...L COOPERATION AGENCY(JICA)

No. 12

MINISTRY OF PHYSICAL PLANNING AND CONSTRUCTION

THE REPUBLIC OF POLAND

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY

FINAL REPORT
MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN

MAY 1993

KOKUSAI KOGYO Co.Ltd.,
PACIFIC CONSULTANTS INTERNATIONAL

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

MINISTRY OF PHYSICAL PLANNING AND CONSTRUCTION
THE REPUBLIC OF POLAND

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY

FINAL REPORT
MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN

MAY 1993

KOKUSAI KOGYO Co.Ltd.,
PACIFIC CONSULTANTS INTERNATIONAL

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY

LIST OF VOLUMES

VOLUME I : EXECUTIVE SUMMARY

VOLUME II : MAIN REPORT

VOLUME III : ANNEXES

A. Profile of the Study Area
B. Waste Amount and Composition Survey
C. Public Opinion Survey
D. Investigation of Present and Candidate Disposal Sites
E. Other Field Surveys
F. Present Municipal Solid Waste Management
G. Evaluation of Present MSWM
H. Examination of Technical System Alternative Plan
I. The Master Plan
J. Feasibility Study of the First Priority Project
K. General Recommendation for the Improvement of ISWM

VOLUME IV : DATA BOOK

MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (English Version)

MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (Polish Version)

CASE STUDY OF MSWM MASTER PLAN MANUAL FOR LUBLIN

This is MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (English Version).

CONTENTS

LIST OF TABLES

Page:

LIST OF FIGURES

Page:

CHAPTER 1 INTRODUCTION

1.1 Necessity of a Manual for Formulation and Implementation of MSWM Master Plan

The Republic of Poland has devoted itself to transforming its economy and social-political systems into a democratic free market economy since 1989. With the reform of the Constitution, autonomous local governments and organization of the Central Government newly set up in March, 1990, and democratization and privatization were implemented.

During the socialist government regime, environmental protection measures were not fully taken because the government gave priority to industrialization and productivity. After the onset of democratization, environmental problems in Poland were given importance and at present the foreign assistance is concentrated on environmental protection projects.

The improvement of municipal services, like MSWM (Municipal Solid Waste Management), directly linked to the welfare of local people can be and should be carried out under the initiative of local governments. The role of the Central Government in this case is to assist the local governments improving their MSWM capabilities.

Solid waste service is one of the most expensive service in many local governments in Poland. Although substantial amount of resources are allocated to these services annually, their being cost-effective is very doubtful because of inadequate planning in short, middle and long-term levels.

As such, the formulation and implementation of municipal solid waste management (MSWM) master plans were adopted as one of the most important strategic programmes in Poland. The Government of Poland, therefore, has planned a study project to formulate an MSWM Master Plan for the City of Poznan as a model for medium sized cities in Poland, and requested the Government of Japan to conduct the study.

The programme will primarily formulate a model master plan and the secondarily transfer the valuable experiences and know-how gained from the formulation and implementation of the model to the master plan. This manual is prepared for the materials to transfer the experiences on formulation of the solid waste management master plan study in the city of Poznan.

1.2 Purpose of the Manual

A municipal solid waste management master plan is prepared in view of the efficient and effective execution of urban cleansing services, especially for long term planning. This manual serves a guide for such as MSWM master plan.

The basic objective behind the manual is to help local officials carry out an MSWM Study independently and to assist the consultants of the study.

1.3 Persons who are expected to use the Manual

Local governments are expected to prepare the municipal solid waste management master plan to improve the environment of cities and towns and to employ more effective and economical system. Persons who are in charge of the SWM of local government, such as the Director of Urban Service Department or Environmental Protection Department and middle class managers such as Senior Environmental Inspectors and engineers who shall carry out the study should refer to this manual.

The MSWM Master Plan should cover all cleansing activities which may be carried out by several authorities. This manual, therefore, is expected to be used by all people responsible for cleansing services.

1.4 Limitations of the Manual

This manual is prepared based on the experience gained from the study of the City of Poznan, Poland, and of other countries.

It should be revised, therefore, this should be revised by the Ministry of Construction (MOC) or the Ministry of Environmental Protection, National Resources and Forestry(MOEPNRF) based on the knowledge gained from the master plan study of Polish governments.

This manual does not cover immediate improvement plan and feasibility study. It is also necessary to establish the planning system on SWM and to prepare the manual or guideline needed.

1.5 Definition of Terms

1) General

- Municipal solid waste management : Management of cleansing service including waste collection, treatment and final disposal, road sweeping and public area cleansing.

- Waste collection : Collection of waste discharged from generative sources.
  There are several waste collection methods, such as door to door collection, curbside collection, stationary container collection and so on.

- Intermediate treatment : Incineration, composting, recycling of reusable material, pulverizing of bulky waste and etc.

- Final disposal : Landfill of waste

- Tipping fee : Charge for the waste hauled directly to a disposal site, a transfer station and an intermediate treatment facility.

- Collection fee : Charge for the waste collection service.

2) Type of Solid Waste

- Household waste : Waste generated and discharged from households

- Commercial waste : Waste generated and discharged from commercial activities.

- Institutional waste : Waste generated and discharged from government and private offices, schools and other institutions.

- Bulky waste : Waste uncollectible due to size i.e., furniture, though normal household waste collection system.

- Market waste : Waste generated and discharged from markets.

- Garden waste : Grass and trees generated through grass cutting or maintenance of gardens.

- Road sweeping waste : Wastes generated and discharged by road sweeping and public area cleansing works.

- Toxic and hazardous waste : Wastes which are inherently dangerous for human, animal and plant lives. They are chemical, flammable, explosive or biological wastes.

3) Classification of Source of Waste

- Residential area : Area where apartment buildings and detached houses are mainly located.

- Commercial area : Area where business and commercial establishments including shops in buildings are located.

- Apartment buildings : Residential high rise buildings having more than 3 stories

4) Refuse Collection System

- Door-to-door collection : House to house waste collection system
- Station collection : System collecting waste, including communal containers, from waste stations.
- Communal container : Hauled container and stationary container used by several houses, etc.
- Curb side collection : Curb side waste collection system
- Waste station : Collection point specified for several houses.

5) Intermediate Treatment

- Incineration : Burning of combustible waste.
- Composting : Converts organic wastes to fertilizer and soil conditioner and soil conditioner from organic waste.
- Size reduction : Reduces the size of waste, including bulky wastes, by shredding and crushing.
- Recycling Centre : Segregates wastes into recyclable, bulky, construction, demolition, etc. through public cooperation.

- Recycling Plant : A facility for size reduction and sorting of wastes, and to recycle the waste.

6) Final disposal

- Sanitary landfill : A disposal system with environmental protection measures.
- Control tipping : A disposal system using periodical soil covering.
- Open dumping : A disposal system without any environmental protection measures.

CHAPTER 2 PURPOSE OF A MUNICIPAL SOLID WASTE MASTER PLAN

2.1 Necessity of a MSWM Master Plan

Presently, many local governments face municipal solid waste management problems such as heavy financial burdens, difficulty in obtaining final disposal sites, difficulty in getting residents' cooperation, and lack of technology to prevent environmental pollution to abide by the national environmental standards and regulations.

Shortages of financial resources, staff, manpower, equipment and final disposal sites are real and urgent problems. These are not only present in the MSWM but also in all services provided by local governments. Furthermore, these problems seem to be very complicated in nature.

The formulation of a proper plan on MSWM describing the actions for long and mid-term plans is very important to solve these problems and to improve the service quality in a systematic way.

2.2 Purpose of a MSWM Master Plan

A municipal solid waste management master plan intends to determine the future direction of MSWM in respective areas including:

- determination of the areas to be served;
- proper system of waste storage, collection, haulage, intermediate treatment and final disposal;
- proper system on road sweeping and public area cleansing;
- proper system on operation and maintenance of equipment;
- organization and institutional improvement;
- financial plan; and
- residents cooperation and training programme.

The cleansing service is a relatively simple operation as it only covers the collection of solid waste and its disposal by means of landfill, and it can be conducted efficiently if sufficient number of vehicles, workers, and a disposal site are acquired. However, it is necessary to expand collection services, better environmental protection measures and to acquire new disposal sites along with the

development of a city. And the measures needed to cope with these new requirements should be adequately introduced on a year to year basis. It is also important to prepare a systematic plan which is divided into phases or stages based on medium and long term objectives and actual ongoing conditions. A circular process is required in any field to achieve development, i.e., planning–execution–evaluation–planning, etc., and the cleansing service is no exception. The process for the cleansing service can start off with a proper MSWM master plan without which any improvement cannot be expected. It is essential to establish a specific unit, e.g. planning unit, within the department responsible for MSWM, to administer the execution of the above-mentioned circular activities.

2.3 Relationship with Other Plan

1) Related Plans

An MSWM master plan should be developed in accordance with the structure or city development master plan of the respective area and the regional and national development plans. On the other hand, it is necessary that city development master plans be developed incorporating the solid waste management as one of the basic municipal services.

The major plans to be based on and taken into account in the preparation of a MSWM master plan are as follows:

- city development master plan (structure plan);
- provincial development plan;
- national solid waste management plan;
- national plan on toxic and hazardous wastes;
- national development plan.

2) Position of a MSWM Master Plan

There are types of plans that needs to be prepared in relation to the municipal solid waste management, and they are as follows:

- a master plan for municipal solid waste management;
- specified project plans;
- annual plans.

Since these plans are closely related to each other, they should be reviewed when any modifications are made or when new plans are established.

This manual intends to describe studies required for the preparation of a municipal solid waste management master plan.

Specific project plans should be prepared for strategic project such as the construction of an incineration plant or a final disposal site which is recommended for implementation in the master plan. These project plans should be prepared through the feasibility study of the projects.

Annual plan should be prepared every year by the Department responsible for municipal solid waste management. Yearly budget should be provided based on this annual plan. The actual performance of the municipal solid waste management (operation and management records,etc.) and modification of the master plan, if any, should be reported to the mayor of the respective municipality at the end of the year.

3) Plan Period

The plan period usually covers 10 years from the year the master plan is formulated. A 15 year or more year plan period is possible when a longer period is required in view of consolidating related facilities such as the introduction of a new intermediate treatment plant or the construction of a large disposal site.

2.4 Contents of the Master Plan

The basic contents of a municipal solid waste management master plan should cover the following:

1. General condition of the study area
2. Present condition of municipal solid waste management
3. Identification of present problems and recommendations for immediate improvement
4. Projection of future conditions
5. Planning framework
6. Examination of alternatives for future system
7. Selection of an optimum MSWM system
8. Detailed examination of the master plan

8.1 Collection and haulage
8.2 Cleansing services
8.3 Major facilities
8.4 Organization and institution
8.5 Privatization
8.6 Stage plan
8.7 Financial plan
8.8 Resident cooperation
8.9 Training
9. Recommendation for implementation

CHAPTER 3 OUTLINE OF THE WORKS

3.1 Study Flow

The activities in this study were divided into two major stages, the Preparatory Stage and the Actual Study stage. The preparation stage is very important for effective conduct of the second stage, and it mainly consists of two kinds of work: a) preparation in terms of reference and b) preparation of study plan.

Item [a)] should at least be carried out by the local Department in charge of MSWM with the help of related authorities. To facilitate each local government's preparation in terms of reference, the Ministry of Construction or Ministry of Environmental Protection, Natural Resources and Forestry is recommended to formulate a model from which the rest will be patterned. Item[b)]will be carried out by the agency in charge of the actual study, but will be evaluated and approved by the Department in charge.

The study flow which was employed by JICA Study Team in the master plan study of Poznan city is shown in Fig.L.3–1. Each item is listed in this figure is described in Chapter 4 according to their numbers in the figure.

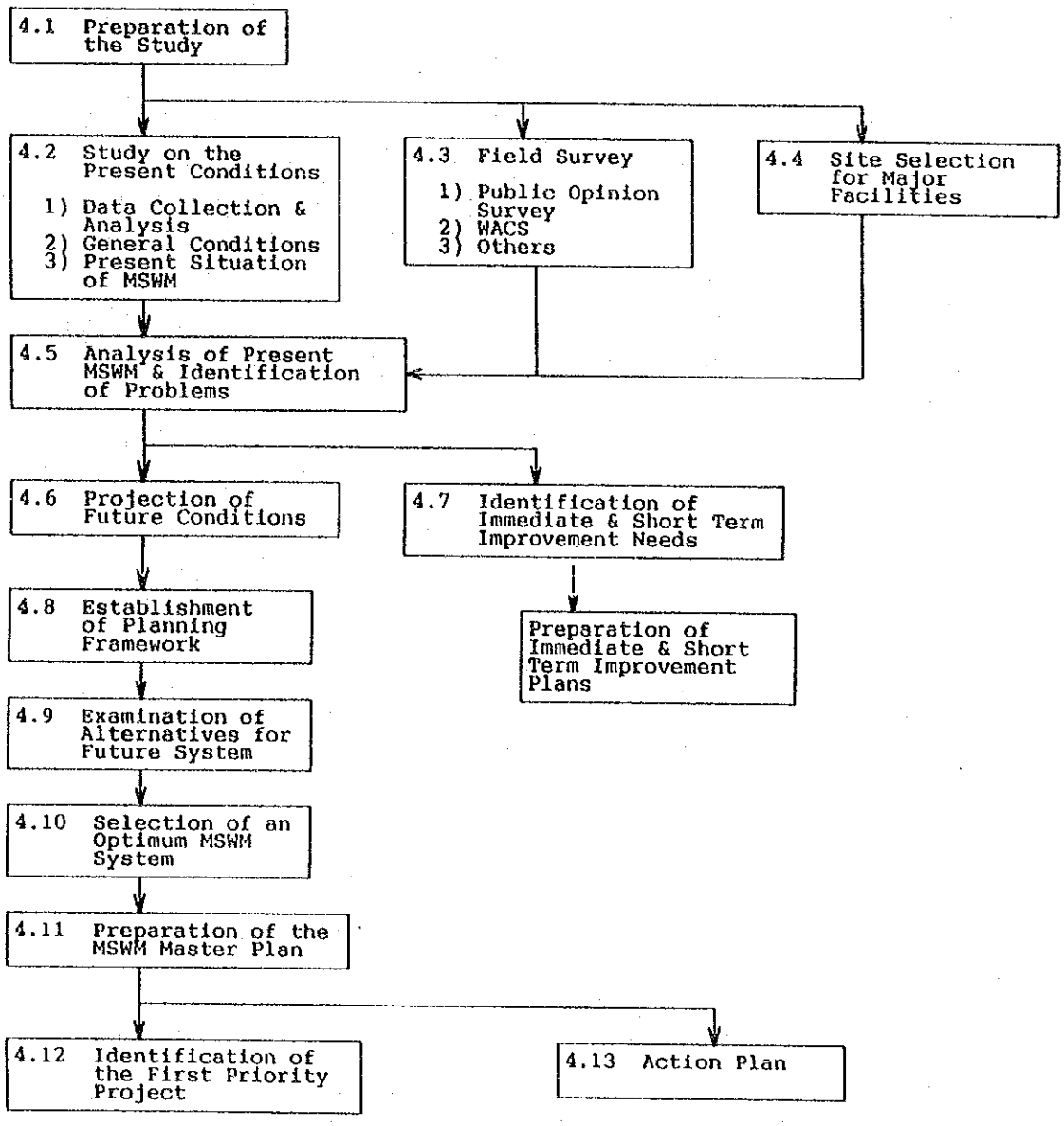

Fig.3-1 Master Plan Study Flow

3.2 Study Organization

The following organization should be established for the study:

- A decision making committee made up of related authorities;
- Working groups.

3.3 Resources Required for Study Implementation

The preparation of a master plan may require an involvement of consultants and universities. It is, therefore, necessary to secure a budget required for their services.

3.4 Terms of Reference

Terms of reference should be prepared by the Department in charge of the MSWM. Further, the data and information of other local governments on solid waste management and the possibilities for acquiring assistance for the implementation of the study should also be discussed with the Ministry of Construction and MOEPNRF. The discussion should cover the following:

- title of the study and study area;
- background information;
- objective of the study;
- scope of the study;
- study schedule;
- reports to be prepared;
- study organization;
- related data, materials and information.

3.5 Study Plan

The study plan will be prepared by work groups which will carry out the study based on the terms of reference. The study will be conducted according to the formulated study plan and shall cover the following:

- detail of study contents;
- study schedule;
- work assignment;
- arrangement to be taken by the Department in charge;
- study organization.

CHAPTER 4 CONTENTS OF THE MASTER PLAN STUDY

4.1 Preparation of the Study

Prior to the work, the following preparation works will have to be completed:

- collection and review of available data and reports related to the study;
- establishment of study policy, study method and preparation of study tools;
- examination of other related projects;
- preparation of Inception Report.

4.2 Study on the Present Conditions

1) Data Collection and Analysis

Data on the following items will be collected and analyzed:

- environmental preservation strategies;
- natural conditions;
- present social and economic conditions;
- urban plan and use plan;
- transportation system;
- legislation and institutions;
- financial condition of the city and waste fee system;
- relevant projects;
- present municipal solid waste management;
- present industrial solid waste management;
- present polluted conditions of the environment caused by MSWM;
- present social impact of MSWM;
- environmental condition.

2) General Conditions of Study Area

Data on the following items will be collected and analyzed:

a. Natural conditions

- location and area of the municipality
- topographical feature
- meteorological feature (climate, temperature, wind rose and rain fall)

b. Area conditions
   - land use
   - road condition
   - housing
   - public service and utility (water supply, sewerage and electricity)

c. Present and future social and economic conditions
   - population
   - business activity
   - regional economic growth
   - revenue of the municipality

d. Urban development planning
   - future land use
   - housing development
   - road construction

e. Relevant projects

f. Status of public health and of public awareness

The authorities which may have related data are as follows:

a. Natural conditions
   - survey department (topographic map, aerial photo)
   - meteorological department

b. Area conditions and urban development planning
   - city development master plan unit
   - statistics department

c. Social and economic conditions
   - city development master plan unit
   - financial department

3) Present MSWM

The current solid waste management should be studied and analyzed, including waste discharge, storage, collection, haulage, intermediate treatment and final disposal practices, as well as those related to administration, organization and finance. This study and analysis shall cover the following aspects:

a. Generation of solid wastes
   - generation amount
   - composition of solid wastes

b. Collection and haulage system

   The following items are surveyed:

   - discharge and storage of solid waste
   - collection of solid waste
   - haulage
   - equipment and workers
   - recycling of reusable materials at generation source
   - organization of collection and haulage
   - operation and maintenance of equipment
   - work planning
   - present of collection and haulage
   - present problems

   In addition to the above, time and motion studies for waste collection as well as cleansing services, such as road sweeping and waste heaping services, will be carried out.

c. Road sweeping and public area cleansing
   - road length to be swept
   - equipment and workers
   - work procedure and maintenance
   - sweeping work condition, such as working hour, work procedure, waste amount collected and so on.
   - present problems

d. Intermediate treatment and final disposal
   - site survey of the present landfill sites
   - outline of the present intermediate facilities and landfill site

- operation status of the present intermediate facilities and landfill sites
- present problems

e. Recycling of reusable materials

The recycling system and market for reusable materials will be investigated through existing data, interviews,and field surveys.

f. Equipment operation and maintenance system

The present O&M system of equipment will be investigated through existing data, interviews and field survey on the workshop.

g. Administration

The present administrative system of MSWM is to be clarified through surveys.

h. Organization and institution

The present MSWM institutions and organizations will be studied and analyzed,to clarify the relationship of the organization,institution and solid waste flow (discharge, collection, processing and final disposal).

i. Financial Status

The financial condition of the cleansing service system will be studied based on existing data and interviews.

j. Present status of private sector of MSWM

The existing capability and degree of utilization of the private solid waste management sector will be clarified through surveys.

k. Regulation and enforcement

Regulation especially on the illegal dumping, and their enforcement will be studied.

l. Market survey of compost

If a composting system is deemed necessary for the future system, a compost market survey will have to be conducted using existing data and questionnaires so as to clarify the compost demand.

m. Other related studies carried out in the city

Other related studies carried out in the city will be examined to establish correlation.

n. Social impact caused by MSWM problems

Existing social problems caused by MSWM is to be clarified.

o. Survey on scavengers

The present conditions of the scavengers will be grasped through interviews.

After the study on the present MSWM conditions, a profile will be prepared to clearly show its present condition. A reference table is prepared and shown in Table A-1 of the Appendix.

4.3 Field Survey

1) Importance of a Field Survey

Basic information such as the quantity and quality of solid waste generated in the study area, population covered by collection services, maps showing the collection area, etc., is the principal and the key factor for a successful and feasible municipal solid waste management plan.

In order to clearly understand the present MSWM, the following field surveys will be conducted:

- time and motion study for waste collection and cleansing works;
- survey on scavengers;
- survey on the recycling system and the market for reusable materials;
- public opinion survey;

- investigation of present and future sites for intermediate treatment facilities and final disposal site:
- study on waste amount and composition both in summer and winter.

2) Public Opinion Survey

a. Objective of the study

A public opinion survey (POS) will be carried out in order to understand the reasoning of the public regarding MSWM, which would be taken into account in the formulation of the master plan.The main objectives are summarized below;

- to collect the basic information on MSWM
- to understand the present MSWM problems on MSWM
- to understand the present waste discharge, storage and collection system
- to understand the ratio of the family discharging ash
- to know the citizen's level of understanding regarding MSWM
- to grasp the possibility of public cooperation in waste segregation at the generation source
- to grasp the allowable waste collection fee for citizens
- to grasp the level of satisfaction citizens feel toward MSWM

b. Selection of survey points

To gather the opinion of the public and the required basic information (especially the waste discharge method for WACS), sample residences and shops will be selected in the following manner:

i. The residential area will be classified into specific categories in accordance with possible differences in waste composition and the interviewees will be selected from each category in the proportion to the actual population. The residential area in Poznan was divided into the following categories:

- new apartments built after 1945
- old apartments build before 1945
- detached or semi-detached housing area

ii. The discharge of ashes from residential stoves into waste containers seems to be very important for the composition of waste. A number of

interviewees will be selected from areas not receiving heat supply from the municipal heat plant, PEC, in proportion to the population of the respective area.

iii. Samples of shops and restaurants will be selected from the area where various kinds of shops and restaurants are located, to be able to acquire the average amount of waste disposed in such shops.

c. Example questionnaire for POS.

An example questionnaire for POS, which was used in the studies of both Poznan and Lublin, was attached in Appendix 2.

3) WACS (Waste Amount and Composition Survey)

a. Objectives of the study

The amount and composition of waste are very fundamental data for planning collection, haulage, treatment and disposal systems. Since the composition and amount of wastes differ at the generation sources and disposal site,WACS will be conducted on both areas.

WACS will be carried out in order to obtain the basic information regarding waste generation ratio, discharge amount of self-disposed and collected wastes,and to finally clarify the waste stream in the study area.

A survey on the amount and composition of waste will conducted at least twice a year (in summer and in winter).

b. Survey of waste amount

i. Types of municipal waste

The municipal wastes to be studied are as shown below:

- household waste (from residences);
- commercial waste (from restaurants and shops);
- institutional waste (from offices and schools);
- market waste (from markets);
- road sweeping waste (from roads and public areas).

Samples will be taken from all wastes listed above to determine the generation ratio at each source. The selection of sampling points and discharge sources is very important as they shall determine waste amount and composition. Therefore, sampling points will be selected from households and shops used in the public opinion survey. Prior to the waste amount survey, a thorough investigation will be conducted on the survey area to classify the waste generation sources for sampling, and existing data will be used to verify the accuracy of the data obtained in this survey. In addition, the amount of wastes disposed will be measured preferably with a weigh bridge or any other weighing equipment, to get the actual amount disposed of at the existing disposal site(s).
A typical waste amount study flow is shown in Fig.4-1.

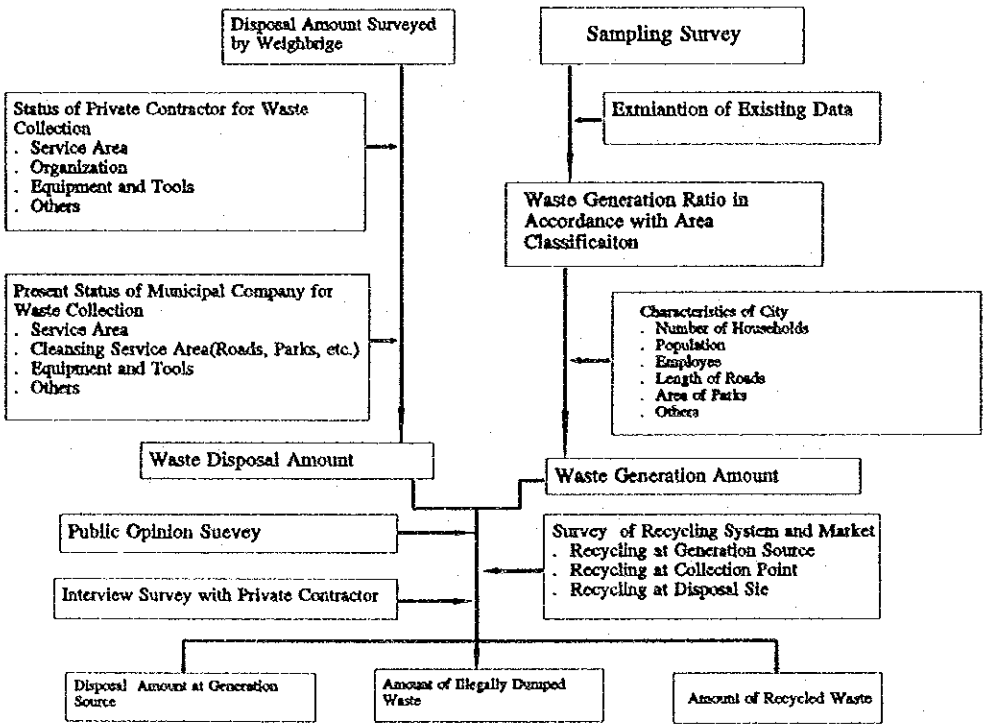

Fig.4-1 Waste Amount Study Flow

ii. Survey method

Samples for household and commercial wastes will be taken from selected houses, shops and offices. The sampling results will determine the waste generation amount per person and per shop or office. As for market wastes, the generation amount per market will be calculated by dividing the amount of waste discharged by the number of shops in selected markets. The amount of waste discharge for every road length swept will be determined too.

iii. Sampling points and quality

After conducting a reconnaissance survey and an interview with relevant personnel, the sampling areas, points and numbers will be decided upon, to represent the waste generation and amount in the study area.

iv. Survey schedule

Sampling will be conducted for eight days,including one extra day. All data, except for those obtained in the first day, will be analyzed.

c. Survey of waste composition

i. General

Generally, waste composition differ by generation source. For instance, wastes discharged from households may differ according to the type of residential area (e.g. buildings with or without heat supply) and income level.

A waste composition analysis is usually conducted on two bases: the wet and the dry base. A chemical analysis will be also required if the Master Plan study touches on the introduction of incinerators or composting plants.

ii. Survey flow

The typical survey flow of waste composition is shown in Fig.L.4-2.

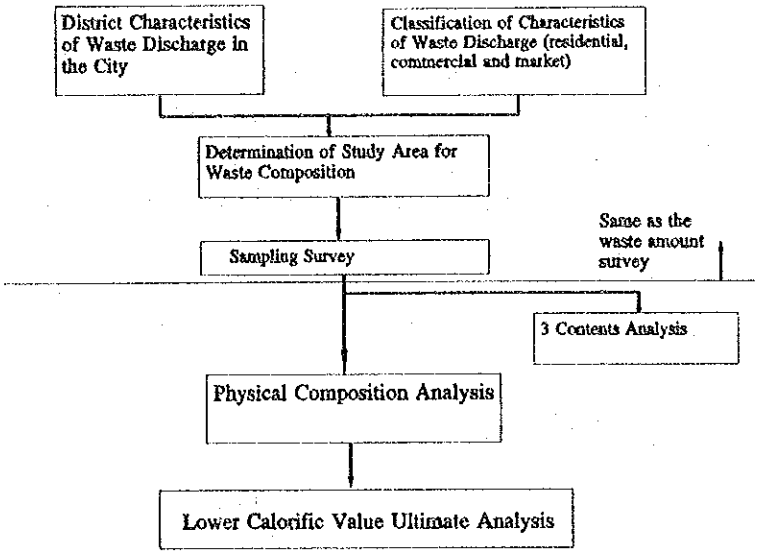

Fig.4-2 Survey Flow of Waste Composition

iii. Method of sampling

The sample for the waste composition analysis will be taken from the sample used in the waste amount survey.

iv. Physical composition

The physical composition analysis will be generally conducted in the wet base, and the following items will be analyzed:

- food waste (garbage);
- paper;
- textile;
- plastic;
- glasses;
- garden waste (grasses and woods);
- leather and rubber;
- metals;
- others.

v. Chemical Analysis

After the samples are dried, the following factors will be analyzed:

- moisture content, combustible and noncombustible constituency;
- lower calorific value;
- ultimate analysis for carbon, hydrogen, nitrogen, sulphur, chlorine and oxygen.

4) Others

In addition to the POS and WACS, the following surveys may be also necessary in understanding the present MSWM for the formulation of the Master Plan:

a. Investigation on the

- topography;
- geology and soil investigation;
- land use;
- environment (water and air quality, noise, traffic, etc.)

of the candidate intermediate treatment and landfill sites.

b. Investigation on the present environmental condition (water and air quality, soil, noise, traffic,etc.)of existing treatment plants and landfill site(s).

c. Sampling survey on:

- waste collection frequency and collection points;
- interview with residents about their collection services;
- location and the name of dischargers of large quantities of wastes in the area;
- frequency of collection, road seeping, public area cleansing and assignment of labourers;
- time and motion studies;

A time and motion study on collection vehicle or a labourers will produce detailed data on the present system, especially with regard to its efficiency.

4.4 Site Selection for Major Facilities

The procedures involved in the selection of sites must be initiated as early as possible because land acquisition processes would take time due to the necessity of administrative and public consensus.

1) Site Selection Criteria

To select appropriate sites for major facilities such as treatment plants and landfill sites, the following should be given major consideration:

- land acquisition possibilities;
- possibility of obtaining neighbourhood consensus;
- compatibility with regional development plan;
- financial feasibility;
- environmental acceptability.

2) Site Selection Steps

It is not practical to assess all the lands in the study area for the selection of sites for major facilities (disposal site, incineration plant, transfer station, etc.). The procedures should be divided into the 3 stages shown below:

- selection of potential sites
- selection of candidate sites
- final selection

Although the selection methods may differ in each study area, the method for the selection of the site for the Master Plan is as shown in Fig.L.4-3.

Potential sites shall be selected in consideration of the following aspects:

- area required for major facilities
- land acquisition possibilities
- possibility of obtaining neighbourhood consensus
- compatibility with regional development plans

Candidate sites will be selected from the potential sites based on financial feasibility and environmental acceptability.

Final site selection should be carried out with consideration of alternatives proposed for the master plan.

The approval for the Provincial Government and other agencies responsible for land settlements is required after suitable sites are selected.

The lands chosen for the construction of MSWM facilities will be clearly stated in the City Development Master Plan.

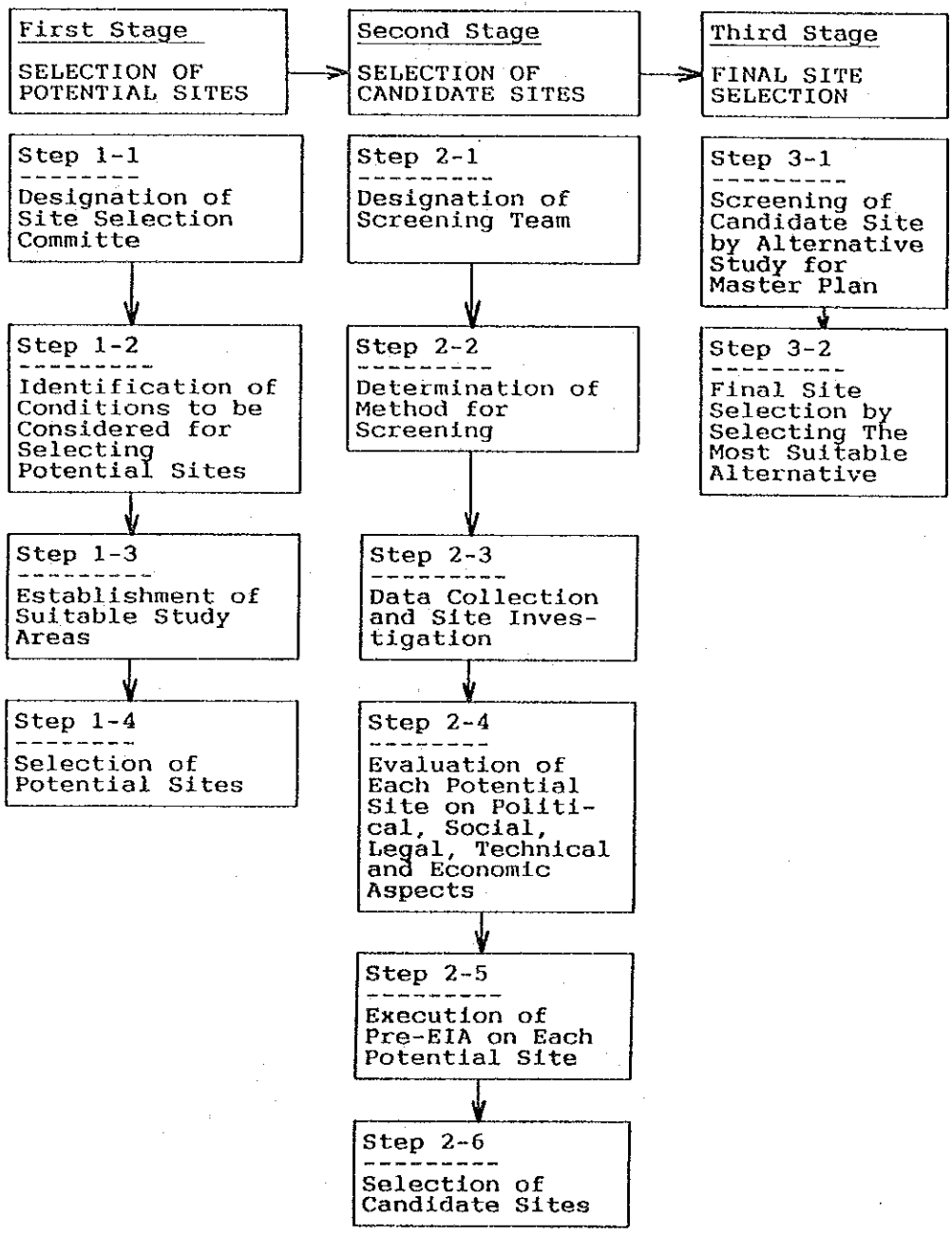

Fig.4-3 Site Selection Method

4.5 Analysis of Present MSWM and Identification of Problems

The current municipal solid waste management conditions should be analyzed and evaluated from various aspects and the following points should be referred to in the course of problem identification.

a. Service coverage in terms of population and area

b. Service level of waste collection
   - collection frequency
   - collection point
   - type of waste covered by municipal services

c. Service level of road sweeping and public area cleaning
   - frequency
   - length and classification of street sand public areas covered by the municipal services.

d. Solid waste amount
   - collection amount
   - treatment amount
   - disposal amount

e. Efficiency of refuse collection
   - efficiency of the vehicles
   - efficiency of the labourers
   - cost efficiency

f. Efficiency of road sweeping and public area cleansing
   - efficiency of the labourers
   - cost efficiency

g. Working conditions
   - safety
   - sanitation
   - work load

h. Sanitary and environmental conditions
   - storage and discharge
   - collection
   - haulage

- intermediate treatment
- final disposal
- scavenging

i. Maintenance of equipment
   - shortage of equipment
   - selection of equipment
   - spare parts
   - maintenance records

j. Public altitude
   - storage and discharge manner
   - complaints
   - fine

k. Revenue and expense of municipal solid waste management
   - budget allocation for municipal solid waste management
   - collection charge
   - tipping charge
   - cost of waste collection and disposal, road sweeping and public area cleansing works

l. Institution and legislation
   - personnel administration
   - planning capability
   - privatization and its management
   - review of law and regulation
   - law enforcement

4.6 Projection of Future Conditions

1) Future Population Estimate

An estimate of the future population should be made at least every five years until the target year. This estimate will serve as the basis for the city development plan and for the municipal solid waste management master plan.

If the city development master plan covers a target year, the population in this target year can be obtained through the master plan.

2) Socio-Economic Forecasting

Almost all the local governments cover the municipal solid waste management expenses from collection and tipping fees and general budget. Therefore, the following items should be estimated for future conditions:

- projection of regional economic growth
- future financial scale of the local governments
- housing developments
- road construction plan
- future collection and tipping fees (including treatment)

3) Estimation of Future Solid Waste Amount

The solid waste amount estimate until the target year should be conducted on a 5 year interval basis.

The amount of solid waste will increase according to the following reasons:

- population increase
- expansion of service coverage
- increase of waste generation rate due to developed standard of living
- increase in economic activities

The future solid waste amount estimate for the Master Plan of Poznan City was made according to the processes shown in Fig.L.4-4. To determine the increase in the generation ratio, the study used the GDP.

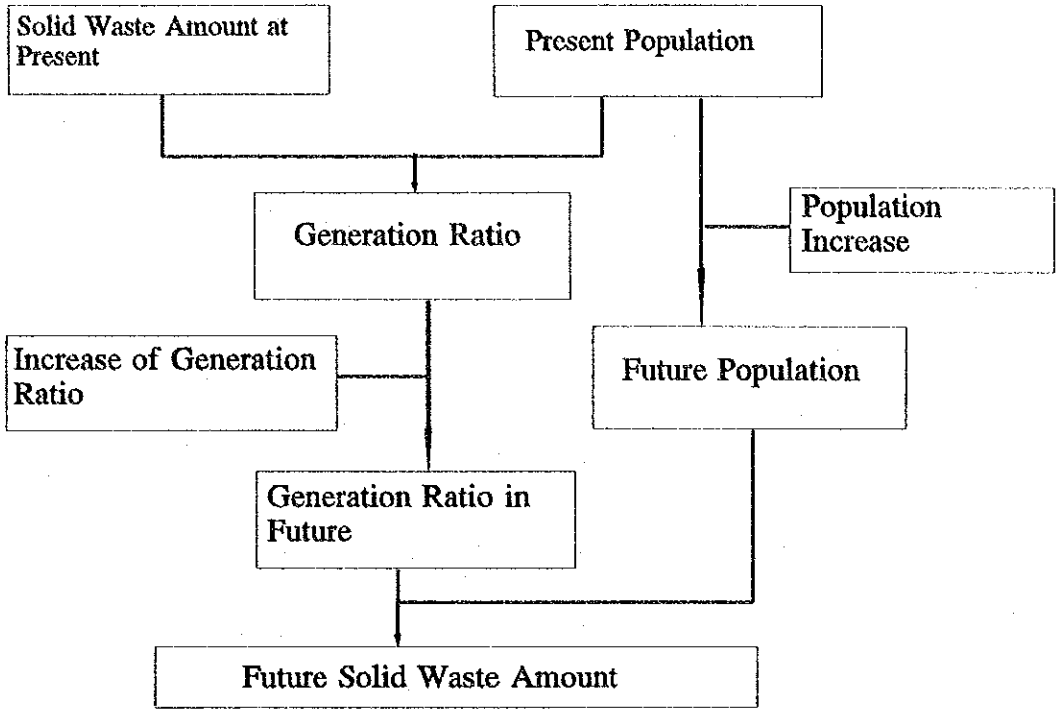

Fig.4–4 Estimation of Future Solid Waste Amount

4) Estimation of Future Solid Waste Composition

With the rise in the standards of living, the ratio of paper wastes, plastics and non-combustible wastes will increase, while the ratio of garbage and wood will generally decrease. The future solid waste composition, therefore, should be determined based on these generalities.

The change in the waste composition in developed countries, particularly western Europe, will be useful for the estimation.

4.7 Identification of Immediate and Short Term Improvement Needs

When identifying problems, it is necessary to start with the easy ones which require less expenses and time. It is then important to prepare an immediate improvement plan to quickly solve these problems. It is also necessary to plan short term improvement projects which will be implemented in the target year of the feasibility study. The feasibility study and the financial preparation and implementation work for the targeted project will require several years, normally 3 to 6 years. These immediate short term improvement projects should be implemented by the local governments themselves.

4.8 Establishment of Planning Framework

1) Goals and Targets

a. Goals

Clearly identified goals should be qualitatively presented to the citizens and authorities concerned, and should be acceptable from a social and economic point of view.

The following goals are proposed for the city of Poznan:

Development of Environmentally Sound Solid Waste Management System in Poznan through;

citizen's participation,
establishment of Self-sustainable Solid Waste Management
Resource Recovery and Recycling .

b. Targets

Subjects and targets for improvement must be presented in a concrete manner. Targets to be achieved in the respective target years should be defined quantitatively to enable an accurate evaluation. They should be identified with respect to the following aspects:

i. technical system

- storage and discharge method at generation sources
- service level of waste collection
- collection method and equipment to be provided
- level of road sweeping and public area cleansing services
- materials and equipment to be provided for road sweeping and public area cleansing
- intermediate treatment facilities to be introduced
- final disposal method
- final disposal site(s) to be constructed

ii. operation

- efficiency of waste collection and other cleansing works
- efficiency of intermediate treatment
- quantitative and qualitative control of wastes at disposal site
- working conditions in terms of work load, safety and sanitation

iii. organization

- establishment of efficient organizational structure
- promotion of privatization

iv. finance

- allocation of budget
- development of charge system for waste collection service and waste disposal

v. law and enforcement

- preparation of by-laws and regulation for municipal solid waste management
- enforcement of by-laws and regulations

vi. training

vii. public participant

2) Prerequisites of the Master Plan

There are certain prerequisites upon which a Master Plan should be prepared and they should be examined based on the future estimates explained in Section 4.6 and the goals and targets above mentioned. They are as follows:

a. Plan period

The plan period is usually covers a span of 7 to 10 years from the year that the Master Plan is prepared. A 15 year-period is also possible if new intermediate treatment plants are required or large disposal sites will be constructed.

b. Waste amount and composition

The present and future amount and composition of waste should be estimated and used as basis for planning. It is also important to note that waste amount and composition may differ depending on waste handling stages, e.g., collection, intermediate treatment, and final disposal.

c. Division of responsibility and solid waste flow

Organization in solid waste management may be related departments of the local governments, local offices of central government agencies and private companies. The solid waste disposal flow indicating the roles of these organizations in dealing with different types of solid waste and the treatment/disposal processes should be clearly determined.

At present, local government have their own solid waste disposal systems that is why it is difficult to introduce a standard system on a national level. Table L.4-1 may be used to indicate the division of the solid waste management responsibilities.

Organizations responsible for solid waste management also include the municipal cleansing companies, secretariat and engineering departments of the local governments in addition to the branches of the Central Government. Moreover, private companies have their own treatment/disposal systems too.

Table 4-1 Division of Responsibility and Solid Waste Flow

	Collection/ Cleansing	Haulage	Intermediate Treatment	Final Disposal
- Household				
- Business Estab- lishment				
- Markets				
- Factories				
- Roads				
. State Roads				
. Provincial Roads				
. Municipal Roads				
- Public Facilities				
. Sports Stadiums				
. Parks				
. Others				

d. Financial conditions

Budget size of the local government and the share of budget for MSWM at a target year should be stated.

In the case of that the municipal budget will be not expected to increase in proportion to GRDP, the solid waste management may not be maintained due to the financial shortage to overcome service demand to be increased in proportion to GRDP. Therefore, special attention should be paid for forecasting future budget scale of the municipalities.

4.9 Examination of Alternatives for Future System

1) System Components in SWM

a. Technical system

The MSWM system consists of technical and institutional systems,and the technical system consists of the following sub-systems:

- discharge and storage;
- collection and haulage;

- roads sweeping and public area cleansing;
- transfer;
- intermediate treatment and recycling;
- final disposal.

Some sub-systems are always necessary, while others such as intermediate treatment depends on several factors, with financial capacity and the waste characteristics as major factors.

It is necessary to examine whether certain sub-systems are required, and if required, their types, methods, and facilities, too. The following table explains to what extent each technical sub-system is to be examined.

Table 4-2 Scope of Examination

Sub-systems	Scope of Examination
- Discharge and Storage	B
- Collection and Haulage	B
- Road Sweeping and Public Area Cleaning	B
- Transfer	A
- Treatment & Recycling	A
. Incineration	A
. Composting	A
. Shredding	A
. Sorting	A
- Final Disposal	B

Note:

A: Examination is to be made as to the sub-system is necessary or not
B: Examination is to be made on the type, method and facility to be used it the sub-system is absolutely necessary.

b. Institutional system

In addition to the technical sub-systems stated above, MSWM also contains the following institutional sub-systems:

- organization and management;
- legislation and enforcement;
- finance (revenue source);
- public cooperation.

2) Selection Method of an Optimum Alternative

a. Basic consideration

The elements of technical systems correspond with the waste flow shown in Fig.4-5 below. Desirable technical systems depend not only whether or not an intermediate treatment system should be introduced, but also on the location and capacity of the final disposal site.

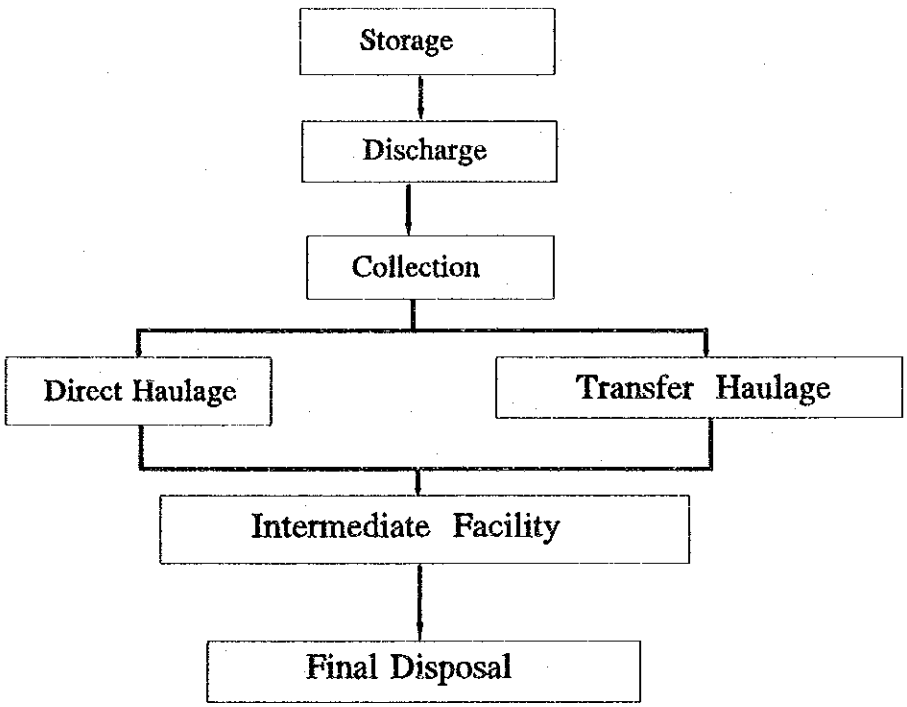

Fig.4-5 Elements of Technical System

In other words, the selection of desirable technical systems largely depend on the capacity, location, distance from collection area, and costs of final disposal sites.

The selection of disposal sites and sites for other facilities is not an easy task. Several potential sites are initially identified then screened, during which the suitability ranking may change, while a master plan study is being carried out. The final selection of the sites usually takes a long time.

Site selection and feasible technical system selection are the two important selections involved in the preparation of the master plan which requires adequate feedback and coordination from them.

An alternative to the MSWM system is a combination of various technical sub-systems such as discharge and storage system, collection and haulage system, road sweeping and public area cleansing system, treatment and recycling systems and final disposal system. Many alternatives can be made by the combination of possible sub-systems.

If all combinations of the above sub-systems were to be studied, the total number of combinations would be equal to hundreds of individual SWM systems. It can be deduced that a Master Plan study is the screening work concerning various alternative systems.

In view of the present MSWM in the study area, a goal is set up to develop an environmentally sound MSWM in Poznan. In addition, the creation of a cost-effective MSWM system is a main issue in the generation of alternatives because the implementation of MSWM may be very costly.

Consequently, the following method, as shown in Fig.L.4-6, is applied in the Study for the selection of an optimum alternative for the Master Plan of Poznan.

b. Selection of an optimum technical system

i. possible intermediate treatment

In order to develop and realize an environmentally sound MSWM in Poznan, the introduction of intermediate treatment facilities shall be examined. Possible intermediate treatment facilities will be examined and selected.

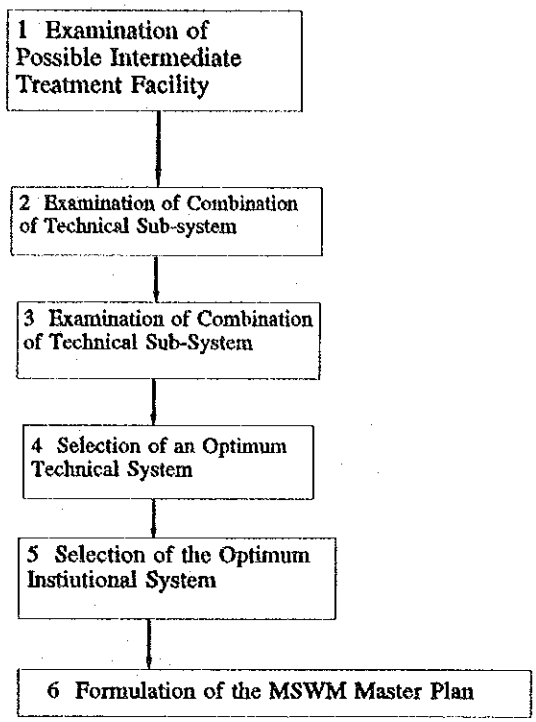

Fig.4-6 Flow Chart of Alternative Study

ii. examination of technical sub-systems

After the selection of possible intermediate treatment facilities, possible sub-system alternatives for each technical sub-system will be examined and optimum sub-systems will be selected for each possible intermediate treatment facility. For example, in exchange for the introduction of composting plant, a segregated collection system (separation of wastes into compostable and non-compostable) may be selected instead.

iii. examination of combinations of technical sub-systems

A comparison study on the technical systems will be carried out by combining each technical sub-system.

iv. selection of an optimum technical system

Upon consideration of the results of the above mentioned alternative study, an optimum technical system will be selected by evaluating the following aspects:

- technical point of view;
- economic and financial point of view;
- social point of view;
- environmental point of view.

c. Selection of an Optimum Institutional System

After the selection of the optimum technical system, a study will be made to generate alternatives for organizational, institutional, and financial aspects suitable top the selected technical system. After the comparative study of the above mentioned alternatives, an optimum MSWM system will be finally selected.

3) Possible Technical System Alternatives

Each sub-system has the following possible system alternatives;

a. Storage and discharge

i. solid waste separation

- *mixed discharge*
- *separate discharge*

ii. waste bins

- *plastic bins*
- *plastic bags*
- *drums*
- *concrete bins*
- *bamboo baskets*
- *communal containers (hauled or stationary)*
- *others*

iii. storage and discharge points

iv. discharge frequency

b. Collection and haulage

i. collection frequency

ii. mixed or separate collection
iii. collection points
- *door-to-door backyard collection*
- *door-to-door curb-side collection*
- *station collection*
- *communal container collection*

iv. working time
- *daytime collection*
- *night collection*

v. collection equipment
vi. haulage method
- *hydraulic system*
- *pneumatic system*
- *motor vehicles*
- *ocean-going vessels*
- *railway*

vii. introduction of transfer station
- *type*
- *capacity*

viii. sites for transfer stations

c. Road sweeping and public area cleansing

i. cleansing frequency
ii. cleansing service area or length
iii. cleansing method
- *manual*
- *mechanised*

iv. cleansing equipment
v. working time

d. Intermediate treatment

i. Possible intermediate treatment method
- incineration
- composting
- RDF (Refuse Derived Fuel)
- pyrolysis
- ash solidification
- biogas
- size reduction (crushing and shredding)
- sorting

- recycling centre

ii. facilities sites

e. Final disposal

i. disposal sites

ii. disposal methods
- sanitary landfill level

iii. landfill structure
- *anaerobic landfill*
- *anaerobic sanitary landfill*
- *improved anaerobic sanitary landfill*
- *semi-aerobic sanitary landfill*
- *aerobic sanitary landfill*

iv. recovery of methane gas

f. Equipment O & M

i. Organization
- *in a municipality*
- *out of a municipality*

ii. O & M system

iii. degree of O & M

iv. training programme

4) Possible Institutional System Alternatives

a. Organization and Management

i. assignment of responsibility in MSWM
- *Environmental Protection Department*
- *Engineering Department*
- *USD (Urban Service Department)*
- *establishment of new organization*

ii. manpower and training

iii. scope and content of privatisation measures

iv. research and development of technology

b. Regulation and enforcement

i. establishment or revision of laws and regulation

ii. enforcement measure

c. Finance (revenue source)

i. revenue source
   - *loan or grant source*
   - *taxes*
   - *service fee*

ii. rates of collection and tipping fees and taxes

d. Public cooperation

i. measure to obtain the public cooperation

ii. responsible bodies

4.10 Selection of an Optimum MSWM System

1) Examination of Combination of Technical Sub-systems

Alternatives to be selected should be ones that would promote the achievement of the targets based on local conditions. many alternatives can be made from combinations of possible sub-systems in consideration of the aspects mentioned above. There are two approaches in the generation of possible alternatives: (Approach A) according to technical view points, and (Approach B) according to institutional and financial view points. Both ways are advantageous and disadvantageous as shown below. The former is explained in this manual.

Approach A

This approach is useful when achievement of a certain target is a "must" and the target (level of achievement) is clearly defined.

Advantages:

- It is relatively easy to evaluate technical systems proposed.
- Target (level of achievement) can be clearly defined, which would help persons concerned to exert effort toward goal attainment.

Disadvantages:

- There might be a case where proposed technical systems prove to be unfeasible from financial or managerial view points.

Approach B

In this approach, emphasis is placed on the existing resources such as financial and managerial capacities of agency responsible for project implementation.

Advantages:

- A realistic and feasible plan can be proposed as the plan reflects possible mobilization of limited resources.

Disadvantage include:

- It is difficult to quantitatively evaluate the resources available to the project.

- Targets might be proposed at a low level as pessimism might dominate in assessing available resources.

An alternative is a combination of various technical systems, such as waste storage and discharge system, waste collection and haulage system, road sweeping and public area cleansing, intermediate treatment systems and final disposal system. There might be alternatives which are merely extensions of the present system. In view of future requirements, however, the existing MSWM systems in most local governments, particularly the disposal system, are adequate technically and it terms of capacity. However, this alternative (an extension of the present system) may be useful for in comparative purposes.

An alternative plan consists of the several technical sub-systems explained earlier. Numerous alternative plans might be possibly generated as a result of the mechanical combination of these components. It is advisable to limit the number of alternative plans to seven or so in consideration of 1) geographical, social, and environmental conditions of the study area, as well as 2) location and other conditions of intermediate treatment and disposal sites.

In the master plan study for the city of Poznan, the following alternatives were examined:

- present collection system (mixed collection) with sanitary landfill site (SL);
- present collection system with recycling centres (RC) and SL;
- segregated collection system with recycling plant (RP) and SL;
- present collection system with RC, incineration plants (IP) and SL;
- segregated collection with RC, IP and SL;
- present collection system with RC, composting plants (CP) and SL;
- segregated collection system with RC, CP and SL.

2) Cost Estimation for Alternatives

The total municipal solid waste management cost should be fairly estimated. The costs can be estimated in terms of investments and annual expenses.

a. Investment costs

- purchase cost of collection vehicles and communal containers.
- construction cost of major facilities such as final disposal site, intermediate treatment plants, garage, workshop and cleansing office.
- purchase cost of heavy equipment required in disposal sites or intermediate treatment plants.
- cost of land cost for major facilities

b. Annual expenses at target years

- operation and maintenance costs
  - . personnel expenditure
  - . utilities
  - . spare parts costs
  - . fuels
- repayments of loans
- depreciation

Estimation results of the investment costs and annual expenses are summarized in Table 4-3 and 4-4.

Revenue of each alternative should be estimated for evaluation. The following are major source of revenue to be considered:

- collection charges from households, shops, etc;
- tipping charges for waste hauled directly to disposal sites or intermediate treatment plants;

- resource recovery through intermediate treatment;
- future land value expected at the time of completion of disposal sites

Table 4-3 Investment Cost

Unit: mill.ZL

	Alt 1	Alt 2	Alt 3	....	No change
1) Construction					
(1) Transfer Station					
- Building and foundation works					
- Machinery & Equipment					
Subtotal					
(2) Incinerator					
- Building and foundation works					
- Machinery & Equipment					
Subtotal					
(3) Disposal Site					
- Building and foundation works					
- Machinery & Equipment					
Subtotal					
2) Purchase of Vehicles & etc.					
(1) Collection Vehicle					
(2) Haulage Vehicle					
- for Transfer Station					
- for Incineration					
(3) Heavy Equipment					
- for Transfer Station					
- for Landfill					
Total					

Table 4-4 Annual Expenses at Target Year

(Unit: ZL million)

	Alt 1	Alt 2	Alt 3	....	No change
- Collection					
. Depreciation					
. Personnel Cost					
. Maintenance					
. Fuel, etc.					
Subtotal					
- Transfer Station					
. Depreciation					
. Personnel Cost					
. Maintenance					
. Fuel, etc.					
Subtotal					
- Incinerator					
. Depreciation					
. Personnel Cost					
. Maintenance					
. Fuel, etc.					
Subtotal					
- Final Disposal					
. Depreciation					
. Personnel Cost					
. Maintenance					
. Fuel, etc.					
Subtotal					
- Cleansing Work					
. Personnel Cost					
. Fuel, etc.					
Subtotal					
- Supervisor & Staff					
. Personnel Cost					
Total Cost					
- Depreciation					
- Personnel Cost					
- Maintenance					
- Fuel, etc.					

Note: "No change refers to an alternative which employs existing collection/haulage system and the disposal system same as in Alt.1.

3) Selection of an Optimum MSWM System

a. Criteria for evaluation

The related authorities should discuss and agree upon a set of criteria with respect to the following aspects.

i. Technical Aspects
ii. Economic and Financial Aspect
iii. Social and Legal Aspect
iv. Environmental Aspect

The criteria should cover the improvement of the labourers working condition, a very important issue as the people's standard of living is expected to rise in the future. Without such improvement, the Local Authorities may have to deal with shortage in manpower for cleansing services.

b. Selection of an Optimum Alternative

Each alternative will be evaluated according to the four aspects used as bases for the formulation of the criteria.

i. Technical Aspect
ii. Economic and Financial Aspect
iii. Social and Legal Aspect
iv. Environmental Aspect

The present economic and financial aspects are very crucial in the formulation of a municipal solid waste management plan, thus all local governments must examine them keenly. The national policy states that local governments should properly provide solid waste management services, and consequently financial sources must be established to achieve this policy. The financial sources will be the Local Governments, Provincial Governments, the Central Government of Poland, and international funding agencies.

Based on the evaluation of alternatives from the several aspects mentioned, the most favourable alternative will be selected by the decision-making committee.

4) Selection of the Optimum Institutional System

a. Administration and Organization

Related authorities should be clearly assigned to take charge of each solid waste management service. The functions of the Department in the target year should be clearly determined and the organization capable of properly conducting these functions should be established with the necessary manpower.

The proper organization for SWM should be studied and established, and the responsibilities of related authorities must be clearly defined.

The Department of Communal and Residential Affairs is responsible for the supervision of the cleansing works in the city of Poznan, while SANITECH, a municipal enterprise, conducts the main part of the service.

It is not clear, however, which municipal department is fully responsible for MSWM.

It is desirable to have a department fully responsible for municipal solid waste management. The maintenance of equipment and operation of sanitary landfill sites will require a civil engineer, a mechanical engineer, and technicians, too. These works involve two alternatives: one is the establishment of a department fully responsible for MSWM, and the other is the decentralization of responsibilities to two or three departments. The choice between the two alternatives will largely depend on the condition of the Municipality, especially its scale.

The major functions of the Department are generally shown below, although they depend on the size of the local government and the system employed:

- cleansing service section
- intermediate and final disposal
- planning and development
- supervision
- procurement and maintenance of equipment
- administration and accounting
- public relations and education of residents
- staff training and fostering of private companies.

If decentralization is carried out, the organizational structure of the Department should be decided upon and established.

The work assignment and allocation of manpower for each organization involved in municipal solid waste management should be clearly outlined in the master plan.

b. Privatization

Privatization of the cleansing service is one of the policies of the central government. Every local government is expected to formulate a policy and plans for privatization of its own. Plans for privatization should cover the types of services to be privatized, extent (percentage) of privatization and its time schedule, etc.

The form of privatization should be prepared by each local government as the municipal solid waste management their responsibility and is one of basic service provided to the residents. It is, therefore, difficult determine the percentage of cleansing work to be contracted by private sectors. It may depend on the conditions of respective local governments. Privatization should bring about the reduction of cleansing service costs, compared to the services provided by the municipality, or it should effect a cleaning service of high quality. Proper privatization requires following considerations:

- proper tendering systems to select reliable contractors
- proper scale of each contract negotiation
- budget preparation for contract negotiations

The extent of privatization depends on:

i. Extent of the difference in the cost-effective concept of the contractor and the municipality (larger differences will make contracting of services more possible).

ii. Availability of reliable contractors (the greater availability of reliable contractors will make contracting of services possible).

iii. The current utilization of the Municipality's resources (manpower and equipment) in a short-term basis. (It is not rational to increase contract negotiations if the municipality's resources are under-utilized. Full utilization of these resources should be promoted prior to the increase if the municipality is unable to immediately reduce manpower, as in the usual case with government sectors.

c. Institution

Laws and regulations for the facilitation of a smooth municipal solid waste management should be introduced and a legal system to enforce these laws should be established.

All local governments should have the following regulations on municipal solid waste management.

- anti-litter regulation
- proper storage and discharge regulations
- regulation for collection and tipping charges
- law enforcement regulations
- regulation on work time and work manner of labourers

Based on the national laws, regulations and systems stipulated by the MOC and MOWPNRF, each local administration should enact by-laws on the following in accordance with the local characteristics:

- division of responsibility on solid waste management
- contracting out work to the private sector and supervision
- collection charge system
- criteria for accepting municipal solid waste for solid waste treatment and disposal facilities.
- illegal dumping
- recycling
- requirements of proper waste discharge
- penalty clauses

d. Public

It is essential to enlist the active participation of residents (producers of solid waste) in the master plan. Measures to obtain residents' cooperation of the following points should be studied:

- use of proper methods for the storage of solid waste
- discharge on the specified day and place
- cooperation to keep the city clean

The municipal solid waste management system should be modified from time to time to cope with the changing characteristics of solid wastes discharged, in turn reflecting urbanization. The active cooperation of the residents is

indeed very important to successfully implement and achieve these changes. Public relation and mass-education activities should be regularly conducted to increase residents' awareness on the importance of solid waste management to facilitate their cooperation to changes. The necessary arrangements should be made on the following to enlist the residents' cooperation.

- provision of a complaint desk
- mass-education activities (newsletters and supplementary textbooks, etc.)
- promotion of district cleaning day
- promotion of recycling activities
- promotion of cooperation with consumer, religious and other organizations

4.11 Preparation of the MSWM Master Plan

After the selection of an optimum MSWM system for the achievement of the established goals and targets, an MSWM Master Plan is finally formulated and contains the following:

1) Collection and Haulage Plan

Collection and haulage will include;

- frequency and service area of waste collection and road sweeping;
- method, equipment, tools and installing places for waste discharge and storage;
- method, equipment and tools for primary and secondary collections;
- collection and working time;
- method, equipment and tools for road sweeping;
- method, facilities and equipment for transfer station (in case its introduction is feasible);
- required manpower and their training system;
- others.

2) Intermediate Treatment and Disposal Plan

Intermediate treatment and disposal plan will include;

- waste treatment plan
- recycling plan
- final disposal plan

3) Proposed Site Plan

The site plan will be prepared based on the optimum location and capacity of the proposed facilities which will be determined from the treatment and disposal plan.

4) Primary Facility Plan

The necessary facilities for the treatment and disposal systems will be proposed and the outline, capacity, etc., of these facilities will be prepared.

5) Project Cost Estimation

The costs for the procurement of equipment, construction of primary facilities, and the operation and maintenance of collection, transportation, treatment and final disposal services will all be computed.

6) Organization and Institution

In order to realize the proposed optimum technical system, the organizational structure, public participation and educational programs, and legislative aspects within the institutional system must be improved. The following plans will be established:

- organization building (structure, manpower and training program);
- public education and participation program;
- regulation and law necessary for the realization of a Master Plan.

7) Stage Plan and Financial Plan

a. Stage plan

The achievement of the targets requires the cooperation of the residents, establishment of proper technical systems and stable financial resources, and the steps to achieve these must be studied in detail.

The implementation of the following should be conducted by stages:

- expansion of service coverage;
- introduction of future collection system;
- introduction of future road seeping and public area cleaning systems;
- construction of major facilities such as intermediate treatment and final disposal sites;
- procurement of equipment.

b. Financial plan

The possibility of acquiring the necessary investment and operation funds to achieve the master plan by the target year should be assessed from a long-term financial prospective.

Though rationalization of MSWM would lead to a decrease in MSWM cost, its will not be large enough to offset an increase which would result from population increase, expansion of socio-economic activities, longer distances from urban areas to disposal sites, and changes in waste composition.

As it may be difficult to secure the initial investment funds because of the relatively small cost-reduction-effect in the immediate future, it is particularly important to clearly show that the rationalization of cleansing services based on the master plan is helpful in improving the environment of the city and reducing future financial problems of local governments. The economical feasibility of the master plan must be examined according to the following aspects:

- total investment amount
- operation and maintenance cost
- transition of municipal solid waste management budget ratio in the municipal budget
- forecast of collection and tipping charges
- available loan sources and loan conditions

- cash flow
- sensitivity analysis on major factors

8) Equipment Maintenance and Training Programme

a. Equipment maintenance

The replacement, procurement, and maintenance of old and new heavy machineries and vehicles are very important to provide stable cleansing services, thus a maintenance system should be properly established. The following are the basis for the proper procurement and maintenance of equipment:

- preventive maintenance
- proper replacement of equipment based on their life span considering the financial losses in the breakdown of operation
- training of drivers to prevent overloading, practice safe driving, and to daily inspect equipment.

The procurement and maintenance of cleansing equipment owned by the local government can be conducted by competent authorities, the private sector or both. As the types and number of equipment owned by the local government depend largely on how much cleansing work is commissioned to the private sector, the maintenance plan should envisage an appropriate maintenance system for the equipment owned by the local government. The maintenance system to be introduced should be capable of performing the following on a daily basis for systematic equipment control.

- operation record
- daily check and maintenance
- maintenance record
- spare parts control

b. Training programme

A training programme on solid waste management should be prepared to upgrade the knowledge and technical level of the staff and the workers.

The local government should provide training courses with due consideration of the local characteristics. Furthermore, a regular forum where the management and the workers can freely exchange opinions and conduct discussions

should be established.The local government should provide the training courses, taking the local characteristics into consideration. Furthermore, a regular forum should be established for the exchange of opinions between management and workers:

In general, courses on the following subjects should be provided for supervi-sors and workers.

- work manner (including attitude towards residents)
- work rules
- accident prevention
- equipment handling

4.12 Identification of the First Priority Project

Among the various projects in the Master Plan, the first priority project will be selected and a feasibility study will be made on it, hence it should conform with the Mater Plan.

As shown in Section 4.11, the master plan is conducted in stages. In order to implement the first stage plan, investment projects and some activities need to be identified and a feasibility study should be carefully carried out.

The topography and the soil characteristics of the major sites, and a budget are required to conduct the feasibility study of these selected projects, and therefore, should be recommended to the department and committee in charge.

4.13 Action Plan

In order to implement the Master Plan and realize the established goals and targets an action plan covering the following shall be prepared;

- project outline
- implementation schedule
- project organization
- financial plan

Appendix 1 Profile of MSWM

Table A-1 Profile of MSWM

Items	Description
1. General 1-1 Population 1-2 Area (km^2) 1-3 Annual Rainfall (m/m) 1-4 GRDP (million ZL) 1-5 Annual Municipal Budget (million ZL) 1-6 Data on Large Generation on MSW & ISW - Markets - Hospitals - Schools - Government Offices - Factories 1-7 Land Use (km^2) - Industry, Commercial and Residential - Forest and Farming - Others 1-8 Infrastructure - Road Length (Paved, Unpaved in km) - Municipal Heat Supply Coverage - Others 1-9 Existing Relevant Studies & Information - City Master Plan - Solid Waste Management Study - Topographical & Geological Data - Others	

Items	Description
2. Present Technical System for MSWM 2-1 Basic Information - Generation Ratio (ton/day) - Treatment & Disposal Amount (ton/day) - Composition of Waste (Low Carolific Value, C/N Ratio, etc) 2-2 Collection & Haulage - Collection Ratio - Population Covered by Collection - Discharge & Storage System (Type of Container) - Haulage System (Type of Vehicle) - Inventory of Equipment - Organization - Recycling at Generation Source - O & M of Equipment - Present Problems 2-3 Road Sweeping & Public Area Cleansing - Road Length for Sweeping (km) - Public Area for Cleaning (ha) - Inventory of Equipment - O & M of Equipment - Organization - Present Problems 2-4 Intermediate Treatment - Outline of Existing Facility - Needs and Candidate Sites - Present Problems 2-5 Final Disposal - Outline of Present Landfill - Scavenger - O & M of Landfill - Inventory of Equipment - Organization - Future or Candidate Sites - Present Problems 2-6 Recycling - Outline of Recycling System - Organization - Present Problems 2-7 Equipment O & M - Organization - Present Problems	

Items	Description
3.Present Institutional System for MSWM 3-1 Administration & Organization - Administrative System - Responsibility of Each Organization - Organization Chart - Inter-municipality Cooperation - Land Acquisition System - Present Problems 3-2 Financial Status - Municipal Budget for MSWM (million ZL) (Personnel, Equipment O & M & Investment) - Fee Tariff (Collection, Tipping, etc.) - Fee Collection System - Subsidiary System - Present Problems 3-3 Privatization - Status of Private Sector - Capacity of Private Sector - Method of Contract-out - Present Problems 3-4 Regulation & Enforcement - Illegal Dumping - Enforcement - Rules & Regulations - Present Problems 3-5 Public Cooperation - Status of Public Cooperation - Related Community Activities - Campaign & Education - Present Problems	
4. Possible Improvement Measures 4-1 Technical System - Collection & Haulage - Intermediate Treatment - Final Disposal - Recycling - Equipment O & M 4-2 Institutional System - Administration & Organization - Financial System - Privatization - Regulation & Enforcement - Public Cooperation	

Appendix 2 Questionnaire for POS

ANKIETA DLA ZBADANIA OPINI PUBLICZNEJ

No. .....

I Wypelnia ankieter

1–1 Data: .....

1–2 Nazwisko ankietera: .....

1–3 Typ budynku: .....
1. Nowy blok mieszkaniowy (po 1945)
2. Stary dom wielorodzinny (przed 1945)
3. Dom jednorodzinny

1–4 Odleglosc od domu (bloku) do pojemnika: .....
1. Przed budynkiem
2. Ponizej 10 m
3. 10 - 29 m
4. 30 - 49 m
5. 50 m i wiecej
6. Brak na tym terenie pojemnika.

II Pytania ogolne **Odpowiedzi**

2–1 Sposob uzytkowania lokalu przez respondenta: .....
1. Mieszkanie
2. Restauracja
3. Sklep
4. Biuro
5. Inne (Prosze wyszczegolnic):
.....

2–2 Ankietowany: .....
1. Gospodyni domowa
2. Wlasciciel/dzierzawca mieszkania/domu/sklepu/biura
3. Dzieci
4. Inny czlonek rodziny
5. Dozorca lub pracownik

6. Inne (Prosze wyszczegolnic):

.....

2–3 Adres: .....

2–4 Liczba osob/pracownikow mieszkania/sklepu/biura:.....

2–5 Lata zamieszkiwania/pracy w danym miejscu: .....

1. Ponizej 5 lat
2. 5 – 9 lat
3. 10 – 19 lat
4. 20 i wiecej

2–6 Powierzchnia mieszkania/sklepu/biura: .....m^2

2–7 Centralne ogrzewanie: .....

1. Centralne ogrzewanie
2. Piec
3. Gaz
4. Inne (Prosze wyszczegolnic):

.....

Jesli wybral Pan/i odpowiedz "2", prosze odpowiedziec na pytania 2–8.

2–8 Jesli "Tak", to czy popiol jest zbierany oddzielnie od innych odpadkow? .....

1. Tak
2. Nie

2–9 Przez ile miesiecy w roku popiol jest wyrzucany? ..... m–y/rok

Jesli odpowiedz na pyt. 2–1 jest "1": dom jest budynkiem mieszkalnym, prosze odpowiedziec na pyt. 2–10 i 2–11.

2–10 Miejsce pracy wlasciciela/dzierzawcy mieszkania: .....

1. Urzednik panstwowy/miejski
2. Pracownik firmy prywatnej
3. Wlasciciel firmy, sklepu, itd.
4. Osoby niepracujace

2–11 Ile wynosza miesieczne wydatki Pana/i/ rodziny ? .....

1. Ponizej 2 mln zl/m–c

2. 2 - 4 mln zl/m-c
3. 4 - 6 mln zl/m-c
4. 6 - 8 mln zl/m-c
5. Ponad 8 mln zl/m-c
6. Nie wiem/Brak odpowiedzi

III Pytania dotyczace usuwania odpadkow z Pana/i domu

3-1 Czy wyrzuca Pan/i popiol ze swojego pieca/kotlowni? .....
1. Tak
2. Nie
Jesli "Tak", prosze odpowiedziec na pyt. 3-2 i 3-3.

3-2 Czy wyrzuca Pan/i popiol razem z innymi odpadami? .....
1. Tak
2. Nie

3-3 Przez ile miesiecy w roku wyrzuca Pan/i/popiol? .....

3-4 Kto wyrzuca smiecie w Pana/i domu? .....
1. Gospodyni domowa
2. Wlasciciel
3. Dzieci
4. Inny czlonek rodziny
5. Dozorca lub pracownik
6. Inni
7. Nie wiem

3-5 Gdzie wyrzuca Pan/i/odpadki ze swojego domu? .....
1. Do oddzielnego pojedynczego pojemnika
2. Do zbiorczego pojemnika
3. Do zsypu
4. Inne (Prosze wyszczegolnic):
.....
5. Nie wiem

3-6 W czym wynosi Pan/i/odpadki ze swojego domu? .....
1. W torbie plastikowej
2. W plastikowym wiaderku
3. W metalowym wiaderku
4. Inne (Prosze wyszczegolnic):

.....

5. Nie wiem

3–7 Dlaczego uzywa Pan/i/taka torbe/wiaderko? .....

1. Zachowuje czystosc
2. Ogranicza nieprzyjemny zapach
3. Latwy do stosowania
4. Ogranicza dostep szkodnikow jak np. muchy
5. Inne (Prosze wyszczegolnic): .....

3–8 Czy wyrzuca Pan/i odpadki w ustalonym przez siebie czasie? .....

1. Tak
2. Nie
3. Nie wiem

3–9 Jesli "Tak", o ktorej godzinie wyrzuca Pan/i odpadki? .....

1. 6:00 – 8:59
2. 9:00 – 11:59
3. 12:00 – 14:59
4. 15:00 – 17:59
5. 18:00 – 20:59
6. 21:00 – 23:59
7. 24:00 – 2:59
8. 3:00 – 5:59
9. Nie wiem

3–10 Do jakiego kontenera wyrzuca Pan/i odpadki? .....

1. Pojedynczy kontener MPO (110 l)
2. Pojedynczy kontener nie bedacy wlasnoscia MPO
3. Zbiorczy kontener MPO
4. Zbiorczy kontener nie bedacy wlasnoscia MPO
5. Inne (Prosze wyszczegolnic):

   .....
6. Nie wiem

3–11 Gdzie znajduje sie kontener do ktorego wyrzuca Pan/i swoje odpadki? .....

1. Przed moim budynkiem
2. Za moim budynkiem
3. Wydzielone specjalne miejsce nalezace do budynku
4. Na chodniku obok mojego budynku

3-12 Czy ma Pan/i jakiekolwiek problemy dotyczace kontenera na odpadki? .....

1. Tak
2. Nie

Jesli "Tak", prosze odpowiedziec na pyt. Nr 3-13.

3-13 Na czym polegaja problemy zwiazane z Pana/i kontenerem? .....

1. Stary i rozpadajacy sie
2. Niewygodna lokalizacja
3. Mala pojemnosc
4. Stan nie spelniajacy wymagan sanitarnych
5. Inne (Prosze wyszczegolnic):

   .....
6. Nie wiem

Jesli na pyt. Nr 3-5 Pana/i odpowiedz brzmi 3. zsyp, prosze odpowiedziec na pyt. 3-14 i 3-15.

3-14 Czy moze Pan/i zanosic swoje odpadki do pojemnika zbiorczego, zamiast wyrzucac je do zsypu? .....

1. Tak
2. Nie
3. Nie wiem

3-15 Jesli "Nie", to dlaczego? .....

1. Obecny system jest lepszy
2. Nie ma u nas nikogo, kto moglby to robic
3. Pojemniki zbiorcze sa za daleko
4. Pojemniki zbiorcze nie sa higieniczne
5. Inne (Prosze wyszczegolnic):

   .....

3-16 W jaki sposob pozbywa sie Pan/i odpadkow gabarytowych (stare meble, lodowki itd.)? .....

1. Odbierane przez Sanitech
2. Sprzedawane lub zbierane przez specjalnych zbieraczy
3. Odwozone osobiscie na wysypisko
4. Sprzedawane na zlomowisku
5. Inne (Prosze wyszczegolnic):

   .....
6. Nie wiem

IV Pytania dotyczace odbioru odpadkow na Pana/i osiedlu.

4–1 Czy na Pana/i/osiedlu funkcjonuje odbior odpadow? .....

1. Tak
2. Nie
3. Nie wiem

Jesli "Tak", prosze odpowiedziec na nastepujace pyt. (4–2 do 4–9), jesli "Nie" przechodzimy do V.

4–2 Kto zajmuje sie odbiorem Pana/i odpadow? .....

1. MPO
2. Firma prywatna na zlecenie MPO
3. Inna firma prywatna
4. Inne (Prosze wyszczegolnic):

.....

4–3 Czy jest Pan/i zadowolony z poziomu uslug? .....

1. Tak
2. Nie
3. Nie wiem

4–4 Jesli "Nie", jakie sa tego powody? Mozna wybrac wiecej jak jedna odpowiedz? .....

1. Mala czestotliwosc
2. Nieregularnosc
3. Zbyt wczesnie/pozno w ciagu dnia
4. Nieodpowiednie zachowanie pracownikow
5. Pozostawianie porozrzucanych odpadow przy pojemnikach
6. Wysoka oplata za usluge
7. Niesprawiedliwy system oplat
8. Inne (Prosze wyszczegolnic): .....

4–5 Czy wie Pan/i w jaki sposob sa odbierane odpadki na Pana/i osiedlu? .....

1. Tak
2. Nie

4–6 Jesli "Tak", w jaki sposob sa odpadki odbierane? .....

1. Przez specjalnego pracownika indywidualnie z mieszkania
2. Mieszkancy sami odnosza swoje odpadki do zbiorczego pojemnika
3. Odbior z kontenerow pod zsypem

4. Inne (Prosze wyszczegolnic): .....
5. Nie wiem

4–7 Jak czesto sa odbierane Pana/i odpadki? .....

1. Raz na 3 dni
2. Raz na 3 – 7 dni
3. Raz na 8 – 14 dni
4. Raz na 15 – 21 dni
5. Raz na 21 – 30 dni
6. Inne (Prosze wyszczegolnic):
   .....
7. Nie wiem

4–8 Czy odbior dokonywany jest o ustalonej godzinie w ciagu dnia?
.....

1. Tak
2. Nie
3. Nie wiem

4–9 Jesli "Tak", o ktorej zazwyczaj? .....

1. 6:00 – 8:59
2. 9:00 – 11:59
3. 12:00 – 14:59
4. 15:00 – 17:59
5. Inne (Prosze wyszczegolnic):
   .....
6. Nie wiem

V Pytania dotyczace odzysku surowcow wtornych i ich wykorzystania.

5–1 Czy bedzie Pan/i/segregowac swoje odpadki na 1) organiczne 2) nie nadajace sie do spalenia 3) inne, jesli miasto wprowadziloby system odbioru posegregowanych odpadkow? .....

1. Tak
2. Nie

5–2 Jesli "Nie", dlaczego? .....

1. Taki system wymaga kilku pojemnikow lub plastikowych workow w mieszkaniu
2. Wymaga to wysilku
3. Wymaga kilku pojemnikow zbiorczych

4. Niewygodne
5. Moze zwiekszyc koszt uslugi
6. Inne (Prosze wyszczegolnic):

.....

5-3 Czy uwaza Pan/i, ze odzyskiwanie surowcow wtornych jest konieczne?

.....

1. Tak
2. Nie
3. Nie wiem

5-4 Jakie zna Pan/i/sposoby odzysku i zagospodarowania surowcow wtornych? .....

1. Ponowne wykorzystanie papieru, butelek itd.
2. Kompostowanie (nawoz z odpadow)
3. Uzysk ciepla ze spalarni smieci
4. Inne (Prosze wyszczegolnic):

.....

5. Nie wiem

5-5 Czy zna Pan/i/kogos, kto przychodzi aby zebrac lub kupic od Pana/i surowce wtorne? .....

1. Tak
2. Nie
3. Nie wiem

Jesli "Tak", prosze odpowiedziec na pyt. (5-6 i 5-7).
Jesli "Nie" prosze przejsc do 5-8.

5-6 Jesli "Tak" , jak czesto zbieracz przychodzi do Pana/i mieszkania?

.....

1. 1x w tygodniu
2. 1x w miesiacu
3. 1x na 2 miesiace
4. 1x na pol roku
5. 1x na rok
6. Nie wiem

5-7 Jaki srodek transportu uzywa zbieracz? .....

1. Pieszo
2. Rower
3. Bagazowka

4. Mala ciezarowka
5. Wozek reczny
6. Inne (Prosze wyszczegolnic):
   .....
7. Nie wiem

5–8 Jesli nie sprzedaje Pan/i surowcow wtornych zbieraczom, to czy sprzedaje Pan/i w punktach skupu? .....
1. Tak
2. Nie

5–9 Jesli Pana/i spoldzielnia/administracja mieszkaniowa zbieralaby fundusze poprzez zbiorke i sprzedaz surowcow wtornych z przeznaczeniem na wspolna dzialalnosc dla mieszkancow, wzialby Pan/i w tym udzial? .....
1. Tak
2. Nie
3. Nie wiem

5–10 Czy karmi Pan/i swoje zwierzeta domowe odpadkami ze swojego gospodarstwa? .....
1. Tak
2. Nie

VI Oplata za odbior odpadow i zagadnienia finansowe.

6–1 Czy Pan/i/wie kto jest odpowiedzialny za zagospodarowanie odpadow komunalnych? .....
1. Urzad wojewodzki
2. Urzad miejski
3. Pan/i/sama
4. Firma miejska (publiczna) np. MPO
5. Prywatne firmy
6. Inni (Prosze wyszczegolnic):
   .....
7. Nie wiem

6–2 Obecny system zagospodarowania odpadow opiera sie o MPO, Urzad Miejski i prywatne firmy. Czy uwaza Pan/i, ze obecny system jest odpowiedni?
1. Tak

2. Nie

6-3 Jesli "Nie", kto powinien byc odpowiedzialny za zagospodarowanie smieci miejskich ? .....

1. Urzad Miejski
2. Urzad Wojewodzki
3. MPO
4. Firma prywatna
5. Inne (Prosze wyszczegolnic):

.....

6-4 Ile Pan/i placi miesiecznie za odbior swoich odpadow?

1. ..... zl/m-e
2. Nie wiem

6-5 Jak pan/i ocenia wysokosc oplaty? .....

1. Drogo
2. Raczej drogo
3. Raczej drogo
4. Niesprawiedliwy system oplat
5. Kosztuje tyle ile powinno
6. Nie wiem

6-6 Czy placi Pan/i oplate za wywoz odpadkow w przedsiebiorstwie wywozowym bezposrednio czy tez poprzez spoldzielnie mieszkaniowa/ administracje budynku? .....

1. Bezposrednio
2. Poprzez spoldzielnie/administracje
3. Nie wiem

6-7 Kto i jak pobiera oplate? .....

1. Poprzez bank
2. Lacznie z innymi oplatami na rzecz spoldzielni/administracji
3. Kasa przedsiebiorstwa
4. Inne (Prosze wyszczegolnic):

.....

6-8 Obecne naklady na oczyszczanie miasta i zagospodarowanie odpadow nie wystarczaja dla utrzymania czystosci miasta i jego okolicy. Kto wedlug Pana/i winiwen poniesc dodatkowy koszt? .....

1. Rzad
2. Urzad Wojewodzki

3. Urzad Miejski
4. Obywatele poprzez zwiekszona oplate
5. Inni (Prosze wyszczegolnic):
.....
6. Nie wiem

VII Wspolpraca ze spoleczenstwem

7-1 Czy uzyskal Pan/i kiedykolwiek instrukcje na temat wlasciwego sposobu usuwania odpadkow? .....
1. Tak
2. Nie

7-2 Czy uwaza Pan/i za pozadane, urzadzanie "Dnia czystosci" (wspolne sprzatanie osiedla) w Pana/i dzielnicy/osiedla? .....
1. Tak
2. Nie
3. Nie wiem

7-3 Czy ktokolwiek w Pana/i rodzinie sprzata chodnik lub sasiadujacy obszar przed domem, nie bedac dozorca? .....
1. Tak, codziennie
2. Tak, czasami
3. Nie

7-4 Czy uwazasz, ze wspolne dzialanie jest konieczne dla utrzymania czystosci miasta i jego otoczenia? .....
1. Tak
2. Nie
3. Nie wiem

7-5 Jesli "Tak", czy moze Pan/i wspoldzialac na rzecz utrzymania czystosci miasta i jego otoczenia? .....
1. Tak
2. Nie

7-6 Czy Pan/i uwaza, ze konieczna jest popularyzacja wiedzy/akcja na rzecz utrzymania czystosci miasta i jego otoczenia? .....
1. Tak
2. Nie
3. Nie wiem

7–7 Jesli "Tak", kto powinien zainicjowac taka dzialalnosc? .....

1. Rzad
2. Urzad wojewodzki
3. Urzad miejski
4. Lubelska Fundacja Ochrony Srodowiska Naturalnego
5. Szkola
6. Czlonek rodziny
7. Kosciol
8. Inne (Prosze wyszczegolnic):

   .....
9. Nie wiem