/Elec+Add Res	3000.00	3099.00			
/Houses/pay-Pro	2142.86	2142.86	48593.10	50196.67	51853.16
ym contrac	3910.71	3910.71	42345.41	43742.81	45186.33
tal Rev	16910.71	13099.00	42345.41	43742.81	45186.33
penses	35502.00	35502.45	36537.00	36537.00	36537.00
ofit	15.00	15.00	15.00	15.00	15.00
nt's portion	17325.00	17325.00	36537.00	36537.00	36537.00
ofit	2598.75	2598.75	5480.55	5480.55	5480.55
tal Exp.	26749.46	26749.46	26749.26	26749.30	26749.26
vestment Schedule					
ih/Deprec.		1880.00	4560.00	4560.00	4560.00
king Capital	-9838.75	-11770.46	20156.15	21553.51	22997.07
iab/Purch	1260.00	9900.00	12800.00		
ance	-11098.75	-34766.98	-33668.88	-18175.77	1549.66
erest 18 %	-1997.77	-6258.06	-6060.40	-3271.64	
king Capital	-13096.52	-41025.04	-39729.28	-21447.40	1549.66

TIASSALE - COTE D'IVOIRE

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ALTERNATIVE III- PILOT PROGRAM
TABLE II - Working Capital - Investment

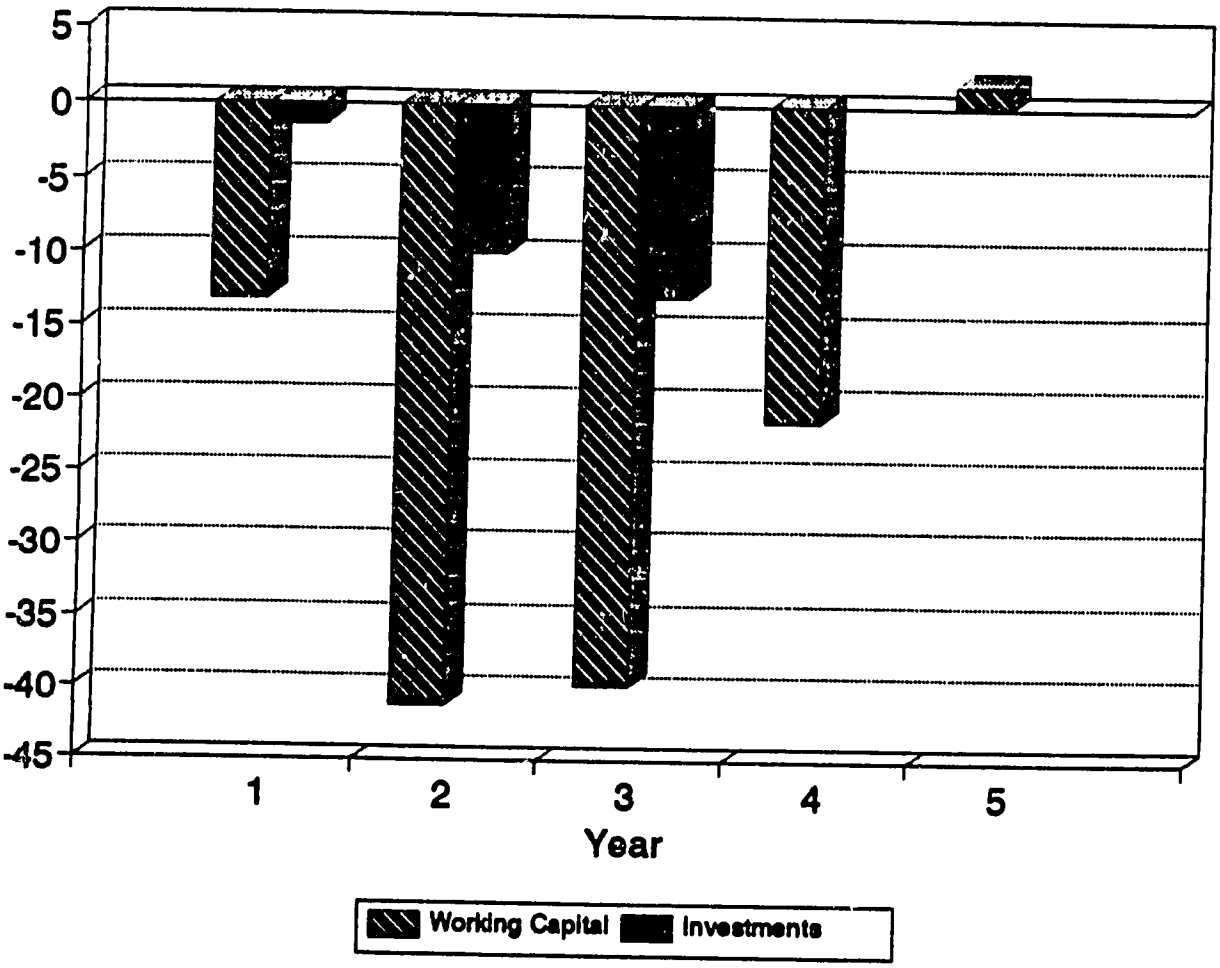

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Fig 6

V CONCLUSIONS AND RECOMMENDATION

5.1 CONCLUSIONS

5.1.1 Financial Constraints

The local government structure for collection and disbursement of funds represents a constraint for the implementation of the solid waste management (*). This situation has motivated the following:

- The municipality has failed to provide the community with the necessary service of collection and treatment of solid waste.

- To enforce regulation of disposal and management of solid waste. The absence of regulations has encouraged indiscriminate dumping.

- Lack of definition of the amount of surcharge on the electricity consumption and excessive delay of payments by the electric company.

5.1.1 Deficient Knowledge of to Solid Waste Impacts

Through the field visit and the responses of the survey the following could be drawn:

- The population indiscriminate dispose garbage in streets, empty lots and drainage of structures

- The population does not relate garbage accumulation to water related sickness

- The population burns garbage without without knowing the related respiratory diseases

5.2 RECOMMENDATIONS

Based on the finding of this study the consultants recommends the following:

a. Sensitivity program

The sensitivity program should include the analysis of:

- Impact on health due to lack of collection and treatment of solid waste.

- Impact of the infrastructure specially on drainage structures

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* Process for budget approval see Volume 1

- Impact on the quality of life

- Impact on air pollution.

b. Training programs*

Solid Waste Management Workshops should be conducted in the following topics:

Solid Waste Collection
Recycling and Re-use of Solid Waste
Sanitary Landfill
Management
Solid Waste Management and its applicability to concrete situations

3. Financial Support

In order to implement the recommended alternative, the municipality will require financial assistance for:

a Implementation of the recommended pilot program.
b Implementation of Workshops
c Implementation of sensitivity training programs
d Financial Support. Table V and picture 6 shows the required charges for implementation of alternative IIIa.

Table VI shows the revenues necessary to implement Alternative III with and without financial support.

TABLE VI - ALTERNATIVES III AND IIIA

Description	With Support	Without Support
Financial Support in millions FCFA	11.16	0
Payment for services		
Year 1		
Municipality in millions FCFA	10.0	10.0
Electricity surcharge in millions FCFA	3.0	3.0
Population FCFA/house	1,825	1,825
Year 2		
Municipality in millions FCFA	10.0	10.0

Electricity surcharge in millions FCFA	3.1	3.1
Population FCFA/house	1,825	1,825
Year 3 - Year 5 Payments in FCFA/house	6,100	5,320

LTERNATIVE IIIA- PILOT PROGRAM - PRIVATIZATION

TABLE V - CASH FLOW AND INVESTMENT SCHEDULE

ɜscription	Year 1	Year 2	Year 3	Year 4	Year 5
ɔpulation	45538.00	47040.75	48593.10	50196.67	51853.16
·owth	0.033	0.033	0.033	0.033	0.033
Houses	6505.43	6720.11	6941.87	7170.95	7407.59
,ymnent per House	1825.00	1825.00	5320.00	5320.00	5320.00
nicipality	10000.00	10000.00			
x/Elec+Add Res	3000.00	3099.00			
/Houses/pay-Pro	2142.86	2142.86	48593.10	50196.67	51853.16
ym contrac	3910.71	3910.71	36930.76	38149.47	39408.40
tal Rev	16910.71	13099.00	36930.76	38149.47	39408.40
penses	35502.00	35502.45	36537.00	36537.00	36537.00
ɔfit	15.00	15.00	15.00	15.00	15.00
ıt's portion	17325.00	17325.00	36537.00	36537.00	36537.00
ɔfit	2598.75	2598.75	5480.55	5480.55	5480.55
tal Exp.	26749.46	26749.46	26749.26	26749.30	26749.26
/estment Schedule					
ıh/Deprec.		1880.00	4560.00	4560.00	4560.00
·king Capital	-9838.75	-11770.46	14741.50	15960.17	17219.14
ıab/Purch			12800.00		
.ance	-9838.75	-23380.18	-25647.12	-14303.43	341.10
.erest 18 %	-1770.97	-4208.43	-4616.48	-2574.62	
·king Capital	-11609.72	-27588.61	-30263.60	-16878.05	341.10

TIASSALE - COTE D'IVOIRE

File tiass8

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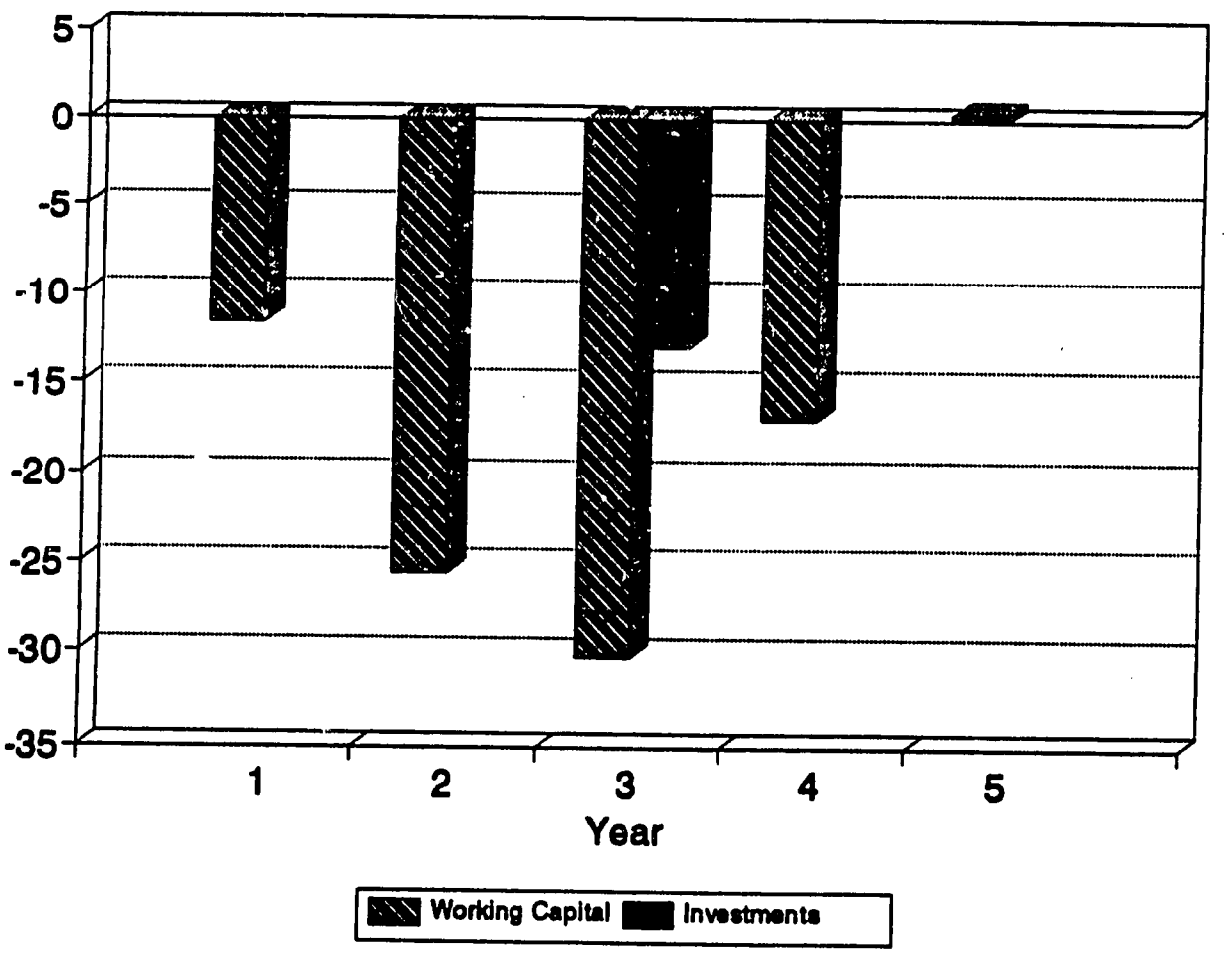
ALTERNATIVE IIIA - PILOT PROGRAM
TABLE II - Working Capital - Investment



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ANNEX - FINANCIAL ANALYSES

File SWMM-2TF

11-26-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: TIASSALE
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

  POPULATION: 45,538

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,554
MOYENNE	60	27,323
BAS	30	13,661

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.19
MOYENNE	0.60	16.39
BAS	0.40	5.46
SOUS-TOTAL		25.05
DIVERS		2.50
TOTAL		27.55

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1992	22.5	1.1	1	0.50	12.38
CAMION	102	1992	22.5	1.1	1	0.50	12.38
TOTAL							24.75

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 20.82 Tons

POURCENTAGE DE COLECTE 0.76 %

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE #	MODEL ANNEE	COUTS
CAMION	101	1992	12,900.00
CAMION	102	1992	12,900.00
TOTAL		FCFA	25,800.00
CONTENEURS	0	1800.00	0.00
TOTAL		FCFA	25,800.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	573.00
MANOEUVRES	420.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08
ABSENCE	0.08

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1992	0	15	1128	3	2148	3275.75
CAMION	1992	0	15	1128	3	2148	3275.75
TOTAL							6,551.50

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.17
CONTENUERS	0.20

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.100
CONTENEURS	0.200

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.20
CONTENEURS	0.01

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN Rparations
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	4282.80	0.00	4282.80
ENTRETEIN	2580.00	0.00	2580.00
REPARATIONS	5160.00	0.00	5160.00
TOTAL	12022.80	0.00	12022.80

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	18.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
VEH - M # 201	6200.00	1149.71	1029.20	620.00	1,240.00	4,038.92
MOBILET # 202	300.00	182.66	49.80	30.00	60.00	322.46
TOTAL						4,361.38

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
DIRECTEUR	1000.00	1	0.17	1170.00
ADJOIN-1	700.00	1	0.08	756.00
MANOEUVR	420.00	4	0.08	1814.40
TOTAL				3740.40

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	3740.40
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.37
TOTAL	3740.77

SOMMAIRE

SIEGE	0.00
TRANSPORT	4,361.38
SALAIRES	3,740.77
SOUS-TOTAL	8,102.15
ASSURANCE (.01 % SOUSTOTAL)	0.81
UTILITAIRES (.01 % SOUSTOTAL	0.81
TOTAL	8,103.77

11-26-1992

1.7 ANALYSE DE LA SITUATION PRESENT

ANNEE 1992

TABLE X SOMMAIRE - ANALISE FINANCIERE 1992

(EN MILLIER FCFA)

DESCRIPTION	COUTS
- COLLECTE	
OPERATION	6,551.50
AMORTISSEMENT	4,282.80
ENTRETIEN	2,580.00
REPARATION	5,160.00
TOTAL	18,574.30
- TRAITEMENT	
DECHARGE	0.00
STATION DE TRANSFERT	0.00
COMPOSTAGE	0.00
- ADMINISTRATION	
ADMINISTRATION	8,103.77
- AUTRES DEPENSES	
AUTRES DEPENSES	150.00
SOUS-TOTAL	26,828.07
DIVERS (10%)	2,682.81
TOTAL	29,510.88

COUT PAR TONNE FCFA 3883.90

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	12900.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	2141.40
ENTRETIEN	1290.00
REPARATION	2580.00

MAN D'OEUVRE	
CHAUFFEUR	1
MANOEUVRE	3
DENSITE DES DECHTES SOLIDES	0.50
CAPACITE DE COLLECTE	9.46

- CONTENEURS

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	360.000
ENTRETIEN	360.000
Reparation	18.000

- COUTS D'OPERATION

SALAIRES	2147.52
CARBURANT	1128.22

- REMBOURSEMENT 4125.13

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 47,041

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	4.70	3.29
MOYENNE	28.22	16.93
BAS	14.11	5.64
SOUS-TOTAL		25.87
DIVERS		2.59
TOTAL		28.46

- BESOINS DE COLLECTE

PRODUCTION 1993 28.46

Cap. de coll. pres 20.82

- PROJECTIONS POUR NIVEAU DE SERVICE = 75 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 0.53 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 0

CAPACITE DE COLLECTION POUR 1993 20.82

COUT DES VEH. ADDITIONEL 0.00
COUT, VEH. EXISTANT 25,800.00
TOTAL COUT DE COLLECTE 25,800.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 0

COUTS ADDITIIONEL 0.00
COUTS DES CONTENEURS EXISTANT 0.00
TOTAL COUTS DES CONTENEURS 0.00

TOTAL COUTS DES EQUIP. DE COLLECTE 25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISSEMENT VEH.	4,282.80
AMORTISSEMENT CONTENEURS	0.00
TOTAL AMORTISSEMENT	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL ENTRETIEN	2,580.00

- REPARATION

VEHICULES	5,160.00
CONTENEURS	0.00
TOTAL REPARATIONS	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL COUTS D'OPERATION	6,551.50

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	4.86		3.40	
MOYEN	29.16		17.49	
BAS		14.58		5.83
SOUS-TOTAL				26.73
DIVERS				2.67
TOTAL				29.40

- BESOINS DE COLLECTE

PRODUCTION 1994 29.40

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.23 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1994		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
TOTAL EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.02		3.51	
MOYEN	30.12		18.07	
BAS		15.06		6.02
SOUS-TOTAL				27.61
DIVERS				2.76
TOTAL				30.37

- BESOINS DE COLLECTE

PRODUCTION 1995 30.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.96 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1995		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMEN

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 51,853

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.19		3.63	
MOYEN	31.11		18.67	
BAS		15.56		6.22
SOUS-TOTAL				28.52
DIVERS				2.85
TOTAL				31.37

- BESOINS DE COLLECTE

PRODUCTION 1996 31.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 2.71 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1996		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 53,564

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.36		3.75	
MOYEN	32.14		19.28	
BAS		16.07		6.43
SOUS-TOTAL				29.46
DIVERS				2.95
TOTAL				32.41

- BESOINS DE COLLECTE

PRODUCTION 1997 32.41

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 3.49 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1997		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	0.00	0.00	0.00	0.00	0.00
AMORTISSEMENT	4,282.80	4,282.80	4,282.80	4,282.80	4,282.80
ENTRETIEN	2,580.00	2,580.00	2,580.00	2,580.00	2,580.00
REPARATIONS	5,160.00	5,160.00	5,160.00	5,160.00	5,160.00
OPERATION	6,551.50	6,551.50	6,551.50	6,551.50	6,551.50
TOTAL COLLECTE	18,574.30	18,574.30	18,574.30	18,574.30	18,574.30
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	8,103.77	8,103.77	8,103.77	8,103.77	8,103.77
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	150.00	150.00	150.00	150.00	150.00
SOUSTOTAL	26,828.07	26,828.07	26,828.07	26,828.07	26,828.07
DIVERS (15 %)	4,024.21	4,024.21	4,024.21	4,024.21	4,024.21
TOTAL	30,852.28	30,852.28	30,852.28	30,852.28	30,852.28

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

Alternative III

File SWMM-2TF

11-26-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: TIASSALE
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

  POPULATION: 45,538

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,554
MOYENNE	60	27,323
BAS	30	13,661

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.19
MOYENNE	0.60	16.39
BAS	0.40	5.46
SOUS-TOTAL		25.05
DIVERS		2.50
TOTAL		27.55

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE #	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1992	22.5	1.1	1	0.50	12.38
TRACTR	102	1992	22.5	1.1	1	0.50	12.38
TOTAL							24.75

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 20.82 Tons

POURCENTAGE DE COLECTE 0.76 %

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE	MODEL ANNEE	COUTS
CAMION	101	1992	12,900.00
TRACTR	102	1992	6,300.00
TOTAL		FCFA	19,200.00
CONTENEURS	0	1800.00	0.00
TOTAL		FCFA	19,200.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	573.00
MANOEUVRES	420.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08
ABSENCE	0.08

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1992	0	15	1128	3	2148	3275.75
TRACTR	1992	0	15	1128	2	1655	2783.68
TOTAL							6,059.43

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.17
CONTENUERS	0.20

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.100
CONTENEURS	0.200

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.20
CONTENEURS	0.01

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN RparationS
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	3187.20	0.00	3187.20
ENTRETEIN	1920.00	0.00	1920.00
REPARATIONS	3840.00	0.00	3840.00
TOTAL	8947.20	0.00	8947.20

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	18.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
VEH - M # 201	6200.00	1149.71	1029.20	620.00	1,240.00	4,038.92
MOBILET # 202	300.00	182.66	49.80	30.00	60.00	322.46
TOTAL						4,361.38

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1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
DIRECTEUR	1000.00	1	0.17	1170.00
ADJOIN-1	700.00	1	0.08	756.00
MANOEUVR	420.00	4	0.08	1814.40
TOTAL				3740.40

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	3740.40
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.37
TOTAL	3740.77
SOMMAIRE	
SIEGE	0.00
TRANSPORT	4,361.38
SALAIRES	3,740.77
SOUS-TOTAL	8,102.15
ASSURANCE (.01 % SOUSTOTAL)	0.81
UTILITAIRES (.01 % SOUSTOTAL	0.81
TOTAL	8,103.77

1.7 ANALYSE DE LA SITUATION PRESENT

ANNEE 1992

TABLE X SOMMAIRE - ANALISE FINANCIERE 1992

(EN MILLIER FCFA)

DESCRIPTION	COUTS
- COLLECTE	
OPERATION	6,059.43
AMORTISSEMENT	3,187.20
ENTRETIEN	1,920.00
REPARATION	3,840.00
TOTAL	15,006.63
- TRAITEMENT	
DECHARGE	0.00
STATION DE TRANSFERT	0.00
COMPOSTAGE	0.00
- ADMINISTRATION	
ADMINISTRATION	8,103.77
- AUTRES DEPENSES	
AUTRES DEPENSES	150.00
SOUS-TOTAL	23,260.40
DIVERS (10%)	2,326.04
TOTAL	25,586.45

COUT PAR TONNE FCFA 3367.41

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	12900.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	2141.40
ENTRETIEN	1290.00
REPARATION	2580.00

MAN D'OEUVRE	
CHAUFFEUR	1
MANOEUVRE	3
DENSITE DES DECHTES SOLIDES	0.50
CAPACITE DE COLLECTE	9.46

- CONTENEURS

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	360.000
ENTRETIEN	360.000
Reparation	18.000

- COUTS D'OPERATION

SALAIRES	2147.52
CARBURANT	1128.22

- REMBOURSEMENT 4125.13

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 47,041

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	4.70	3.29
MOYENNE	28.22	16.93
BAS	14.11	5.64
SOUS-TOTAL		25.87
DIVERS		2.59
TOTAL		28.46

- BESOINS DE COLLECTE

PRODUCTION 1993 28.46

Cap. de coll. pres 20.82

- PROJECTIONS POUR NIVEAU DE SERVICE = 75 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 0.53 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 0

CAPACITE DE COLLECTION POUR 1993 20.82

COUT DES VEH. ADDITIONEL	0.00
COUT, VEH. EXISTANT	19,200.00
TOTAL COUT DE COLLECTE	19,200.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 0

COUTS ADDITIIONEL	0.00
COUTS DES CONTENEURS EXISTANT	0.00
TOTAL COUTS DES CONTENEURS	0.00
TOTAL COUTS DES EQUIP. DE COLLECTE	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISSEMENT VEH.	3,187.20
AMORTISSEMENT CONTENEURS	0.00
TOTAL AMORTISSEMENT	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL ENTRETIEN	1,920.00

- REPARATION

VEHICULES	3,840.00
CONTENEURS	0.00
TOTAL REPARATIONS	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL COUTS D'OPERATION	6,059.43

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	4.86	3.40
MOYEN	29.16	17.49
BAS	14.58	5.83
SOUS-TOTAL		26.73
DIVERS		2.67
TOTAL		29.40

- BESOINS DE COLLECTE

PRODUCTION 1994 29.40

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.23 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1994		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00

TOTAL EQUIPEMENT 19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	5.02	3.51
MOYEN	30.12	18.07
BAS	15.06	6.02
SOUS-TOTAL		27.61
DIVERS		2.76
TOTAL		30.37

- BESOINS DE COLLECTE

PRODUCTION 1995 30.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.96 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1995		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 51,853

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	5.19	3.63
MOYEN	31.11	18.67
BAS	15.56	6.22
SOUS-TOTAL		28.52
DIVERS		2.85
TOTAL		31.37

- BESOINS DE COLLECTE

PRODUCTION 1996 31.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 2.71 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1996		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 53,564

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	5.36	3.75
MOYEN	32.14	19.28
BAS	16.07	6.43
SOUS-TOTAL		29.46
DIVERS		2.95
TOTAL		32.41

- BESOINS DE COLLECTE

PRODUCTION 1997 32.41

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 3.49 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1997		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	19,200.00

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	0.00	0.00	0.00	0.00	0.00
AMORTISSEMENT	3,187.20	3,187.20	3,187.20	3,187.20	3,187.20
ENTRETIEN	1,920.00	1,920.00	1,920.00	1,920.00	1,920.00
REPARATIONS	3,840.00	3,840.00	3,840.00	3,840.00	3,840.00
OPERATION	6,059.43	6,059.43	6,059.43	6,059.43	6,059.43
TOTAL COLLECTE	15,006.63	15,006.63	15,006.63	15,006.63	15,006.63
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	8,103.77	8,103.77	8,103.77	8,103.77	8,103.77
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	150.00	150.00	150.00	150.00	150.00
SOUSTOTAL	23,260.40	23,260.40	23,260.40	23,260.40	23,260.40
DIVERS (15 %)	3,489.06	3,489.06	3,489.06	3,489.06	3,489.06
TOTAL	26,749.46	26,749.46	26,749.46	26,749.46	26,749.46

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

REDSO/PMO/UD

MUNICIPAL DEVELOPMENT SUPPORT PROJECT
681-0004

PRIVATE PROVISION OF SOCIAL SERVICES (PPSS)
PDC-1008-C-00-9091-00

SOLID WASTE STUDY

for

TIASSALE

VOLUME 3 OF 3

by
Jean Tchimon Assemian
and
Mito Bessalel, PE
Consultants

ICMA
Washington, DC
USA

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I. EXISTING CONDITIONS

BACKGROUND

The commune of Tiassale is located 130 km north of Abidjan and 136 km south of Yamoussoukro. The Bandama and N'zi rivers pass through Tiassale. The Department encompasses two urban agglomerations, Tiassalé and N'Douci and four villages Taboitien, Niamoue, Nianda, and Kanganianze.(See Figure 1)

The beginning of Tiassale City can be traced to the establishment of the N'Gbattra. These settlers were displaced by the Baoules-Elomoin from Ghana. Tiassalé was a commercial center and a stopping point for travelers.

Area

Area of the Commune	16,800 ha.
Area of Tiassale	490 ha.
Percentage of urban/commune	2.93 %
Property division	630 ha.

Population

1988	39,922
1992	45,538

Population Growth 3.3%

At the present growth rate the projected population for five years is indicated below.

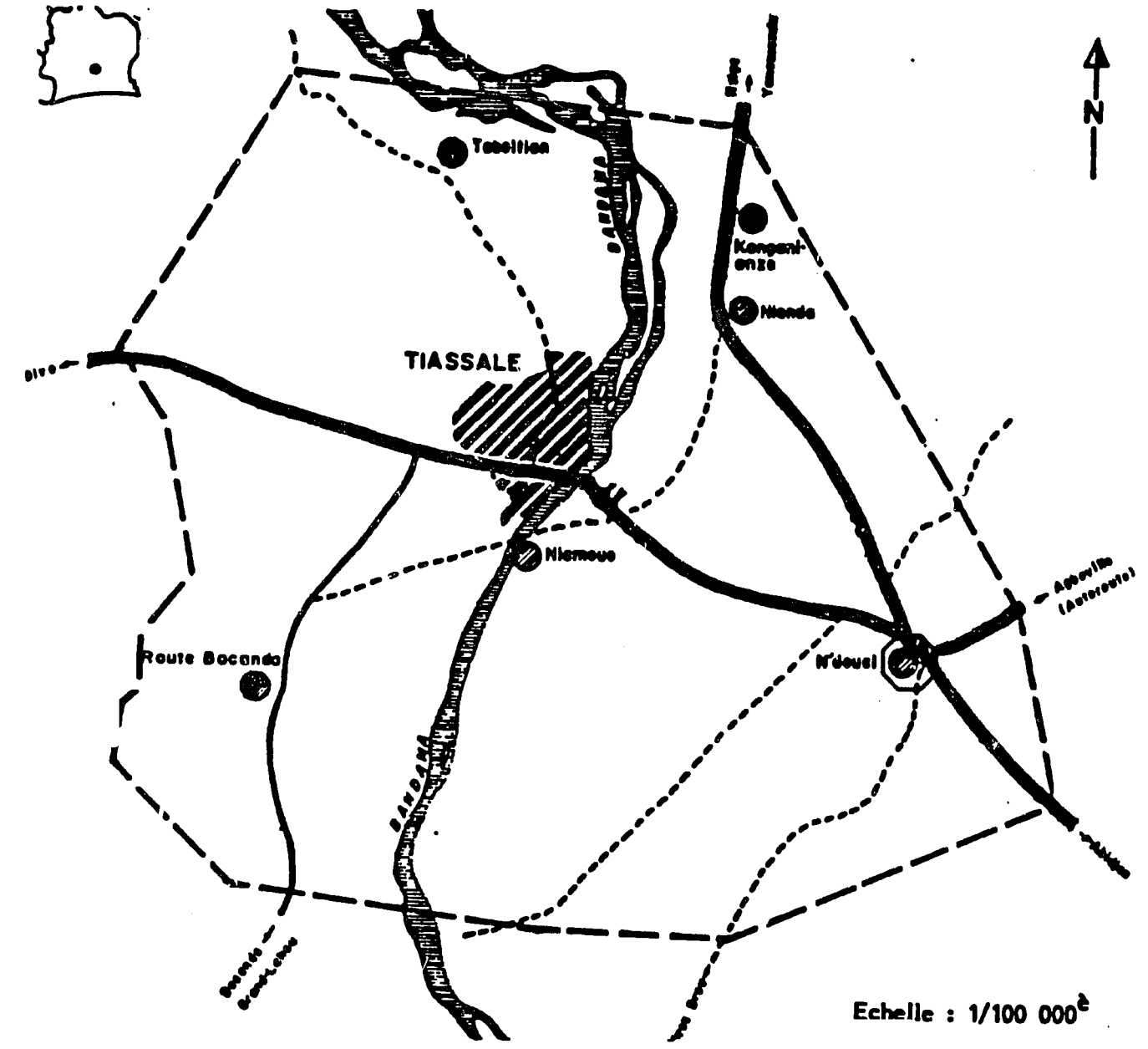
Year	Population
1992	45538
1993	47040
1994	48593
1995	50197
1996	51853
1997	53564

The populations of the nearby villages are:

Village	Population (1988)	Population(1992)
Tabotien	972	1004
Niamone	1378	1569
Nianda	1600	1821
Kanganianze	1870	2129

Density

Tiassale has a density of 69 person/ha.



LEGENDE

- Limite de territoire communal
- Route goudronnée
- Route en terre
- Piste
- Fleuve
- Rivière
- Espace urbanisé
- Village rattaché à la commune

FIGURE 1 - MUNICIPALITY OF TIASSALE

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Topography

The topography is basically flat, surrounded by secondary forest. The forest is exploited for agricultural purposes.

Weather

The climate is characterized by two rainy seasons: a major season covering April to mid-July, and a minor season which begins mid-September and ends mid-November.

Type of Residences:

There are two types of residences:

a. Medium Level

Medium level residences are located in the residential area where revenues are high. Sanitary facilities are either indoor or outdoor, and are generally relatively well maintained.

b. Low Level

Low level residences are located in poor areas. The sanitary facilities are located outside the houses and generally are not well maintained.

1.2 ECONOMIC RESOURCES

1.2.1 Agricultural Activities

The major cash crops are coffee, cacao, and pineapple. The agriculture production of levels of 1991 were as follows:

Coffee:	7000 Tons
Cacao:	21000 Tons
Rice :	9100 Tons
Corn:	6700 Tons
Pineapple	8000 Tons

1.2.2 Industrial Activities

a. Wood Products

The production of wood for 1991 was approximately 10,000 tons, of which 8700 tons were exported.

b. Pineapple

From 1989 to 1991 the S.A.F.C.O. processed 30,800 tons of pineapple.

1.3 INFRASTRUCTURE

Other than the old road to Toumodi and a small portion of the main street, roads are unpaved.

In addition to the two markets, there are bus/taxi stations, a hospital with three doctors and a dentist. There are no slaughter facilities.

Running water and 24-hour electricity are available in most neighborhoods, with access dependent on ability to pay.

The following services are provided by the city:

- 2 Preschool education centers, 1 private and 1 public
- 2 Kindergarten
- 3 French-Arab schools
- 1 Post office in Tiassalé and N'Douci
- 1 Telephone company
- 1 Water Company
- 1 Electric Company
- 2 Pharmacies
- 1 Cinema
- 1 Hospital
- 1 Rural Health Clinic

1.4 MANAGEMENT

The city is managed by the Mayor, Mr. Rene Amichia, and his 31 advisers. The Mayor expressed his desire to provide the best possible sanitation system for the city. His desire is also shared by his first assistant and the General Secretary.

The technical department is run by Mr. Kambo. His major responsibilities include the supervision of the solid waste collection and maintenance of roads and drainage structures.(See figure 2 shows the management organization chart)

1.5 PROJECT RELATED CONDITIONS

1.5.1. Erosion and Stagnation

The city contracted a private company to clean streets and ditches. This action has prevented erosion and stagnation. However, some of the areas are impassable due to the poor conditions of the roads. Flat areas are notable for the presence of stagnant water.(See Picture 1)

1.5.2 Washwater

Washwater from daily usage is routinely discarded in the streets and between houses. This exacerbates the stagnation problem and poses a contamination threat to the wells.

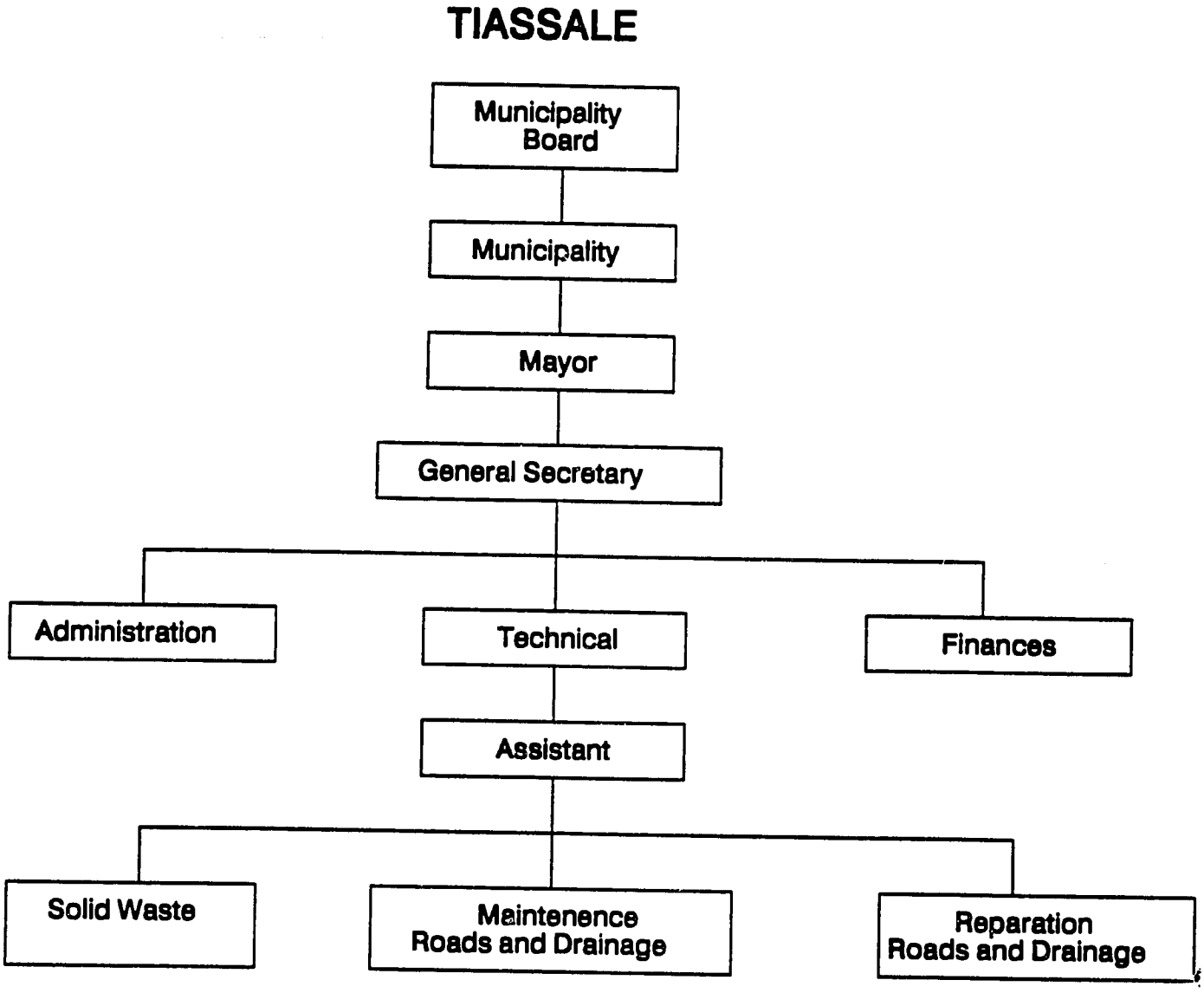

FIGURE 2 - ORGANIZATION CHART

1.5.3 Wastewater

Wells are prevalent and subject to contamination by the proliferation of uncontained latrines. The tendency of these latrines to flood during heavy rainfall is similarly problematic. An additional problem is posed by the widespread practice of urinating at roadside or at the side of buildings.

1.5.4 Solid Waste

Solid waste is noticeably absent from the main roads and street, due to the effective collection of the municipality and the cleaning of the gutters. Off the main roads, however, the situation is quite different since collector can not reach these areas.

Waste is disposed of in an assigned area located approximately 2.5 kilometers from downtown. Waste is dumped with no treatment.

The municipal efforts are almost exclusively focused on trash collection. Cleaning of streets and ditches is performed by an entrepreneur.

The Technical Department operates two collection trucks daily with three workers and a driver each.(See Picture 2) Trucks follow regular circuits through both commercial and residential areas. One truck collects the garbage from Tiassale and the other collects the trash from N'Douci. The system appears to work well while the two trucks are in good working condition (estimated collection percentage 75%).

1.6 IMPACT ON HUMAN HEALTH

1.6.1 General

Under warm, moist conditions, organic waste becomes an ideal breeding ground for disease-causing organisms. Pathogens predominate, having easy access to the waste via vectors. In the case of solid waste, the primary vectors are flies, rodents and mosquitoes.

The generation of harmful organisms and their transmission is not the only health hazard. Similarly important are the health risks posed by the indiscriminate disposal of solvents, pesticides, and medical waste.

A number of sources of potential health hazards can be easily identified:

- **Municipal** refuse containing human fecal matter and industrial waste.

- **Organic material**, whose decomposition can release contaminants into drainage, seepage and the atmosphere.

Picture 1 - Stagnant Wastewater

Picture 2 - Collection Equipment

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- Open burning of waste in the dumps creates extensive air pollution.

- Accumulation of piles of garbage in empty lots and streets.

1.6.2 Identification of Major Diseases

According to the statistics obtained in the Tiassale hospital, the major solid waste/wastewater-related sicknesses are:

- Enteric Diseases

  Diarrhea is a prevalent and chronic problem in environments where there are lax hygiene habits and the population is exposed to contaminated sources of food and drink.

- Malaria

  Wherever water accumulates, such as in ditches or near broken pipes, a natural urban breeding place for the anopheles mosquito is located. Malaria is transmitted through the bite of the infected female of this species.

- Respiratory Ailments

  The generation of harmful smoke from burning garbage and dust during dry seasons cause and exacerbate respiratory diseases.

1.7 DEFINITION OF BASIC PARAMETERS

1.7.1 General

The parameters shown below were used for the development of a five year financial analysis.

a. Population (1992): 43,538

b. Population growth: 3.3%

c. Waste Generation Rates

Waste generation rates are difficult to determine since there is no available data concerning solid waste production. However, based on the consultants' experience, the following solid waste production rates can be estimated:

- high income	0.70 kgr/pers
- medium income	0.50 kgr/pers
- Low income	0.40 Kgr/pers
- Miscellaneous	10 % of total

d. Density, Composition, and Moisture

Density, composition and moisture are the main parameters used for determining appropriate garbage collection and treatment design.

Density and composition are especially important, as they vary from area to area in the city. In wealthy neighborhoods, density tends to be low and garbage tends to have a high percentage of non-putrescible materials such as paper, plastics, glass, and metals. The garbage composition in lower-income areas, by contrast is mostly organic, with natural compaction. For the purposes of this analysis, the density used for the calculation of the volume to be transported was 0.50.

The following list shows the ranges of municipal refuse composition for low income communities[1] (% of total refuse, by weight):

Paper	1 to 10%
Glass and ceramics	1 to 10%
Metals	1 to 5%
Plastics	1 to 5%
Leather and rubber	1 to 5%
Wood, bones and straw	1 to 5%
Textiles	1 to 5%
Vegetable/putrescible	40 to 85%

1.7.2 Solid Waste Production and Collection Costs

Collection and disposal were calculated using a solid waste management model written in Quick Basic. A sample of typical runs are included in Appendix A.

---

1 Source: Environmental Management of Urban Solid Waste in Developing Countries - By Sandra J. Cointreau

II. IMPACT OF INADEQUATE WASTE COLLECTION ON THE ENVIRONMENT

2.1. GENERAL

The conditions observed during the field visit to Tiassale in general were not good. Piles of solid waste have accumulated in the streets, and at intersections, affecting other sectors of the city's infrastructure, as well as the health of the population. Furthermore, the evident neglect of the solid waste situation breeds widespread public apathy toward the problem, thereby further compounding it.

2.2 IMPACT ON THE CITY INFRASTRUCTURE

The trash discharged in the streets is carried into the drainage system, clogging pipes and ditches and forcing water to find its way down the streets until it reaches flat areas where it stagnates. In some locations, after a heavy rain, accumulation of mud, sludge, and garbage is not unusual.

2.3 IMPACTS ON THE HEALTH OF THE POPULATION

2.3.1 Garbage Accumulation

In addition to the solid waste indiscriminately discharged, the collected garbage is dumped untreated in open land in areas outside the limits of the city. During the rainy season, these accumulations become ideal breeding places for disease-producing organisms. During the dry season, the accumulations generate contaminated dust that blows over the city, promoting respiratory diseases.

According to the doctor at the Tiassale hospital, the three major sicknesses treated in the hospital are: malaria, diarrhea and bronchitis. Sanitary conditions are contributing factors in the prevalence and severity of all three.

See section 1.6.1 for a listing of potential health hazards posed by poor waste collection and disposal.

2.3.2 Identification of Major Diseases

See section 1.6.2

2.4 AIR POLLUTION

The industrial activities of Tiassale have no impact on air quality. However, lack of maintenance of the unpaved roads do contribute to the prevalence of airborne dust. This situation is aggravated by the presence of piles of garbage. Some waste is burned in the open to reduce the volume and control odors.

Little attention is paid to the fact that open burning decreases

air quality. The low temperature and the open burning increase the emission of particles, carbon monoxide, and hydrocarbons. Some of the emissions associated with open burning are:[2]

Particles	8.0 kgr. per ton.
Sulfur oxide	0.5 kgr. per ton.
Nitrogen oxide	3.0 kgr. per ton.
Carbon monoxide	42.9 kgr. per ton.

---

2. Source: Market Survey of Solid Waste Management, Port-au-Prince Water and Sanitation for Health Project

III. SURVEY APPROACH

3.1 GENERAL

There are three groups of waste producers -- household, commercial and industrial -- each contributing to the production of waste in varying ways.

3.1.1 Households

As this group is presumed to be the biggest producer of waste and also the most unknown in terms of production and disposal habits, most of the survey emphasis was placed here. A household questionnaire was used to identify some of the basic parameters to be used for the elaboration of the alternatives for the solid waste collection system.

The questionnaire asked questions relating to waste production, quality of service, and willingness to pay for solid waste collection (Sample of questionnaire in Appendix C, Volume 1). A total of ten household questionnaires were completed by the Technical Services Department of Tiassale.

3.1.2 Commercial and Industrial

No survey was performed for the commercial and industrial sector, because the incidence in the overall solid waste production was estimated to be minor.

3.2 SURVEY OUTCOME

The key findings of the survey are outline below:

a. Number of people per house:

10 or more	20 %
7-9	40 %
4-6	40 %

The average household in Tiassale, then, is made up of about seven people.

b. Disposal of Organic Material

60% of residents dispose of organic material.
40% of the survey's respondents had no comment.

c. Composition of Non-Organic Waste

Plastics	90%
Cartons	80%
Metal	60%

d. Purchase of recycled waste

No positive response to this question.

e. Location of garbage disposal

In front of my house	30%	
At a collection point	10%	
In a ditch		0%
In an empty lot	20%	
Burned	10%	
Other	30%	

f. Responsibilities for Garbage Collection

Municipality	40%
Private	40%
do not know	20%

g. Willingness to pay for Collection Service

1000 FCFA/w	0%
500 FCFA/w	20%
300 FCFA/w	20%
200 FCFA/w	10%
Unwilling to pay	50%

h. Community Participation

100% responded that currently there is no community participation in the SWM system, but that they would like to know more about potential in this area.

IV. ALTERNATIVES AND RECOMMENDED SOLUTIONS

4.1 GENERAL

The system for the collection and treatment of solid waste in Tiassale has deteriorated through the years. The most important reason is that no investment has been made for replacement and reparation of existing equipment. The present collection level of service is estimated at 75%. (With only one truck in working condition, however, the level of service estimate drops to only 50%).

4.2 PRESENT COLLECTION CAPABILITY

- Equipment

  Two trucks (models 1986 and 1987) with a capacity of 5 m^3 each collect garbage 6 days a weeks. The daily collection capacity is estimated at 22.5 m^3 (4.5 trips each day). It is estimated, however, that 50% of the time one or more of the trucks are broken.

- Collection Personnel

  Each truck is operated by a driver and three laborers.

- Operation Costs

  Table I indicates the actual expenditures and the estimated operating cost necessary to maintain the same level of service for 1991. All data was provided by the Finance Department of Tiassale.

TABLE I - PRESENT EXPENDITURE AND ESTIMATED OPERATING COSTS in FCFA

Description	Expended	Required	Shortfall
Diesel	3,000,000	2,438,000	-562,000
Salary	6,068,319	6,068,319	-
Repairs and Maintenance	961,940	7,740,000	6,778,060
Depreciation	-	-	-
Total	10,030,259	16,246,319	6,216,060

The following can be concluded:

- Depreciation was not estimated.
- Not sufficient maintenance and repairs were performed.

To maintain a level of service of 75%, it will be required to allocate an additional 6.2 million FCFA annually.

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4.3 ALTERNATIVE SOLUTIONS

Three alternatives were studied.

4.3.1 ALTERNATIVE I - MINIMUM INVESTMENT

This alternative proposes:

- that Solid Waste Management remains a municipal responsibility, and
- rehabilitation of equipment.

4.3.1.1 Assumptions

- Increase electricity surcharge from 1 FCFA/kw-h to 3.4 FCFA/kw-h.

- Repair collecting equipment, estimated cost 1.26 million FCFA.

- Purchase and rehabilitation of equipment as follows: (see Table II and Figure 3)

  Year 1 - Rehabilitation of trucks, estimated cost: 1.26 million FCFA

  Year 4 - 1 Tractor and 2 containers on wheels, estimated cost: 9.9 millions FCFA [3].

- Additional charges on electricity bills are:

  Year 1 - 10,200,000 FCFA
  Year 2 - 10,535,600 FCFA
  Year 3 - 10,884,310 FCFA
  Year 4 - 11,243,490 FCFA
  Year 5 - 11,614,530 FCFA

4.3.1.2 Major Constraints

- Increased electricity surcharge

- Only electricity users pay for services of collection and treatment of solid waste

- Low level of production of the waste collectors

- Disposal habits of the population

- Repair and maintenance capability of the municipality

---

[3] Source: CICA - Abidjan, Cote d'Ivoire

ALTERNATIVE I - MINIMUM INVESTMENT

TABLE II - CASH FLOW - ADDITIONAL RESOURCES

escription	Year 1	Year 2	Year 3	Year 4	Year 5
opulation	45538.00	47040.75	48593.10	50196.67	51853.16
rowth	0.033	0.033	0.033	0.033	0.033
# Houses	6505.43	6720.11	6941.87	7170.95	7407.59
evenues					
unicip'y	10000.00	10000.00	10000.00	10000.00	10000.00
nergy charges SW	10200.00	10536.60	10884.31	11243.49	11614.53
otal Rev	20200.00	20536.60	20884.31	21243.49	21614.53
xpenses					
resent	17325.00	17900.00	18474.00	19048.00	19622.00
eparat/Purch.	1260.00			9900.00	
otal	18585.00	17900.00	18474.00	28948.00	19622.00
alance	1615.00	2636.60	2410.31	-7704.51	1992.53
rking Capital	1615.00	4251.60	6661.91	-1042.60	949.92
stimated Energy /h/year('000)	3000.00	3099.00	3201.27	3306.91	3416.04
charge/kw/h	3.40	3.40	3.40	3.40	3.40

TIASSALE - COTE D'IVOIRE

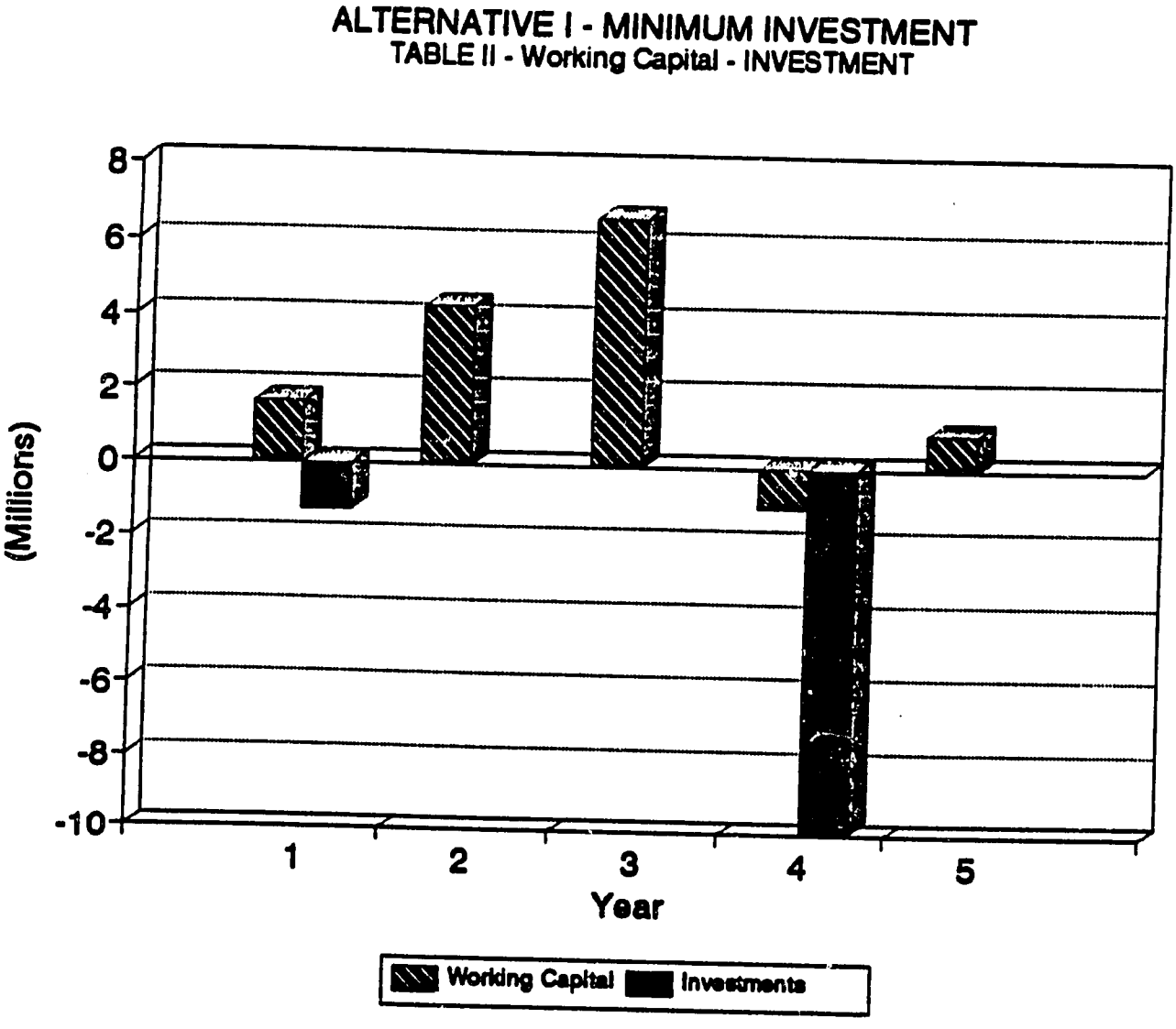

FIGURE 3 ALTERNATIVE I - MINIMUM INVESTMENT

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21.4

4.3.2 ALTERNATIVE II - PRIVATIZATION OF THE SWM SYSTEM

Alternative II proposes the rehabilitation of the existing equipment, and purchase of new equipment as required (see Table III and Figure 4).

The financial analysis of this alternative was calculated using a charge of 5,550 FCFA per house (estimated 7 people/house).

4.3.2.1 Assumptions

- Repair collecting equipment, estimated cost 1.26 million FCFA

- Purchase and rehabilitate equipment as follows:
  (see Table III and Figure 3)

  Year 1 - Rehabilitation of trucks,
  estimated cost 1.26 million FCFA
  - 1 Tractor and 2 containers on wheels
  estimated cost 9.9 millions FCFA [3].

  Year 3 - 1 Truck with a capacity of 5m3 (Approx 3 Ton.)
  estimated cost 12.9 million FCFA [3].

4.3.2.2 Major Constraints

- The population is not prepared to pay for the collection of their solid waste.

- Disposal habits of the population.

4.3.3 ALTERNATIVE III PILOT PROGRAM

This alternative proposes the rehabilitation of existing equipment and the purchase of a tractor, two containers, and a truck with a capacity of 5 m^3. (See Table IV and Figure 5)

This solution should be implemented in two phases:

- Phase I Implementation of a two year pilot program

  N'Douci, with an estimated population of 15,000 people, was selected as the area for the development of the pilot program (See figure 1).

- Phase II Implementation of privatization of the solid waste management of Tiassale.

ALTERNATIVE II - SOLID WASTE MANAGEMENT - PRIVATIZATION

TABLE III - WORKING CAPITAL AND INVESTMENT SCHEDULE

Description	Year 1	Year 2	Year 3	Year 4	Year 5
Population	45538.00	47040.75	48593.10	50196.67	51853.16
Growth	0.033	0.033	0.033	0.033	0.033
# Houses	6505.43	6720.11	6941.87	7170.95	7407.59
Rev/House	5500.00	5550.00	5550.00	5550.00	5550.00
Total Rev	35779.86	37296.60	38527.39	39798.79	41112.15
Expenses	30852.00	30852.00	30852.00	30852.00	30852.00
Profit 15%	15.00	15.00	15.00	15.00	15.00
Total	35479.80	35479.80	35479.80	35479.80	35479.80
Balance	300.06	1816.80	3047.59	4318.99	5632.35
Investment Schedule	1260.00	9900.00		12900.00	
Depreciation		1800.00	1800.00	4560.00	4560.00
Working Capital	-959.94	-7243.15	-3699.33	-8386.21	296.62
Interesr - 18%		-1303.77	-665.88	-1509.52	
Total Cash	-959.94	-8546.91	-4365.20	-9895.73	296.62

TIASSALE - IVORY COAST

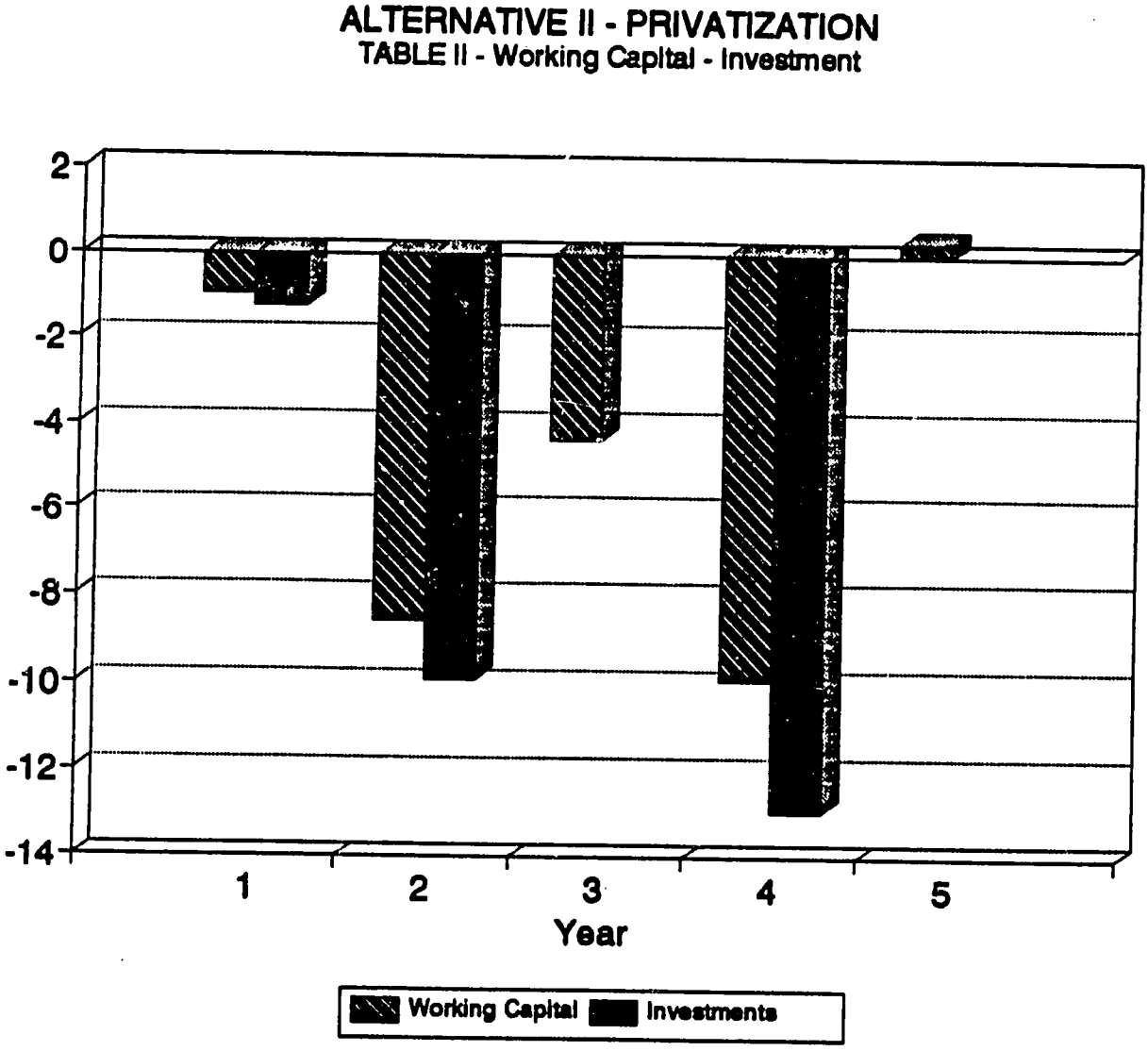

FIGURE 4 - ALTERNATIVE II - PRIVATIZATION

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4.3.3.1. Assumptions:

a. Estimated Revenues

- Year 1 Charges to the population 1825 FCFA/year/house
  Electricity surcharges 3.0 million FCFA
  Municipality contribution estimated 10 million FCFA

- Year 2 Charges to the population 1825 FCFA/year/house
  Electricity surcharges 3.138 million FCFA
  Municipality contribution estimated 10 million FCFA

- Years 3-5 Charges to the population of 6100 FCFA/year/house

b. Schedule of Investments

- Year 1 Rehabilitation of equipment
  Estimated Cost 1.26 million FCFA

- Year 2 Purchase 1 tractor and 2 containers on wheels
  estimated cost 9.9 million FCFA

- Year 3 Purchase of 1 truck estimated cost 12.9 million

4.3.3.2 Constraints

- High investment and payment by the population.

- Only a portion of the population will participate in the program for the first two years.

4.3.3.3 Advantages

- The population will have the opportunity to participate in community sensitivity training.

- Disposal habits of the population are addressed.

- During the implementation of the pilot program the municipality will use the rehabilitated equipment for the collection of garbage produced in Tiassale.

4.4 RECOMMENDED ALTERNATIVE

Based on the benefits described above and the adjustment period required by the population to convert from a public to a private system of Solid Waste Management, we recommend alternative III.

ALTERNATIVE III - PILOT PROGRAM - PRIVATIZATION

TABLE IV - WORKING CAPITAL WITHOUT FINANCIAL SUPPORT

Description	Year 1	Year 2	Year 3	Year 4	Year 5
Population	45538.00	47040.75	48593.10	50196.67	51853.16
Growth	0.033	0.033	0.033	0.033	0.033
# Houses	6505.43	6720.11	6941.87	7170.95	7407.59
Payment per House	1825.00	1825.00	6100.00	6100.00	6100.00
Municipality	10000.00	10000.00			
Tax/Elec+Add Res	3000.00	3099.00			
# /Houses/pay-Pro	2142.86	2142.86	48593.10	50196.67	51853.16
Paym contrac	3910.71	3910.71	42345.41	43742.81	45186.33
Total Rev	16910.71	13099.00	42345.41	43742.81	45186.33
Expenses	35502.00	35502.45	36537.00	36537.00	36537.00
Profit	15.00	15.00	15.00	15.00	15.00
Cont's portion	17325.00	17325.00	36537.00	36537.00	36537.00
Profit	2598.75	2598.75	5480.55	5480.55	5480.55
Total Exp.	26749.46	26749.46	26749.26	26749.30	26749.26
Investment Schedule					
Cash/Deprec.		1880.00	4560.00	4560.00	4560.00
Working Capital	-9838.75	-11770.46	20156.15	21553.51	22997.07
Rehab/Purch	1260.00	9900.00	12800.00		
Balance	-11098.75	-34766.98	-33668.88	-18175.77	1549.66
Interest 18 %	-1997.77	-6258.06	-6060.40	-3271.64	
Working Capital	-13096.52	-41025.04	-39729.28	-21447.40	1549.66

TIASSALE - COTE D'IVOIRE

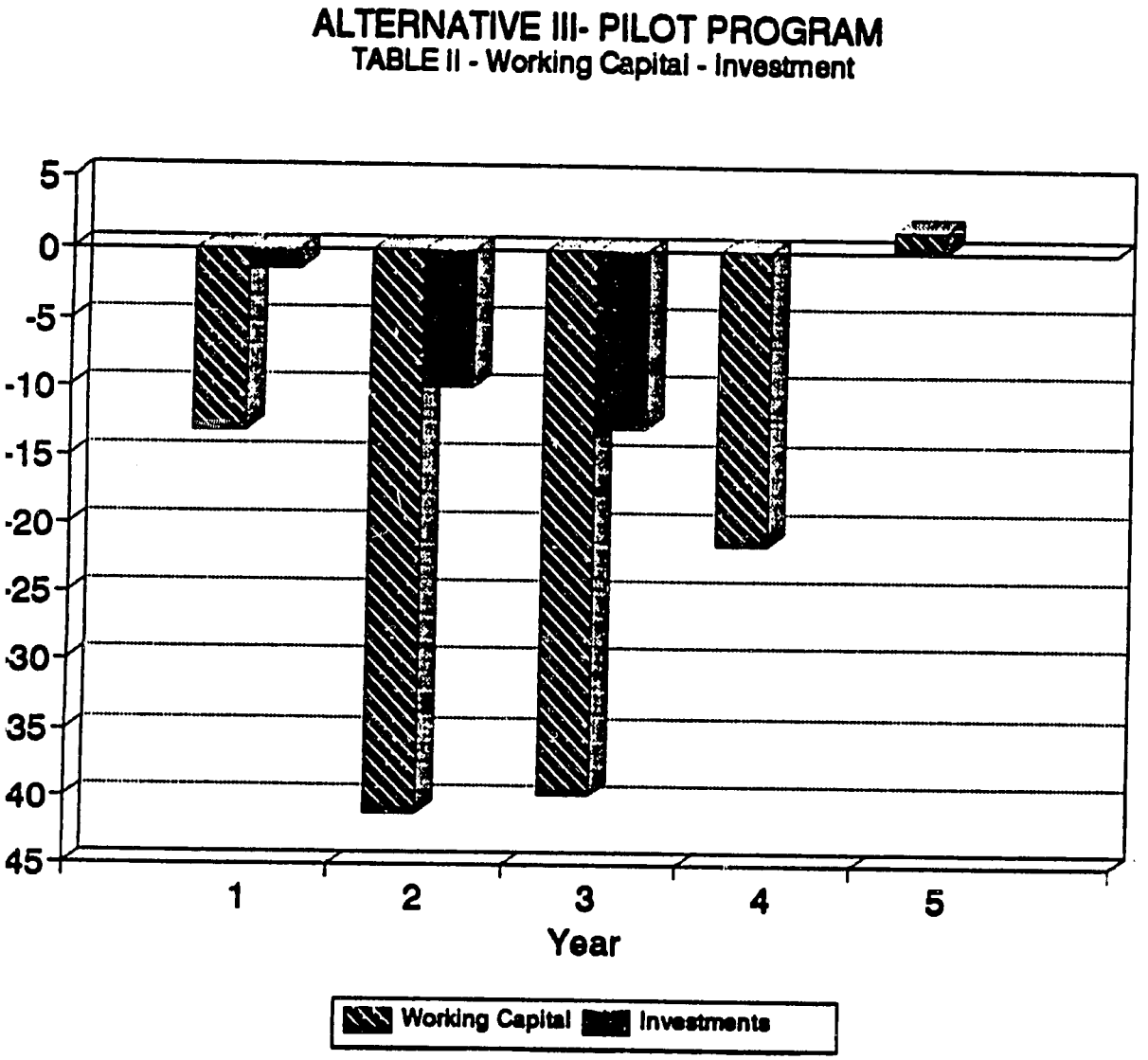

FIGURE 5 - ALTERNATIVE III - WITHOUT FINANCIAL SUPPORT

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V. CONCLUSIONS AND RECOMMENDATION

5.1 CONCLUSIONS

5.1.1 Financial Constraints

The local government structure for collection and disbursement of funds represents a constraint for the implementation of the solid waste management program (see Vol.1 for description of budget approval process). This situation has motivated the following:

- A municipal failure to provide the community with the necessary service of collection and treatment of solid waste.

- A municipal failure to enforce regulation of disposal and management of solid waste. Moreover, the absence of regulations has encouraged indiscriminate dumping.

- Lack of definition of the amount of surcharge on the electricity consumption and excessive delay of payments by the electric company.

5.1.1 Deficient Understanding of Solid Waste and Its Impacts

Throughout the field visit and the responses of the survey the following conclusions can be drawn:

- The population indiscriminately disposes of its garbage in streets, empty lots, and into drainage structures.

- The population does not relate garbage accumulation to water-related sickness.

- The population burns garbage without knowing the related respiratorial implications.

5.2 RECOMMENDATIONS

Based on the finding of this study the consultants recommend the following:

a. Sensitivity program

The community-wide sensitivity program should cover the impacts of improper collection and treatment of solid waste on:

Health
Drainage infrastructure
Air/Water quality
Quality of life

b. Training programs

Solid Waste Management Workshops should be conducted in the following topics:

Solid Waste Collection
Solid Waste Treatment
Recycling and Re-use of Solid Waste
Sanitary Landfill
Management
Solid Waste Management and its applicability to concrete situations

c. Financial Support

In order to implement the recommended alternative, the municipality will require financial assistance for:

Implementation of the recommended pilot program.
Implementation of Workshops
Implementation of sensitivity training programs

The revenues necessary to implement Alternative III with financial support are shown in Table V and Figure 6. Table VI shows a summary of charges for alternative III with and without financial support.

ALTERNATIVE III - PILOT PROGRAM - PRIVATIZATION

TABLE V - WORKING CAPITAL WITH FINANCIAL SUPPORT

Description	Year 1	Year 2	Year 3	Year 4	Year 5
Population	45538.00	47040.75	48593.10	50196.67	51853.16
Growth	0.033	0.033	0.033	0.033	0.033
# Houses	6505.43	6720.11	6941.87	7170.95	7407.59
Payment per House	1825.00	1825.00	5320.00	5320.00	5320.00
Municipality	10000.00	10000.00			
Tax/Elec+Add Res	3000.00	3099.00			
# /Houses/pay-Pro	2142.86	2142.86	48593.10	50196.67	51853.16
Paym contrac	3910.71	3910.71	36930.76	38149.47	39408.40
Total Rev	16910.71	13099.00	36930.76	38149.47	39408.40
Expenses	35502.00	35502.45	36537.00	36537.00	36537.00
Profit	15.00	15.00	15.00	15.00	15.00
Cont's portion	17325.00	17325.00	36537.00	36537.00	36537.00
Profit	2598.75	2598.75	5480.55	5480.55	5480.55
Total Exp.	26749.46	26749.46	26749.26	26749.30	26749.26
Investment Schedule					
Cash/Deprec.		1880.00	4560.00	4560.00	4560.00
Working Capital	-9838.75	-11770.46	14741.50	15960.17	17219.14
Rehab/Purch			12800.00		
Balance	-9838.75	-23380.18	-25647.12	-14303.43	341.10
Interest 18 %	-1770.97	-4208.43	-4616.48	-2574.62	
Working Capital	-11609.72	-27588.61	-30263.60	-16878.05	341.10

TIASSALE - COTE D'IVOIRE

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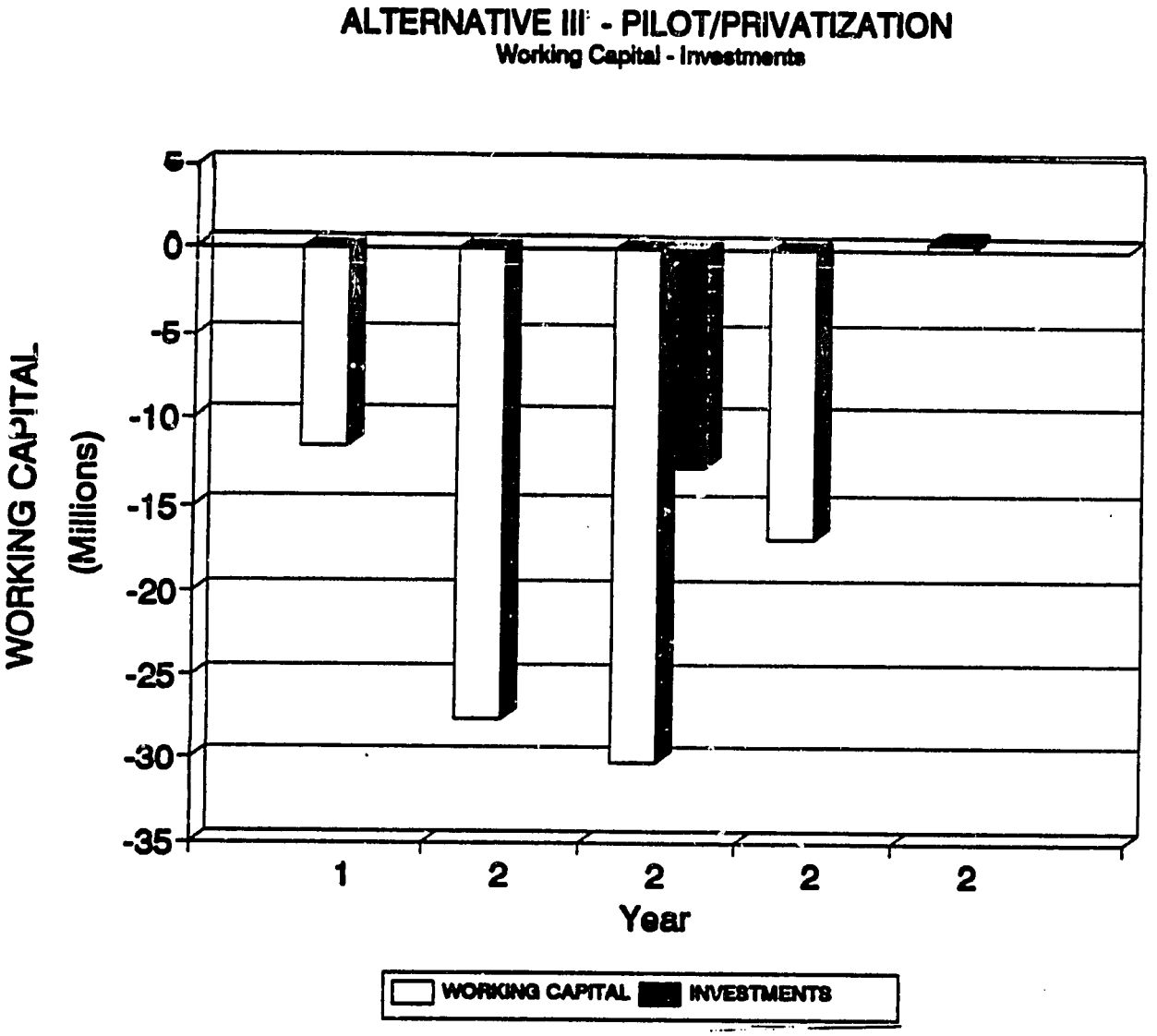

FIGURE 6 - ALTERNATIVE III - WITH FINANCIAL SUPPORT

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TABLE VI - ALTERNATIVE III WITH/WITHOUT FINANCIAL SUPPORT

Description	With Support	Without Support
Financial Support in millions·FCFA	11.16	0
Payment for services		
Year 1		
Municipality in millions FCFA	10.0	10.0
Electricity surcharge in millions FCFA	3.0	3.0
Population FCFA/house	1825.0	1825.0
Year 2		
Municipality in millions FCFA	10.0	10.0
Electricity surcharge in millions FCFA	3.1	3.1
Population FCFA/house	1825.0	1825.0
Year 3 - Year 5 Payments in FCFA/house	6100.0	5320.0

APPENDIX - FINANCIAL ANALYSES

Alternative II	A - 1
Alternative III	A - 21

File SWMM-2TF

11-26-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: TIASSALE
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

  POPULATION: 45,538

- DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,554
MOYENNE	60	27,323
BAS	30	13,661

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.19
MOYENNE	0.60	16.39
BAS	0.40	5.46
SOUS-TOTAL		25.05
DIVERS		2.50
TOTAL		27.55

1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE #	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1992	22.5	1.1	1	0.50	12.38
CAMION	102	1992	22.5	1.1	1	0.50	12.38
TOTAL							24.75

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 20.82 Tons

POURCENTAGE DE COLECTE 0.76 %

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE	MODEL ANNEE	COUTS
CAMION	101	1992	12,900.00
CAMION	102	1992	12,900.00
TOTAL		FCFA	25,800.00
CONTENEURS	0	1800.00	0.00
TOTAL		FCFA	25,800.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	573.00
MANOEUVRES	420.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08

ABSENCE	0.08

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1992	0	15	1128	3	2148	3275.75
CAMION	1992	0	15	1128	3	2148	3275.75
TOTAL							6,551.50

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.17
CONTENUERS	0.20

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.100
CONTENEURS	0.200

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.20
CONTENEURS	0.01

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN Rparations
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	4282.80	0.00	4282.80
ENTRETEIN	2580.00	0.00	2580.00
REPARATIONS	5160.00	0.00	5160.00
TOTAL	12022.80	0.00	12022.80

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	18.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION	COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
VEH - M # 201	6200.00	1149.71	1029.20	620.00	1,240.00	4,038.92
MOBILET # 202	300.00	182.66	49.80	30.00	60.00	322.46
TOTAL						4,361.38

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
DIRECTEUR	1000.00	1	0.17	1170.00
ADJOIN-1	700.00	1	0.08	756.00
MANOEUVR	420.00	4	0.08	1814.40
TOTAL				3740.40

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	3740.40
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.37
TOTAL	3740.77

SOMMAIRE

SIEGE	0.00
TRANSPORT	4,361.38
SALAIRES	3,740.77
SOUS-TOTAL	8,102.15
ASSURANCE (.01 % SOUSTOTAL)	0.81
UTILITAIRES (.01 % SOUSTOTAL	0.81
TOTAL	8,103.77

1.7 ANALYSE DE LA SITUATION PRESENT

ANNEE 1992

TABLE X SOMMAIRE - ANALISE FINANCIERE 1992

(EN MILLIER FCFA)

DESCRIPTION	COUTS
- COLLECTE	
OPERATION	6,551.50
AMORTISSEMENT	4,282.80
ENTRETIEN	2,580.00
REPARATION	5,160.00
TOTAL	18,574.30
- TRAITEMENT	
DECHARGE	0.00
STATION DE TRANSFERT	0.00
COMPOSTAGE	0.00
- ADMINISTRATION	
ADMINISTRATION	8,103.77
- AUTRES DEPENSES	
AUTRES DEPENSES	150.00
SOUS-TOTAL	26,828.07
DIVERS (10%)	2,682.81
TOTAL	29,510.88

COUT PAR TONNE FCFA 3883.90

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	12900.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	2141.40
ENTRETIEN	1290.00
REPARATION	2580.00

MAN D'OEUVRE	
CHAUFFEUR	1
MANOEUVRE	3
DENSITE DES DECHTES SOLIDES	0.50
CAPACITE DE COLLECTE	9.46

- CONTENEURS

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	360.000
ENTRETIEN	360.000
Reparation	18.000

- COUTS D'OPERATION

SALAIRES	2147.52
CARBURANT	1128.22

- REMBOURSEMENT 4125.13

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 47,041

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	4.70	3.29
MOYENNE	28.22	16.93
BAS	14.11	5.64
SOUS-TOTAL		25.87
DIVERS		2.59
TOTAL		28.46

- BESOINS DE COLLECTE

PRODUCTION 1993 28.46

Cap. de coll. pres 20.82

- PROJECTIONS POUR NIVEAU DE SERVICE = 75 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 0.53 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 0

CAPACITE DE COLLECTION POUR 1993 20.82

COUT DES VEH. ADDITIONEL	0.00
COUT, VEH. EXISTANT	25,800.00
TOTAL COUT DE COLLECTE	25,800.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 0

COUTS ADDITIIONEL	0.00
COUTS DES CONTENEURS EXISTANT	0.00
TOTAL COUTS DES CONTENEURS	0.00
TOTAL COUTS DES EQUIP. DE COLLECTE	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISSEMENT VEH.	4,282.80
AMORTISSEMENT CONTENEURS	0.00
TOTAL AMORTISSEMENT	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL ENTRETIEN	2,580.00

- REPARATION

VEHICULES	5,160.00
CONTENEURS	0.00
TOTAL REPARATIONS	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL COUTS D'OPERATION	6,551.50

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	4.86		3.40	
MOYEN	29.16		17.49	
BAS		14.58		5.83
SOUS-TOTAL				26.73
DIVERS				2.67
TOTAL				29.40

- BESOINS DE COLLECTE

PRODUCTION 1994 29.40

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.23 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1994		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
TOTAL EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.02		3.51	
MOYEN	30.12		18.07	
BAS		15.06		6.02
SOUS-TOTAL				27.61
DIVERS				2.76
TOTAL				30.37

- BESOINS DE COLLECTE

PRODUCTION 1995 30.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.96 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1995		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 51,853

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.19		3.63	
MOYEN	31.11		18.67	
BAS		15.56		6.22
SOUS-TOTAL				28.52
DIVERS				2.85
TOTAL				31.37

- BESOINS DE COLLECTE

PRODUCTION 1996 31.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 2.71 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1996		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL
COUT CONT. EXISTANT
TOTAL

Total EQUIPEMENT

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 53,564

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS		POPULATION EN '000		DECHETS SOLIDES EN TONNE.
HAUT,	5.36		3.75	
MOYEN	32.14		19.28	
BAS		16.07		6.43
SOUS-TOTAL				29.46
DIVERS				2.95
TOTAL				32.41

- BESOINS DE COLLECTE

PRODUCTION 1997 32.41

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 3.49 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1997		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	25,800.00	
Total	25,800.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	25,800.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	4,282.80
AMORTISEMENT	0.00
TOTAL	4,282.80

- ENTRETIEN - EQUIPEMENT

VEHICULES	2,580.00
CONTENEURS	0.00
TOTAL	2,580.00

- REPARATION

VEHICULE	5,160.00
CONTENEURS	0.00
TOTAL	5,160.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,551.50
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,551.50

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	0.00	0.00	0.00	0.00	0.00
AMORTISSEMENT	4,282.80	4,282.80	4,282.80	4,282.80	4,282.80
ENTRETIEN	2,580.00	2,580.00	2,580.00	2,580.00	2,580.00
REPARATIONS	5,160.00	5,160.00	5,160.00	5,160.00	5,160.00
OPERATION	6,551.50	6,551.50	6,551.50	6,551.50	6,551.50
TOTAL COLLECTE	18,574.30	18,574.30	18,574.30	18,574.30	18,574.30
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	8,103.77	8,103.77	8,103.77	8,103.77	8,103.77
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	150.00	150.00	150.00	150.00	150.00
SOUSTOTAL	26,828.07	26,828.07	26,828.07	26,828.07	26,828.07
DIVERS (15 %)	4,024.21	4,024.21	4,024.21	4,024.21	4,024.21
TOTAL	30,852.28	30,852.28	30,852.28	30,852.28	30,852.28

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

Alternative III

File SWMM-2TF

11-26-1992

GESTION DES DECHETS SOLIDES

CHAPITRE 1 - SITUATION PRESENTE

1.1 GENERALITES

- VILLE: TIASSALE
- PAYS: COTE D'IVOIRE
- ANNEE ETUDE: 1992

1.2 PRODUCTION DE DECHETS SOLIDES

- POPULATION ANNEE: 1992

POPULATION: 45,538

DISTRIBUTION DE LA POPULATION SUIVANT LES REVENUES

TABLE I DISTRIBUTION DE LA POPULATION SUIVANT BASE SUR LES REVENUES

En MILLIER FCFA

DESCRIPTION	POURCENTAGE	NUMBRE DE PERS.
HAUT	10	4,554
MOYENNE	60	27,323
BAS	30	13,661

- PRODUCTION JOURNALIERE DES ORDURES

TABLE II - PRODUCTION JOURNALIERE DES ORDURES SUIVANT LES REVENUES

REVENU	PRODUCTION PAR PERSONNE EN KGR	PRODUCTION EN TONNE
HAUT	0.70	3.19
MOYENNE	0.60	16.39
BAS	0.40	5.46
SOUS-TOTAL		25.05
DIVERS		2.50
TOTAL		27.55

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1.3 CAPACITE DE COLLECTE

1.3.1 COUTS D'OPERATION

- 1.3.1.1 EQUIPE - CAPACITE DE COLLECTE

TABLE III - CAPACITE DE L'EQUIPE DE COLLECTE

DESCRIPTION	VEHICULE	MODEL ANNEE	CAPACITE M3 *	COMPRESSION	ROTATION JOURNALIERE	DENSITE	COLLECTE TONNE
CAMION	101	1992	22.5	1.1	1	0.50	12.38
TRACTR	102	1992	22.5	1.1	1	0.50	12.38
TOTAL							24.75

* CAPACITE PER VOYAGE 5 M3 - NOMBRE DE VOYAGE PAR JOUR=4.5

NOMBRE DES JOURS DE TRAVAIL DE CHAQUE CAMION (ESTIME) 307

CAPACITE ESTIME POUR LES JOUR D'OPERATION DES CAMIONS

(*) 307 JOURS/365JOURS=) 20.82 Tons

POURCENTAGE DE COLECTE 0.76 %

1.3.1.2 - COLLECTE - COUTS D'EQUIPEMENT

TABLE IV COLLECTE - COUTS D'EQUIPEMENT

EN MILLIER FCFA

DESCRIPTION	VEHICULE #	MODEL ANNEE	COUTS
CAMION	101	1992	12,900.00
TRACTR	102	1992	6,300.00
TOTAL		FCFA	19,200.00
CONTENEURS	0	1800.00	0.00
TOTAL		FCFA	19,200.00

- 1.3.1.3 COUTS D'OPERATION

- 1.3.1.3.1 SALAIRES ET FRAIS DE GESTION (MILLIER DE FCFA)

SALAIRES

MANOEUVRES ET CHAUFFEURS	573.00
MANOEUVRES	420.00

FRAIS

Chauffeurs	0.08
Manoeuvres	0.08
ABSENCE	0.08

PRIX UNITAIRE ESSENCE ET GASOIL

ESSENCE	350.00
GASOIL	245.00

- 1.3.1.3.2 COUTS D'OPERATION

TABLE V - COUTS D'OPERATION

En MILLIER FCFA

DESCRIPTION	VEH. #	ESS. G	GASOIL G	COUT	MANOEUV.	SALAIRES	TOTAL
CAMION	1992	0	15	1128	3	2148	3275.75
TRACTR	1992	0	15	1128	2	1655	2783.68
TOTAL							6,059.43

1.4 EQUIPE DE COLLECTE - AMORTISSEMENT ENTERTIEN ET REPARATIONS

- AMORTISSEMENT, COEFFICIENTS

EQUIPEMENT	0.17
CONTENUERS	0.20

- ENTRETIEN COEFFICIENTS

EQUIPEMENT	0.100
CONTENEURS	0.200

- REPARATION, COEFFICIENTS

EQUIPEMENT	0.20
CONTENEURS	0.01

TABLE VI - EQUIPE DE COLLECTE - AMORTISSEMENT, ENTERTIEN Rparations
(EN '000 FCFA)

DESCRIPTION	VEHICULES	CONTENUERS	TOTAL
AMORTISSEMENT	3187.20	0.00	3187.20
ENTRETEIN	1920.00	0.00	1920.00
REPARATIONS	3840.00	0.00	3840.00
TOTAL	8947.20	0.00	8947.20

1.5 ADMINISTRATION

1.5.1 BATIMENT ET TERRAIN

COUT DE TERRAIN (EN MILLIER FCFA)	0.00
COUT DE BATIMENT (EM MILLIER FCAF)	0.00
TAUX D'INTERET	18.00
DUREE DE PRET	40 years

ADMINISTRATION DEPENSES DE BATIMENT ET DE TERRAIN

REMBOURSEMENT	0.00
AMORTISSEMENT	0.00
ENTRETIEN	0.00
REPARATIONS	0.00
TOTAL	0.00

1.5.2 TRANSPORT

TABLE VII - ADMINISTRATION - COUTS DE TRANSPORT

EN MILLIER FCFA

DESCRIPTION		COUT	CARB.	AMMORTISEMENT	ENTRETIEN	REPARATIONS	TOTAL
VEH - M #	201	6200.00	1149.71	1029.20	620.00	1,240.00	4,038.92
MOBILET #	202	300.00	182.66	49.80	30.00	60.00	322.46
TOTAL							4,361.38

1.5.3 SALAIRES

TABLE VIII SALAIRES

EN MILLIER FCFA

DESCRIPTION	SALAIRE '000FCFA	NOMBRE	FRAIS	TOTAL '000FCFA
DIRECTEUR	1000.00	1	0.17	1170.00
ADJOIN-1	700.00	1	0.08	756.00
MANOEUVR	420.00	4	0.08	1814.40
TOTAL				3740.40

1.5.4 SOMMAIRE

TABLE IX COUTS D'ADMINISTRATION

DESCRIPTION	MONTANT '000 FCFA
SALAIRE	3740.40
CONTRIBUTION DE LA SOCIETE POUR L'ASSURANCE DE MALADIE	0.37
TOTAL	3740.77

SOMMAIRE

SIEGE	0.00
TRANSPORT	4,361.38
SALAIRES	3,740.77
SOUS-TOTAL	8,102.15
ASSURANCE (.01 % SOUSTOTAL)	0.81
UTILITAIRES (.01 % SOUSTOTAL	0.81
TOTAL	8,103.77

1.7 ANALYSE DE LA SITUATION PRESENT

ANNEE 1992

TABLE X SOMMAIRE - ANALISE FINANCIERE 1992

(EN MILLIER FCFA)

DESCRIPTION	COUTS
- COLLECTE	
OPERATION	6,059.43
AMORTISSEMENT	3,187.20
ENTRETIEN	1,920.00
REPARATION	3,840.00
TOTAL	15,006.63
- TRAITEMENT	
DECHARGE	0.00
STATION DE TRANSFERT	0.00
COMPOSTAGE	0.00
- ADMINISTRATION	
ADMINISTRATION	8,103.77
- AUTRES DEPENSES	
AUTRES DEPENSES	150.00
SOUS-TOTAL	23,260.40
DIVERS (10%)	2,326.04
TOTAL	25,586.45

COUT PAR TONNE FCFA 3367.41

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA

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PROJECTION - CINQ ANN

2.1 DONNEES DE BASE DES EQUIPEMENTS PROPOSES

- VEHICULE

COUT EN '000 FCFA	12900.00
CAPACITE - METRE CUBIE	22.50 (4.5 VOYAGE DE 5 M3/VOYAGE)
TAUX DE COMPRESSION	1.10
GASOIL	15.00 LITRES
NOMBRE DE JOURS DE TRAVAIL	307
AMORTISSEMENT	2141.40
ENTRETIEN	1290.00
REPARATION	2580.00

MAN D'OEUVRE	
CHAUFFEUR	1
MANOEUVRE	3
DENSITE DES DECHTES SOLIDES	0.50
CAPACITE DE COLLECTE	9.46

- CONTENEURS

UN CONTENEUR PAR TRANCHE DE
15000 PERS. (APROX 7.5 tONNE)

AMORTISSEMENT	360.000
ENTRETIEN	360.000
Reparation	18.000

- COUTS D'OPERATION

SALAIRES	2147.52
CARBURANT	1128.22

- REMBOURSEMENT 4125.13

2.2 - PROJECTION DE L'ANNE 1993

- POPULATION

POPULATION 47,041

- POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES NEVEAUX DE REVENUS

TABLE XI - PROJECTIONS 1993

POPULATION ET DECHETS SOLIDES

REVENUS	POPULATION EN '000	DECHETS SOLIDSs EN TONNE.
HAUT	4.70	3.29
MOYENNE	28.22	16.93
BAS	14.11	5.64
SOUS-TOTAL		25.87
DIVERS		2.59
TOTAL		28.46

- BESOINS DE COLLECTE

PRODUCTION 1993 28.46

Cap. de coll. pres 20.82

- PROJECTIONS POUR NIVEAU DE SERVICE = 75 POURCENT

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 0.53 TONNE

- CAMIONS ADDITIONELS

NOMBRE ADDITIONEL DE VEH.= 0

CAPACITE DE COLLECTION POUR 1993 20.82

COUT DES VEH. ADDITIONEL	0.00
COUT, VEH. EXISTANT	19,200.00
TOTAL COUT DE COLLECTE	19,200.00

- CONTAINEURS ADDITIONELS

NOMBRE ADDITIONELS, CONTENENEURS= 0

COUTS ADDITIIONEL	0.00
COUTS DES CONTENEURS EXISTANT	0.00
TOTAL COUTS DES CONTENEURS	0.00
TOTAL COUTS DES EQUIP. DE COLLECTE	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISSEMENT VEH.	3,187.20
AMORTISSEMENT CONTENEURS	0.00
TOTAL AMORTISSEMENT	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL ENTRETIEN	1,920.00

- REPARATION

VEHICULES	3,840.00
CONTENEURS	0.00
TOTAL REPARATIONS	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL COUTS D'OPERATION	6,059.43

2.3 - PROJECTION DE L'ANNE 1994

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1994

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	4.86	3.40
MOYEN	29.16	17.49
BAS	14.58	5.83
SOUS-TOTAL		26.73
DIVERS		2.67
TOTAL		29.40

- BESOINS DE COLLECTE

PRODUCTION 1994 29.40

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.23 tons

- VEHICULE ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1994		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
TOTAL EQUIPEMENT	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

2.3 - PROJECTION DE L'ANNE 1995

- POPULATION

POPULATION 48,593

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS

TABLE XII - PROJECTIONS 1995

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	5.02	3.51
MOYEN	30.12	18.07
BAS	15.06	6.02
SOUS-TOTAL		27.61
DIVERS		2.76
TOTAL		30.37

- BESOINS DE COLLECTE

PRODUCTION 1995 30.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75

ESTIMATION DE LA CAPACITE ADDITIONALLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 1.96 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1995		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE 0

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

2.4 - PROJECTION DE L'ANNE 1996

- POPULATION

POPULATION 51,853

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1996

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	5.19	3.63
MOYEN	31.11	18.67
BAS	15.56	6.22
SOUS-TOTAL		28.52
DIVERS		2.85
TOTAL		31.37

- BESOINS DE COLLECTE

PRODUCTION 1996 31.37

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 2.71 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1996		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE 0

COUT ADDITIONEL	0.00
COUT CONT. EXISTANT	0.00
TOTAL	0.00
Total EQUIPEMENT	19,200.00

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

- REMBOURSEMENT

EQUIPEMENT	0.00
AMORTISEMENT	3,187.20
AMORTISEMENT	0.00
TOTAL	3,187.20

- ENTRETIEN - EQUIPEMENT

VEHICULES	1,920.00
CONTENEURS	0.00
TOTAL	1,920.00

- REPARATION

VEHICULE	3,840.00
CONTENEURS	0.00
TOTAL	3,840.00

- COUTS D'OPERATION

EQUIP. EXISTANT	6,059.43
SALAIRES	0.00
CARBURANT	0.00
TOTAL D'OPERATION	6,059.43

2.5 - PROJECTION DE L'ANNE 1997

- POPULATION

POPULATION 53,564

POPULATION ET PRODUCTION DES DECHETS SOLIDES SUIVANT LES REVENUS
TABLE XII - PROJECTIONS 1997

REVENUS	POPULATION EN '000	DECHETS SOLIDES EN TONNE.
HAUT	5.36	3.75
MOYEN	32.14	19.28
BAS	16.07	6.43
SOUS-TOTAL		29.46
DIVERS		2.95
TOTAL		32.41

- BESOINS DE COLLECTE

PRODUCTION 1997 32.41

CAPACITE DE COLLECTE 20.82

- PROJECTION POUR NIVEAU DE SERVICE= 75 %

ESTIMATION DE LA CAPACITE ADDITIONELLE POUR
ATTEINDRE 75 % NIVEAU DE SERVICE = 3.49 tons

- VEHICULES ADDITIONELS

NOMBRE ADDITIONEL DE VEH = 0

CAPACITE DE COLLECTE POUR 1997		20.82
COUT DES VEH. ADDITIONEL	0.00	
COUT DES VEH. EXISTANT	19,200.00	
Total	19,200.00	

- CONTENEUR ADDITIONEL

NOMBRE	0	
COUT ADDITIONEL		0.00
COUT CONT. EXISTANT		0.00
TOTAL		0.00
Total EQUIPEMENT		19,200.00

2.7 ANALIZE FINANCIERE - (1993 A 1997)

TABLE XVI SOMMAIRE ANALISE FINANCIERE

EN MILLIER FCFA

DESCRIPTION	1993	1994	1995	1996	1997
COLLECTE					
REMBOURSEMENT	0.00	0.00	0.00	0.00	0.00
AMORTISSEMENT	3,187.20	3,187.20	3,187.20	3,187.20	3,187.20
ENTRETIEN	1,920.00	1,920.00	1,920.00	1,920.00	1,920.00
REPARATIONS	3,840.00	3,840.00	3,840.00	3,840.00	3,840.00
OPERATION	6,059.43	6,059.43	6,059.43	6,059.43	6,059.43
TOTAL COLLECTE	15,006.63	15,006.63	15,006.63	15,006.63	15,006.63
DECHARGE	0.00	0.00	0.00	0.00	0.00
POSTE DE TRANS	0.00	0.00	0.00	0.00	0.00
COMPOSTAGE	0.00	0.00	0.00	0.00	0.00
ADMINISTRATION	8,103.77	8,103.77	8,103.77	8,103.77	8,103.77
INTERET	0.00	0.00	0.00	0.00	0.00
AUTRES	150.00	150.00	150.00	150.00	150.00
SOUSTOTAL	23,260.40	23,260.40	23,260.40	23,260.40	23,260.40
DIVERS (15 %)	3,489.06	3,489.06	3,489.06	3,489.06	3,489.06
TOTAL	26,749.46	26,749.46	26,749.46	26,749.46	26,749.46

* AUTRES DEPENSES

EDUCATION	100,000 FCFA
TRAINING	50,000 FCFA